Agricultural Water Use for Homestead Gardening Systems

Volume 2: Resource Material for Facilitators and Food Gardeners

Part 3: Chapters 6-7

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 6

Soil Fertility Management:
Optimising the Productivity of Soil and Water

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)

Chapter 6 Table of Contents:

Soil fertility management: Optimising the productivity of soil and water

	Chapters: Resource Material	iii
	Table of Contents: Soil fertility management: Optimising the prod	uctivity of
	soil and water	
	List of Figures	
	List of Tables	vii
	List of Activities	
	List of Facilitation Tools	viii
	List of Case Studies & Research	
	Aims	ix
	What am I going to learn?	ix
	Icons	XI
6.1	Introduction	1
6.2	Understanding soils	3
	The living soil	
	Soil management principles (Laker, 2007)	
6.3	Soil Texture and Soil Components	
0.0	How to tell your soil type	
	Characteristics of soils	
	Telling through looking	
	Telling through touch	
4 Δ	Soil Structure	
U.T		
	Management practises affecting soil structure	
	Harmful practices	
	Soil management principles (Laker, 2007)	
	Practices which improve soil structure (Vukasin, 1995)	
6.5	Soil fertility	19
	Soil nutrients	19
	Nitrogen	20
	Phosphorus	
	Potassium	22
	Soil acidity (acid) and salinity (salts)	
	What is soil acidity?	
	How do you know if your soil is acidic?	
	How can you solve the problem of acidity?	
	Soil biology	

	Humus	28
	The role of organic matter in soils and the value of organic material	
	applications	
	Nutrient fixing plants	30
6.6	Soil building techniques	32
	Mulching	32
	Why is mulching important?	32
	What to use as mulch	34
	How do we mulch? (Altiere et al., 1984)	34
	Manure	36
	Use of animal manure in homestead food gardening (Van Averbeke, 1	-
	Use of chicken manure	
	Compost	40
	What do you need to make a compost heap?	
	Where to make a compost heap	40
	How to make a compost heap	40
	Handling compost	44
	Liquid manures/teas	44
	How to make liquid manures from plants (EMBRAPA, 1998)	44
	How to make liquid manure from animal manure (Valley Trust, 1996)	46
	How to make a foliar spray	
	Using legumes and cover crops	
	Cover crops improve the soil in various ways	
	Green manures	
	Introduction to worm farms	52
6.7	Bed design	53
	How to make a deep trenched bed (GTZ, 1993)	54
	Why small-scale deep trenched beds work so well	
	Trench beds influence the structure of the soil	59
	Deep trenching reduces soil acidity	59
	Deep trenching increases phosphorus in the soil	61
	Deep trenching gives good potassium levels in the soil	62
	Alternative bed designs	63
	Shallow trenches	
	Double digging (Hall, 1987)	
	Key-hole beds	
	Summary of principles for good soil management	67
6.8	References	68
6.9	Further reading	69
	Understanding soils	69
	Soil fertility	69
	Soil building techniques	69
	Composting	69
	Manure	69

	Chapter 6: Soil fertility management: Optimising the productivity of soil and water
	Earthworms
Index (C	hapter 6)71
	ead Food Gardeners' Resource Pack (Handouts) – Chapter 6: Soil tility management: Optimising the productivity of soil and water 71
List o	of Figures
	Figure 1: Making good soil in family food gardens
	Figure 4: Bottle test for soil type (Vukasin, 1995)
	Figure 6: Wrong watering can destroy soil and plants (Du Preez, 1992)12 Figure 7: Deep trenching (left) and double digging (right) (Vukasin, 1995
	Figure 8: Nitrogen cycles in nature (Kruger, 2008)
	Figure 11: The effect of mulch on evapotranspiration, weed growth and soil temperature
	Figure 12: Management and use of Manure (Kruger, 2008)
	Figure 14: Making animal liquid manure (Vukasin, 1995)
	Figure 16: Digging a deep trench bed (ACAT, 2001)54 Figure 17: Comparison of soil moisture at different depths in trench beds (JD Sturdy, 2008
	Figure 18: Comparison of soil moisture at different depths in normal beds (JD Sturdy, 2008)58
	Figure 19: How to make a shallow trench (Kruger, 2008)
	Figure 21: a key-hole garden (Kruger, 2008)63
List o	of Tables
	Table 1: Characteristics of soils

Agricultural	water use for Homestead Gardening Systems – Resource Material	
	Table 4: Advantages and disadvantages of plant brews	46

Table 5: Advantages and disadvantages of animal liquid manures......48

Table 7: Acidity in Sizakele (S), Dladla (D) and Ketiwe's (K) normal and trench beds (JD Sturdy, 2008)60

List of Activities

List of Facilitation Tools

Facilitation Tool 1:	Soil types and characteristics	6
Facilitation Tool 2:	Soil pit for texture, structure and depth	11
Facilitation Tool 3:	Soil water management: Working the soil	14
Facilitation Tool 4:	Soil acidity experiment (Gibberd, 2003)	26
Facilitation Tool 5:	An experiment to test mulching	35
Facilitation Tool 6:	Household experiment on liquid manures	50
Facilitation Tool 7:	Experiment using bed designs	66

List of Case Studies & Research

Aims

This chapter aims to introduce you to ways of optimizing the productivity of soil and water available to homestead food gardeners. The chapter starts with looking at how to understand soil. This refers to various characteristics of different soil types and soil structures. The chapter then looks at soil fertility. When is soil fertile? This is followed by techniques to increase the fertility of soil, i.e. soil building techniques and bed design.

Throughout the chapter the importance is emphasized of gardeners' doing their own experimentation. In gardening there are always challenges and gardeners need to test their new knowledge and new ideas without taking undue risks. An experiment is a test on a small scale, with a 'control', to see if an idea works compared to traditional practice.

Experimentation becomes the main technique for interventions in the garden itself. As a facilitator, your job is thus to introduce new ideas and innovations that gardeners can try out for themselves and make their own decisions about rather than trying to convince gardeners to adopt a specific new practice.

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 <u>do</u> after completing this unit?	Done √ Can't do ×
			J F
1	Understand soils and management options	Compare types of soils Differentiate between different structures of soil Recognize practices affecting soil Facilitate experimentation in terms of soil fertility	
2	Understand plant nutrients and their ources and manage soil fertility using a range of technique	Find plant nutrient sources to apply to different soils Implement an experiment to deal with soil acidity Plant nutrient fixing plants and crops including legumes and cover crops	
3	Apply soil building techniques	 Use mulch and manure effectively Make and use compost Make and use plant and animal liquid manures and foliar sprays 	
4	esign garden beds for optimal plant prowth and water nolding capacity	 Make trench beds and variations according to the site requirements Make shallow trenches Use double digging in garden beds 	
5 Im	plement good soil management practices	Facilitate the implementation of principles to ensure sustainable soil management	

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.

6.1 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**. To ensure an intensive and diverse homestead food garden, soil fertility is crucial, and this requires an understanding of soil structure and soil building techniques.

Soil structure plays a critical role in soil water management. Soil structure depends on the type of soil, i.e. is it sand, loam or clay and the balance of organic materials and minerals in the soil. The optimum structure is achieved if the soil is loamy and if a balance of minerals (i.e. nitrogen, potassium and phosphorus) is present. A healthy soil is a living soil. This means there is plenty of organic matter, which breaks down in it. This feeds the micro-organisms such as fungi and bacteria which in turn feed the macro organisms such as beetles and worms. A healthy balance of micro-organisms and macro-organisms are essential for healthy plant growth.

Techniques to build the soil to ensure a balanced living soil include regular mulching, regular addition of manure and compost, and/or regular application of liquid manures/teas. Legumes can be used as cover crops in beds or fields that are left to rest. Some gardeners farm with earthworms, whose droppings are used as compost.

An important aspect of soil building is to make sure that the fertile topsoil is deep enough to enable the plant to develop deep, healthy roots – in other words, a deep rooting zone is created.

Making deep trenched beds is a good way of ensuring deep healthy soil for deep root systems for healthy plants. Shallow trenching, double digging and keyhole gardens are other methods of creating healthy soil.

Water infiltrates easily into soft porous soils, but cannot penetrate well into compacted soils which lack organic material. Soil building techniques thus also aim to improve how water is absorbed and stored in soil for use by plants.

Figure 1 (overleaf) summarises what a gardener can do (green blocks) and what to avoid (red blocks) to achieve the ideal characteristics of good soil (brown blocks) in a home food garden, namely soil which is:

- Deep;
- ❖ Well-drained;
- Loose, crumbly and uniform throughout the root zone;
- Healthy, with no harmful chemical conditions; and
- Rich, with lots of nutrients for uptake by the plant roots.

From Figure 1 it is clear that the most important strategy for a gardener in solving almost every soil problem is to add lots of organic matter. By **creating permanent planting beds**, a gardener can concentrate his/her efforts and build up positive effects from one season to the next. By making **deep trenched planting beds**, the gardener can achieve almost all the soil management objectives simultaneously.

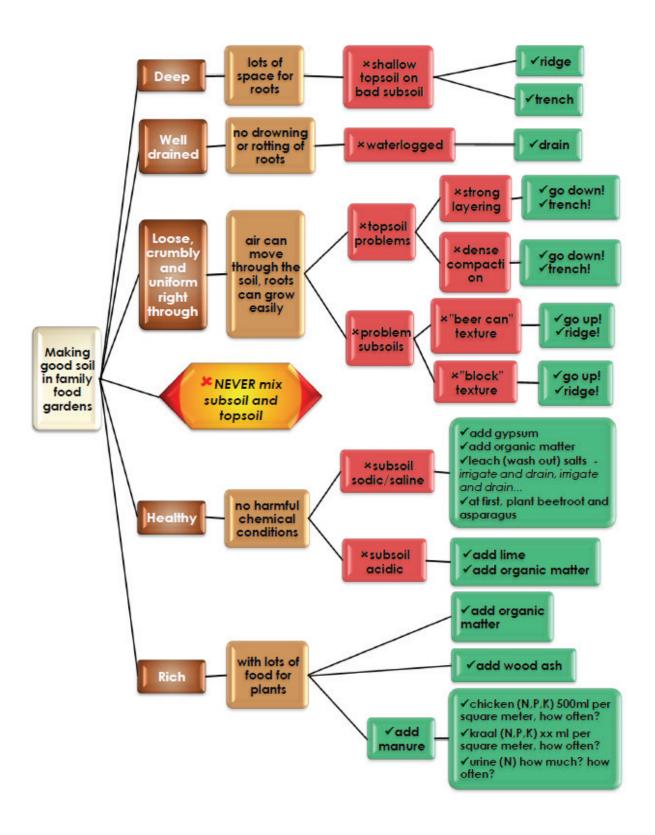


Figure 1: Making good soil in family food gardens

6.2 Understanding soils

The three different soil types, namely sand, silt and clay differ in how much water they can hold and make available to plants (plant-available water). Sand is the weakest at holding water. Soils vary in structure, texture and depth. They contain different minerals from broken down rock.

The living soil

Healthy soil is living soil. It has many different nutrients in it as well as micro- and macro-organisms living and working in it. Living soil is a mixture of many things:

- Sand, silt or clay (types of soil);
- Organic matter (like leaves, grass and manure);
- Inorganic matter (like rocks and silica);
- Mineral salts (such as potassium);
- Air and water;
- Different macro-organisms (such as worms, larvae, beetles and termites);
- Different micro-organisms (such as bacteria that break down organic matter); and
- Nutrients (such as nitrogen) that plants need to grow well.

Soil management principles (Laker, 2007)



The objectives of soil management are to create or maintain:

- Favourable physical conditions in the soil (what it looks like);
- Favourable chemical conditions in the soil (what it consists of); and
- Optimum soil fertility.

In the next sections we will look at how to identify a soil type (section 6.3), and how to manage the physical, chemical and fertility aspects of soils (sections 6.4, 6.5 and



6.6). Then we will learn how 'deep trenching' achieves all these objectives simultaneously (section 6.7).

Living soil, soft with many microand macroorganisms present

Soil Texture and Soil Components



Soil is made up of individual particles or clusters of particles, with small spaces (pores) between The Diger picture... them containing air and water. A good soil has pores of many different sizes, large and small. It contains many living organisms.

Soil is a mixture of sand, silt and clay. It also contains mineral salts and organic matter (Evans, 2001).

Sand

Sand has large particles. It feels coarse or rough between the fingers. Water easily infiltrates a very sandy soil because of the space between the grains. Sandy soil does not stick together; it erodes easily and dries out easily. It does not hold onto soil nutrients.

Silt

Silt is finer than sand. Silt holds water and plant foods/nutrients better than sandy soil. Silt and sand are easily washed out of the soil into rivers and dams.

Clay

Clay consists of very tiny particles. They are so small that you cannot feel them with your fingers. That is why clay feels slippery and sticky. There are very small pores or spaces between the particles. The particles stick together in lumps or clods. Clay holds onto water and nutrients in the soil. Certain types of clay will swell when they are wet and shrink and crack when they are dry. They can be difficult to work.

The best soils are called **LOAMS** and are equal mixtures of sand, silt and clay.

Mineral salts

These salts can be visible (in the form of crystals, powder or granules) or invisible (dissolved in the water). They can also be combined with organic matter. Ashes spread on the ground are visible salts, as are fertilizer granules or crushed shells. When it is dry these salts remain on the ground. As soon as it rains some of these salts dissolve and infiltrates between the soil grains.

Soil Structure Examples



Sand - light soil, no water-holding capacity



Clay - heavy soil, holds water, root penetration difficult



Sandy clay - holds water, root penetration easy



Loam - optimum water holding capacity, optimum root penetration, contains organic matter.

from: Production without Destruction

Figure 2: Soil is a mixture of sand, silt and clay (Vukasin et al., 1995)

Leaching

Leaching is when the water moving through the soil dissolves and removes the salts to layers lower down. Homestead food gardeners have to keep replenishing their soil with mineral salts and humus to counter the effects of leaching.

Salts can also be pushed up to the surface when a soil is waterlogged (too wet for a long time), and this can be very harmful for the soil and plants. To solve this, the gardener needs to make sure the soil is well-drained, and then induce leaching to wash out excess salts.

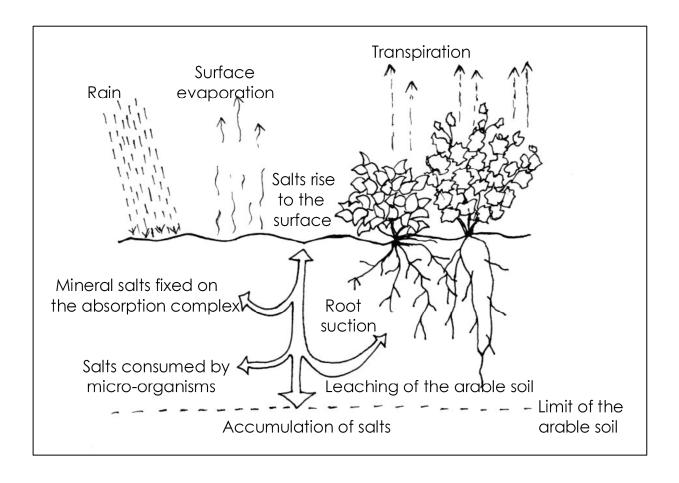


Figure 3: Movement of water and minerals in the soil (Du Preez *et al.*, 1992)

From: Ways of Water

How to tell your soil type

There are different soil characteristics that help you recognise different soil types. Touching and looking at soils can help us identify the different types.

Characteristics of soils

Table 1: Characteristics of soils

SANDY SOIL		
Good things about this type of soil	Bad things about this type of soil	
 It is easy to dig and work with It warms up quickly in spring after winter It is good for root crops Water and air can get into the soil easily 	 It gets dry quickly It does not keep much fertility It does not hold water well 	
LOAM SOIL (Mixture of sand and clay)		
Good things about this type of soil	Bad things about this type of soil	
 Holds water well Best for root growth Contains more organic matter 	This soil can be hard when dry	
CLAY SOIL		
Good things about this type of soil	Bad things about this type of soil	
 Holds water well and for a long time Holds fertility well and for a long time 	 Hard to work; heavy Slow to warm up in spring Sticky when wet Hard when dry 	



Facilitation Tool 1: Soil types and characteristics

Aim:

- We want to be able to touch, see and smell soils so that we can use our knowledge to discuss different soil types.
- ❖ We want to use peoples' own ways of distinguishing between soils and their own management practices as the basis for our discussions.
- We can use the bottle and soil sausage tests below to guide a discussion on soil types, their characteristics and good and bad management practices.
- ❖ As facilitators we can augment the local knowledge with our more formal information after the initial discussions.

Instructions:

What Materials do I need?

For the bottle test: You will need three clear plastic or glass bottles (for each small group), such as 2 litre coke bottles, with caps. You will also need handfuls of three different types of soil from the area; preferably of the three main soil types. These can be collected from the river (sandy), low lying wet areas (clayey) and good cropping fields (silt).

For the sausage test: You will also need at least three types of soil (about a handful of each) and some water.

2. How do I start the exercise?

Hand out the pages that describe how to do the bottle and sausage tests. These are provided in the text below.

Explain that we will be working with soil to identify the different kinds.

Ask the group to write down all their comments on each soil type, how this soil behaves, and how it is managed by people.

Then, divide your learning group into three small groups and instruct them to each place a different type of soil into their bottle. Fill the bottle with water and watch what happens. Explain that the soil will settle in different layers over time and that their task is to work out what those layers are. They should think about the structure of the soil, i.e. how much sand, silt or clay is there and what does this mean regarding how the plants will grow.

While they are waiting for the bottles to settle, they can do the sausage tests.

3. What other information can I discuss?

Once each group has reported back, discuss with the group the significant information coming up. This could include the difficulties of managing certain types of soil; good management practices for different soil types; which crops are grown in which soils; how these crops are grown; etc.

You can then discuss the principles of building a good soil if the one they are working with is not satisfactory. This will include issues such as water holding capacity, aeration, microbial life (fertility and organic matter), and acidity. This can be done using the splash and infiltration demonstration. This demonstration is described in Facilitation Tool 3: Soil water management: Working the soil.

4. What other facilitation tools can I use?

You can use the splash and infiltration demonstration to discuss the issues of water holding, aeration and fertility.

You can use drawings to depict deep and shallow rooting and how this affects the size of plants.

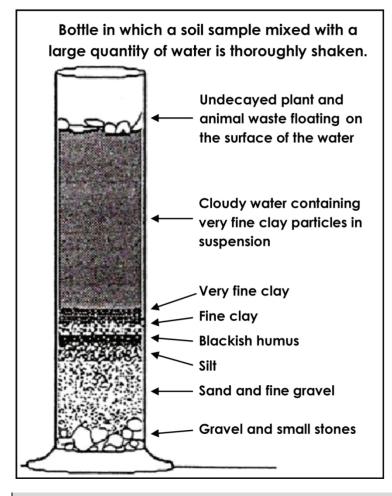
You can take a walk into a field where participants distinguish between plants that are growing well and ones that are not. They discuss the differences in the soil type, and soil characteristics (such as aeration, depth, structure, organic matter, soil life and water infiltration). Carry a spade and dig down to see where the roots are and where the water is.

Time: 1.5 hours

Telling through looking

Bottle test

Fill a bottle a third full of soil. Then, fill the bottle almost to the top with water and shake vigorously for several minutes to separate the soil grains. Leave the bottle to settle and note what takes place hour by hour.



The substances settle in layers, the heaviest at the bottom and the lightest on top. Some particles float on the surface. Others remain suspended in the water.

- Some substances are lighter than water and float on its surface. They are pieces of organic matter such as leaves, seeds, fruit or insect litter and fungus spores.
- Other heavy elements such as gravel, pebbles and sand quickly fall to the bottom.
- The finer elements then accumulate; first the silt, followed by the fine and very fine clay. These layers vary in consistency and colour.
- The layer of water above the settled material remains cloudy for a long time. It contains clay particles so fine that they stay

suspended in the water.

If some salt crystals were added to the soil before the bottle is shaken, we notice that they have now disappeared. They have dissolved in the water and can no longer be seen. Some soil components are visible and others are invisible.

Figure 4: Bottle test for soil type (Vukasin, 1995)

Humus:

The organic component of soil, usually formed by the decomposition of plants and leaves by soil bacteria

Telling through touch

Sausage test

You can tell how much sand, silt or clay is in your soil by how it feels. Wet some soil and roll it into a ball between your hands. Then roll this ball into a sausage. You can tell what kind of soil it is by looking at Figure 5 below.

WHAT SOIL LOOKS LIKE	WHAT SOIL FEELS LIKE		ROLLED SAUS A GE	THE SOIL IS
VERY SANDY	VERY ROUGH	CANNOT BE ROLLED INTO A SAUSAGE		VERY SANDY 0-5% clay
QUITE SANDY	ROUGH	CAN BE ROUED INTO A SAUSAGE BUT IT CANNOT BEND		SANDY 5-10% clay
HALF SANDY & HALF SMOOTH	ROUGH	SAUSAGIE CAN BEND A LITTLE		SANDY LOAM 10-15% clay
MOSTLY SMOOTH	A LITTLE SANDY, QUITE SMOOTH BUT NOT STICKY	SAUSAGE CAN BEND ABOUT HALF WAY AROUND		LOAM OR SUT LOAM 15-35% clay
MOSTLY SMOOTH	A LIFACE SAND QUITE SMOOTH AND STICKY			CLAYLOAM OR SANDY CLAY 35-55% clay
SMOOTH	SMOOH AND STICKY	SAUSAGE CAN BEND INTO A RING		CLAY More than 55%

Figure 5: Sausage test for soil type

6.4 Soil Structure



Soil structure tells us how the soil particles are mixed or grouped together. It also tells us how well the smaller particles stick together in clusters. It influences how easily water and air (and plant roots) can move through the soil (Kruger, 2008).

The soil structure depends on:

- The soil type,
- The proportion of the different materials that make up the soil, and
- The way in which the soil was worked by tillage implements, water and microorganisms.

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.

Soil structure is observed in the field by sight and by touch. (See Facilitation Tool 1: Soil types and characteristics.)

Structureless soils

In structureless soils the grains of sand or silt are not bound together. A dry structureless soil will slip through your fingers like sorghum grains when they are poured into a container. These soils are infertile unless they are rich in humus. They are unable to hold water and are easily leached, as the water flowing through carries away mineral salts in large quantities. These soils are susceptible to water and wind erosion as there is no sticky matter to keep them in place.

Heavy soils

Heavy soils contain a lot of clay. They are sticky when wet. These soils are not easily worked by people or plants. The plants must expend a lot of energy to make their roots penetrate this type of soil. When they dry out, they harden so much that neither roots, nor farm implements can penetrate them. They contract, and cracks appear.

Granular or aggregate soils

These soils are composed of a mixture of well proportioned elements. It is divided into little clods which in turn are divided into crumbs in which the coarse granules of sand and gravel are stuck together by clay, humus and minerals. Between the crumbs there are cavities and free spaces where water and air can circulate.

The crumbs are formed by everything working in the soil, such as roots, microorganisms, implements, earthworms, moles, ants and termites. These soil workers are forever moving material in the soil, decomposing it and producing it.



Facilitation Tool 2: Soil pit for texture, structure and depth

Aim:

To assist a homestead gardener to analyse their soil characteristics and the related fertility and potential for plant growth.

Instructions:

First look at the general environment and soil characteristics.

How are the plants growing? Are they all the same? Describe the differences.

What does the soil look like? Is it cloddy, sandy or granular? What colour is it? Can you see any organic matter or humus in or on the soil?

What life forms can you find that are working the soil? Describe them and give an idea of what you think they are doing in the soil in terms of moving material, decomposition and production. Make drawings of your life forms, or take some pictures if that is possible.

Next, dig a pit about 40-50 cm wide and 40-50 cm long. Keep on digging until there is a change in soil colour and consistency (that is when you move from the top-soil into the sub-soil). Now do the following activities:

- Check and record how deep your topsoil is.
- Check for root growth and give a comment.
- ❖ Are there any impermeable layers in between the topsoil and subsoil? Describe what they look and feel like.
- ❖ Use the texture assessment guideline (Figure 5) to assess the texture of your topsoil and subsoil. Include the % clay in each.
- Describe the structure of your topsoil and subsoil. Does your soil come out in clods or is it crumbly?
- ❖ Give an opinion of the ability of your topsoil to support plant growth and what effect the subsoil will have.
- ❖ Give an indication of what can be done to overcome some of the restrictions.

Time: 5 hours

Management practises affecting soil structure

The structure of the soil is influenced by how we manage our soil. Some practices are harmful, while others are beneficial. Harmful practices will break down the structure of the soil and make it a lot harder to work with and for plants to grow well. Beneficial practices will build up the structure of the soil and also its quality. Then the soils will be easier to work with and plants will grow well.

Harmful practices

- Too much water, too often (permanent flooding): This is harmful, because the soil organisms and plants are choked for lack of air.
- The unnecessary poisoning of the soil by overuse of chemical products such as pesticides and fertilizers.
- Too much activity of microbial life (micro-organisms) caused by ashes of burning vegetation or by mineral fertilizers (bought from shops) that have been badly taken up in the soil. After the initial stimulation, the micro-organisms die of lack of food. It can be compared to a grassy enclosure where too many goats for example, are fenced in, with the result that the herd quickly declines for lack of fodder.
- Heating of the bare soil surface through fire or prolonged sunlight. The ground dries up and micro-organisms are killed.
- Destruction of the crumbly structure of the soil through splashing of raindrops on bare soil and through the frequent passage of heavy wheeled machinery.

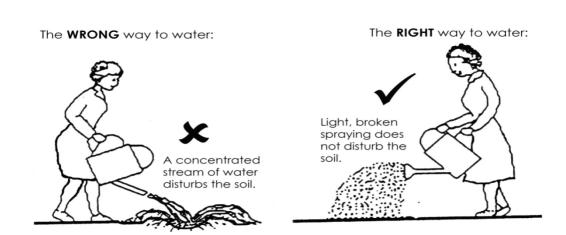


Figure 6: Wrong watering can destroy soil and plants (Du Preez, 1992)

Soil management principles (Laker, 2007)



The objectives of soil management are to create or maintain:

- favourable physical conditions in the soil (what it looks like);
- favourable chemical conditions in the soil (what it consists of); and
- optimum soil fertility.

A lot of information about the quality of a specific soil can be found by looking at the physical conditions of the different horizons (layers) of soil, which are exposed when a pit is dug in a soil. These physical conditions can be seen or felt. For example: A soil layer that has light grey and/or blue-green colours and/or dull yellow mottles and feels very sticky, is a very poorly drained layer which is almost always wet.

Normally there are similar types of soil in an area, and it is not difficult to get to know them and their qualities.

Table 2: The most important physical factors in soil are (Laker, 2007):

	Soil porosity	Small and larger spaces in between soil particles
	Soil aeration	How well air can move through the soil
		How easily water can <u>infiltrate</u> into the soil (infiltration), how much water the soil can <u>store</u> in plant-available form how well water can drain out of the soil (drainage)
	Soil compaction	The hardness or density of the soil
	Soil crusting	Surface sealing of the soil (whether it forms a hard crust on the soil surface, which resists infiltration of water into the soil)

Different soils need different management to ensure optimum conditions.

If the above three conditions are achieved (favourable physical and chemical conditions and optimum soil fertility), **favourable biological** conditions will be created or maintained in soils.

Favourable biological conditions mean that there is optimum activity of favourable micro-organisms (bacteria, fungi) and macro-organisms (earthworms, etc.) in soils.

Favourable

Suitable, has special advantages.

Optimum

The best possible situation, most favourable.

It means that there is suppression of unfavourable organisms such as those that cause root diseases, or produce toxic substances, or have negative effects on the availability of plant nutrients. Favourable biological conditions lead to optimal plant and crop growth.



Facilitation Tool 3: Soil water management: Working the soil

Aim

To assist a homestead gardener to see how water is absorbed into the soil when the soil is worked, i.e. as a result of digging, mulching and composting.

Instructions

What Materials do I need?

You will need a reasonably flat space, where you are allowed to dig, and which is typical of the gardens or fields in the area. You will need a spade, a bag of compost, a bag of mulch, a large 20 litre bucket and a one litre container.

2. How do I start the exercise?

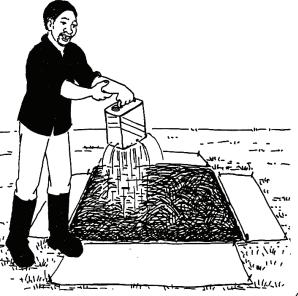
Prepare the demonstration before you start the session. Mark out four equal sized plots of about 45 x 45 cm each. Then treat each square as follows:

- -Leave the first square as is;
- -Place mulch on the 2nd square;
- -Dig over the 3rd square to one spade depth, and place mulch on top; and
- -Dig over the 4^{th} square to one spade depth, incorporate a lot of compost, and place mulch on top.

Lay pieces of white A4 paper next to each little plot before you start the demonstration. This paper will get wet and muddy when water splashes on it.

Now, take your one litre container and ask people to count with you how many containers are poured onto each little plot before the water runs off the plot onto adjoining land. Pour the water from the jug from a standing position.

Ask the group to discuss what they have seen and what this may mean for their gardening.



Experiment to see the effect of digging, mulching and compost on water absorption into the soil.

3. What other information can I discuss?

You can introduce the household experimentation process (see section in Chapter 4.2: "Household experimentation"), so that participants can go home and try a specific intervention in their own gardens. Use the outline below (Facilitation Tool 4: Small-scale experimentation) for this purpose.

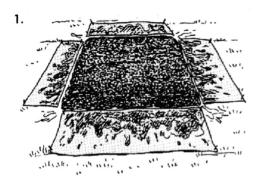
You can also use this exercise to introduce the idea of having deep soft soil that is fertile.

4. What other facilitation tools can I use?

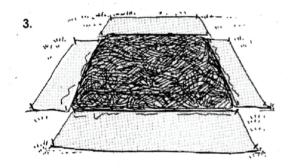
A demonstration of digging and filling a trench bed can fit in well.

The making of compost or other bed designs can follow on.

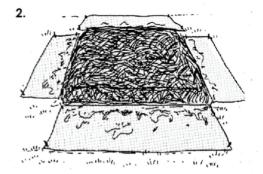
Facilitator's notes:



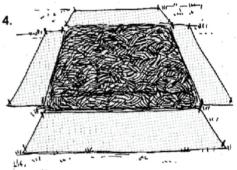
After one bucket of water, the water starts to run off the patch. A lot of mud is splashed onto the piece of paper.



After three to four buckets of water, some water starts to run off the patch, but much less than for No. 2. No mud is splashed onto the piece of paper.



After two buckets of water, the water starts to run off the patch, but not as far as with No. 1. Very little mud is splashed onto the piece of paper.



After eight buckets of water the water is still not running off the patch! No mud is splashed onto the piece of paper.

There are five main points to this demonstration which should be brought up through questioning:

- a). Bare ground: The impact of falling raindrops loosens soil and splashes, forming mud. Mud seals the pores in the soil surface so water is unable to filter into the soil,
- b). Covered soil: By covering the soil with mulch or vegetation, we protect it from the impact of the raindrops. This allows the water to filter into the soil and become absorbed.
- c). Covering and loosening the soil permits more filtration of water into the soil.
- d). Adding compost permits even more absorption and retention of water.
- e). Mulch also prevents water from evaporating from the soil as quickly as it does from bare ground.

Practices which improve soil structure (Vukasin, 1995)

Control of soil erosion and rainwater run-off

Water and wind erodes bare soil and soils not well covered with vegetation. Valuable topsoil is blown away or washed into our streams and rivers. Soil erosion control structures and rainwater run-off control structures can help to minimise damage to soil and crops.

Adapted tillage

Repeated and shallow cultivation of soil (ploughing and hand hoeing) can cause the soil to develop a hard compact layer just under the surface (10-15 cm below the soil surface). It is then difficult for water, nutrients and roots to move into the soil. Soil structure is destroyed. There are two main approaches to minimise this, namely to either:

- practise deep ploughing and ripping, but to also minimise the movement of tractors and heavy machinery over the land; and/or
- practise minimum and zero tillage options where little or no ploughing is carried out. In a garden the practice of deep trenching has a similar effect.

Tillage: The preparation of land for crop bearing.

Fallow: Ploughed and harrowed but left unsown for a period up to a year.

Fallow intervals

These are periods of time where

fields/plots are rested and not used for production, to give them time to recover soil structure and fertility to more optimal levels before planting again. Various plant species grow naturally on the plot, re-occupying and filling the ground space which is unexploited during cropping. After some years, badly structured soil can improve greatly.

The cultivation of soil enriching crops

Species *high in biomass* add a lot of organic matter to the environment and soil, while *green manures* add nutrients such as nitrogen to the soil.

Spreading of animal manure or compost

Incorporation of organic matter onto or into the soil increases the soil life and structure of the soil. It is crucial for a healthy, well balanced soil that is alive and can support plant growth.

Soil structure benefits when the soil is occupied by the roots of many different plants, because:

- They move the soil;
- They create a network of living matter which dies and rots to create humus;
- When the roots die, they leave tunnels which improve the porosity and drainage of the soil; and
- They help to control leaching and hold large quantities of minerals in the soil.

Burying organic matter, straw and manure, is indeed worthwhile. Producing humus or compost (with its positive effects on fertility and soil moisture), is an essential part of soil water management.

Below are two examples of how one can incorporate organic matter into the soil. The picture on the left shows a deep trench (or 'fertility trench'). On the right the process of double digging is shown. In both cases, organic matter is buried in the soil to increase fertility and water holding. These methods will be described in more detail later in this Chapter.

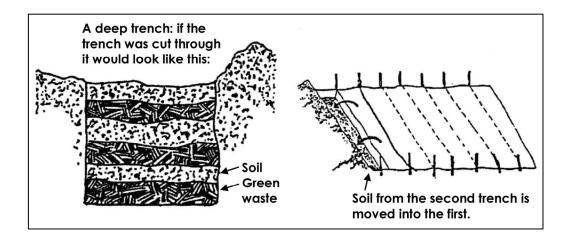


Figure 7: Deep trenching (left) and double digging (right) (Vukasin, 1995)



Activity 1: Small-scale experimentation

Aim:

To practise doing a small-scale experiment to understand how an experiment works for soil water management and be better able to introduce small-scale experimentation to food gardeners that you are working with.

Instructions:

Start by thinking through a problem you have with your soil water management – it may be that your plants are not growing well, it may be that you have little water to use or it may be that the soil is hard and compacted. **Choose one problem**.

Now think of a possible solution for this problem and how you would implement it. Fill in the Small Scale Experiment Plan below, describing in detail what your experiment would look like, what you will monitor, and what you will measure.

Small Scale Experiment Plan

- 1. What is the problem?
- 2. What is the possible solution?
- 3. Why will this solution solve the problem?
- 4. How will I test this solution step by step?

- 5. What will I look for and what will I measure?
- 6. How will I measure the results or outcomes?
- 7. How will I compare my experiment to my usual way of gardening?
- 8. Drawing of the experiment in the field.



Facilitator's note:

Household experimentation becomes the main technique used for interventions in homestead gardening. Small-scale experimentation is a way in which food gardeners can try out new ideas without risking their crops and livelihoods. They try out these ideas in a small area of their garden, comparing it with their normal gardening practices, and observing closely what the outcomes are. Then they are well informed to make their own decisions about their preferred practices and how they would like to adapt them.

Once an innovation (new idea) has been tried and established, that gardener may begin experimenting with other innovations. At the same time s/he may teach to others the innovation s/he had already implemented. When technology is introduced slowly overcoming limiting factors one by one, gardeners have a much better chance, not only to test, implement and share innovations, but also to build up strong circles of knowledge amongst themselves.

It also means that as a facilitator your job is not to try and 'convince" gardeners to 'adopt" specific technologies and innovations that you think are a good idea; rather your job is to introduce new ideas and innovations that food gardeners can try out for themselves and make their own decisions.

6.5 Soil fertility

Soil nutrients

Soil nutrients are mostly made up of chemicals and minerals. These minerals mostly come from base rocks and decomposed organic matter. Some chemicals are taken from the air by plants and fixed in the soil (e.g. nitrogen is fixed by plants called legumes, such as beans and peas).

Creating or maintaining optimum soil fertility is very important in an intensive production system like deep trench vegetable production. Soil fertility management usually deals only with the three major plant nutrients, namely **nitrogen (N)**, **phosphorus (P)** and **potassium (K)**. However, it is important to also look at other nutrients that are often deficient. **Zinc (Zn)** deficiencies are, for example, widespread in South African soils (Laker, 2007), and thus – not surprisingly – Zinc is also one of the important deficiencies in South Africans' diets (see Chapter 3).

The following nutrients play an important role in the growth and health of plants:

N= Nitrogen: Essential for the growth of leaves and stems.

K= Potassium: Increases disease resistance and quality of fruits and grain.

P= Phosphorus: Promotes early maturity and root growth.

Ca= Calcium: Essential for plant cell division.

S= Sulphur: Used by the plant to make amino acids, proteins and vitamins. **Fe**= Iron: Helps in chlorophyll formation (the plant uses chlorophyll to

convert sunlight into green matter).

Si= Silica: Helps plants to absorb sunlight and fight fungal diseases.

Nutrients move from the soil through the ecosystem in a cycle:

Plants absorb the nutrients through their roots...

- → Animals eat the plants...
- → The manure and decomposing bodies are eaten by soil micro-organisms...
- → And they, in turn, create soil nutrients for plants.

A natural farmer works with this cycle by **always trying to increase organic matter and micro-organisms** in the soil.

Below is a diagram of how nitrogen is cycled through nature:

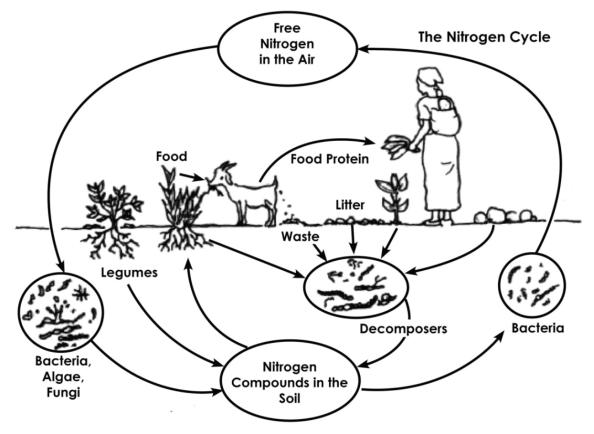
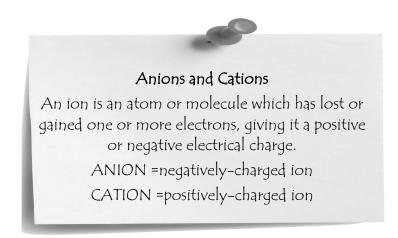


Figure 8: Nitrogen cycles in nature (Kruger, 2008)

Nitrogen

- Nitrogen is strongly affected by microbial activity. Nitrogen in organic material is mineralised by soil microbes into inorganic forms in which it can be taken up by plants. The final product is nitrate.
- Nitrogen is leached (or washed) through soil quite easily. Since it is an anion (a negatively-charged ion), it is not adsorbed in soils and leaches out very quickly during heavy rains or excessive irrigation.
- Also, nitrogen can evaporate into the air. It can thus be lost from the soil, from manure, or from compost into the air.



How do you know if your soil needs more nitrogen?

You will know your plants need more nitrogen when the leaves are turning yellowish, instead of being a strong bright green.

How can you add nitrogen to your soil?

Nitrogen is found in most manure (cattle, sheep, pig, goat, chicken and rabbit). There is more nitrogen in chicken and goat manure. Manure must be dried before being used in the garden; otherwise they can be too strong and burn the plants. Yearly applications can be very effective. The quantity of cattle manure applied by small-scale farmers in their maize fields is usually too small to supply adequate nitrogen. In cattle manure, most of the nitrogen is in the urine, with very little in the solids. This makes preservation of nitrogen in the manure quite tricky.

Nitrogen is also found in legumes

Legumes are plants that form nodules or little knots on their roots. These nodules "fix" nitrogen from the air so that the plant can take it up through its roots. There are micro-organisms in the roots that help to fix the nitrogen. Thus, legumes make their own nitrogen.

After the roots of the plant die, the nitrogen is released into the soil and can be used by surrounding plants. Some people however argue that such legumes remove more nitrogen to make their pods and seeds, and that they actually need small nitrogen applications themselves. Even soybean, which has a high nitrogen-fixing capacity, concentrates nitrogen in the pods, adding little to the soil.

Homestead food growers will have to experiment for themselves to see what works. Perhaps working the green plant into the soil before the plant starts to pod will ensure the most nitrogen for the soil.

Phosphorus

How do you know if your soil needs more phosphorus?

You will know that your plants need more phosphorus when they do not grow as fast as they should. The leaves may also start to show unusual red or pinkish colours, especially around the edges. If your plants are small and will not grow, even if compost or manure is added, then you almost certainly have a severe phosphate deficiency. Phosphorus deficiency can also be caused by acidity in the soil.

How can you add phosphorus to your soil?

Almost all soils in South Africa **do not naturally have enough phosphate** for crop production, and therefore some Phosphorus needs to be added for good plant growth. With the exception of light grey sandy soils, **phosphorus does not move in soils**, not even in red or yellow sands.

In the red sandy soils at Vaalharts (North-West Province) for example, it was found that some soils contained high Phosphorus levels in the plough layer (which decreased crop yields), but immediately below the plough layer the Phosphorus level was even lower than in soil that was not being ploughed. Despite intensive heavy flood irrigation for more than 30 years, the Phosphorus did not leach through to these deeper soil layers. Thus, it is essential that **Phosphorus must be incorporated physically to the required depth**.

It is slightly difficult to add phosphorus to the soil in an organic way, as most of the sources are somewhat tricky to work with. They include urine, bone, hair, feathers

and blood. Usually we add these as ingredients to compost.

Natural rock phosphate can be added directly to the soil. This is also not easily available.

A good source of phosphorus is bone-meal. You can usually buy this from an agricultural supply store, but it is not cheap.



You can also make your own bonemeal to add phosphorus to your soil. Place bones in a fire for a few hours. You can then grind them into a powder more easily.

Potassium

Many South African soils are well supplied with potassium, but some of the highly weathered (or leached) soils in high rainfall areas have potassium deficiencies. Most vegetables require potassium fertilization to ensure a good quality crop. Potassium also increases the tolerance of crops to various diseases.

How do you know if your soil needs more potassium?

You will know your plants need potassium when your plants become brittle and the leaf edges become brown and dry. When fruit do not form properly, you should also suspect a lack of potassium. Other signs can be hard to distinguish. One of these is a yellowing around the veins of the leaves. This could also be caused by diseases, so it is difficult to be sure.

How can you add potassium to your soil?

Cattle manure has high potassium content relative to nitrogen and phosphorus. In contrast, chicken manure is low in potassium relative to nitrogen and phosphorus. A good source of potassium is fresh wood ash. Never use ash from coal as this is very poisonous to the soil and plants.

Another good source of potassium is a plant known as comfrey. This plant has large hairy leaves and grows in wet shady places. The leaves contain a lot of potassium. These can be used to mulch your vegetable beds and also to make liquid feeds/manures for your plants.



Soil acidity (acid) and salinity (salts)

What is soil acidity?

The minerals or nutrients needed by plants to grow are dissolved in the water inside the soil. This is a bit like salt or sugar dissolved in a glass of water.

Soil acidity is when the soil is sour or acid. It is a bit like a glass of water that has vinegar dissolved in it. In places where it rains a lot, some of the minerals can be washed out of the soil. The soil then becomes acidic. The use of chemical fertilizers over a long period of time can also make the soil acidic.

If there is too much acid in the soil, some minerals or plant food will dissolve too quickly and the plants cannot use them. Other minerals will not dissolve at all when the soil is acidic – so again, the plants cannot use them. Phosphorus is one of the minerals that cannot be used by plants when the soil is acidic, even if Phosphorus is present in the soil.

There are mainly two soil chemical conditions that have strong negative effects on plant growth. These are:

- 1. High soil acidity (low pH); and
- 2. Salinity/sodicity (salts in the soil).

High soil acidity (low pH)

Soils with high acidity (pH 3.5-5.5) are found in high rainfall areas. The water in the soil washes away many of the chemicals in the soil. It either runs off the surface (this is called weathering or erosion) or runs deep into the soil where plant roots cannot reach (this is called leaching).

Some of the problems associated with **acidic soils** include the following:

Aluminum toxicity: Aluminum is one of the chemicals that are not washed away in soils. So, as the other chemicals are leached out of the soil, more and more aluminum remains behind. Eventually it becomes too much and becomes toxic/ poisonous to plants. This is a serious problem on some highly acid soils. It causes



How do we measure 'acidity'?

Neutral: Where pH=7 Neither acidic, nor alkaline.

Acidic: Where pH<7
The lower the pH, the more acidic.
-For example, swimming pool
acid is at about pH=3

Alkaline: Where pH>7
The higher the pH, the more alkaline.
-For instance, liquid ammonia is at
about pH=10

- stunted root growth and small plants. These roots are usually very short with thick dark tips.
- Phosphorous deficiencies: In leached soils (high rainfall areas where rain washes chemicals out of the soil or deep down into the soil), phosphorous (P) becomes

- attached to soil particles in forms that are unavailable to plants, leading to serious phosphorus deficiencies.
- Deficiencies of calcium and/or magnesium due to leaching of these basic cations.
- ❖ Deficiencies of trace elements such as molybdenum and zinc.
- Low activity of favourable bacteria, e.g. nitrifying bacteria that convert nitrogen to nitrate, the most important form in which nitrogen is taken up by plants.
- Increased activity of some soil-borne fungal diseases of crops, e.g. clubroot of cabbage.

High soil acidity is corrected by **adding lime** to the soil until a favourable pH is reached. The amount of lime needed to correct the pH of different types of acidic soil can differ. If you are not very familiar with a soil, it will be necessary to have the soil tested, so that a recommendation can be made. pH is a measure of the acidity in soils. Acidic soils generally have a pH range of 3.5 to around 5.5. Neutral soils have a pH range of 6-7.5 and alkaline soils have a pH of higher than 7.5.

Salinity/sodicity (salts in the soil)

Alkaline soils contain more lime than acidic soils. The lime content makes a difference to the fertility of the soil and determines the range of plants you can grow, as it has the ability to make some nutrients unavailable to the plants. This is because of the high levels of salts in these soils that combine with some of the elements in the soil and make them unavailable to plants. Nutrient deficiencies of iron, manganese and boron are common in alkaline soils. Plants in these soils show symptoms of yellowing between the veins and internal "corkiness" or hardness, especially in root crops and brassicas.

Salinity and/or sodicity problems are found in some soils in dry areas, as well as in some types of soils on lower slopes. It is usually too expensive and difficult to fix saline and sodic soils, although application of large quantities of compost, manure and mulch will lower the pH sufficiently.

For saline soils it's possible to leach the salts out of the soil by watering and drainage of the excess water away from the cropping areas. This does not work for sodic soils. Growing crops on raised beds may help. (Hamilton, 1987).

Growing crops that are tolerant to high salinity is a good way to overcome the problem. Vegetable crops with high salt tolerance include beetroot, spinach and asparagus. There is a wide range of vegetable crops with medium salt tolerance. The most noticeable one with low salt tolerance, i.e. which cannot be grown on such soils, is green beans.

How do you know if your soil is acidic?

You will know your soil is acidic if you provide compost or manure for your plants and enough water, but they still do not grow. The plants remain small and stunted.

How can you solve the problem of acidity?

It is possible to make the soil less acidic by adding a lot of compost and other organic matter to the soil over a period of a few years.

The only practical and reasonably quick way of dealing with soil acidity is to add lime to the soil. Lime can be bought and is either a white powder or grey granules. Usually lime is added 2-3 months before planting, as it is slow acting in the soil. It needs to be dug into your soil, at least as deep as most of the roots are growing. For vegetables, this is 30-60 cm deep. For field crops like maize and sorghum that have deep roots, this is from 60 cm to 1 meter deep.



Facilitation Tool 4: Soil acidity experiment (Gibberd, 2003)

Aim:

To assist a food gardener to do an experiment to test whether there is a lack of phosphorus and or lime in their soil, and to see the results on plant growth of adding phosphorus and lime to their soil.

Instructions:

Start by talking through the issues of soil fertility with the food gardeners.

Fill in the Small Scale Experiment Plan with the food gardener. You will go through the questions, work out the solutions (in this case addition of phosphorus and lime), and discuss how you will 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 gardening?
- Drawing of the experiment in the field.

The layout and implementation:

In this experiment you will need to measure out 4 plots of the same size. Make these plots about 1 metre long and 1 metre wide. Be sure to mark out your plots with sticks/stakes, so that you will know throughout the season where your plots are.

- ❖ PLOT 1: This is your control plot. Prepare and plant this plot in your normal way.
- PLOT 2: Prepare the plot in your normal way and then add 2 big spoonfuls (20 grams) of superphosphate. This is spread evenly over your soil and is then dug into the soil. Then plant in your normal way.
- PLOT 3: Prepare the plot in your normal way and then add one big tin (400 gram jam tin) of lime. This is spread evenly over your soil and is then dug into the soil. Then plant in your normal way.
- PLOT 4: Prepare the plot in your normal way and then add 2 big spoonfuls (20 grams) of superphosphate and one big tin (400 gram jam tin) of lime. This is spread evenly over your soil and is then dug into the soil. Then plant in your normal way.

Below is an example of what your experiment might look like.

Chapter 6: Soil fertility management: Optimising the productivity of soil and water

Experimental plots (four plots of 1 m x 1 m each)	Plot 1: Control	Plot 2: Phosphate	Plot 3: Lime	Plot 4: Lime & Phosphate
		Garden planted	with vegetables	

The monitoring:

Now you will monitor or look at your experiment. Every week you will check and see which plants look better. Actually you will make sure that the food gardener doing the experiment will do the monitoring! So you will need to follow-up with them how the monitoring is going and ensure that they are filling in the form correctly. You will look at the plants' growth (size); their colour (bright green, yellowish...); and their health (are there signs of diseases – spots, discolouration...)

Time and resources:

You will need to buy small quantities of lime and superphosphate to do this experiment. You will need the sticks/ stakes to mark our plots.

Time: 8 hours

Soil biology

Soil biology refers to the living micro-organisms and other creatures that live in the soil. A healthy soil is alive with organisms, fungi, bacteria, worms, insects and small animals. Compost, organic mulch, manure and decomposing plant roots break down and are quickly recycled into humus.

Humus

Humus is an important source of many nutrients.

Humus also:

- Generates porous soils and stabilizes soil structure;
- ❖ Helps retain water in the soil and prevents nutrients from leaching out of the soil;
- Prevents soil loss from wind and water erosion;
- ❖ Generates high levels of beneficial soil organisms, especially earthworms;
- Regulates soil temperature; and
- Opens up small channels for seedling roots to follow into the soil.

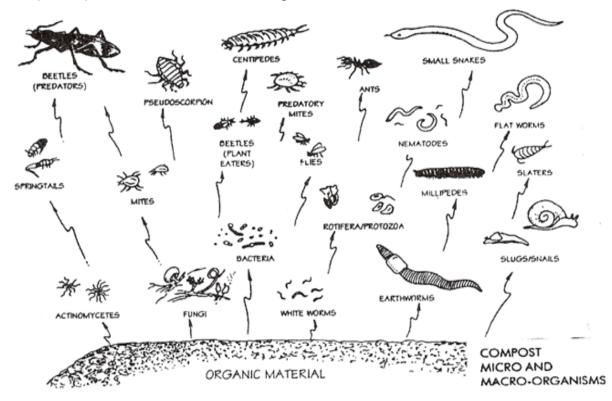


Figure 9: Organic matter and micro-organisms

The role of organic matter in soils and the value of organic material applications

Organic matter has a number of very important functions in soil:

It enables plants to grow strong roots:

It is important in the formation of a good crumbly or granular structure in soils. Especially in clayey soils, this is necessary to enable good aeration (enough air in the soil), good water infiltration into the soil and the development of strong, deep root systems. Thus it improves the uptake of nutrients and water by plants.

It improves the ability of the soil to store and supply plant food:

Decomposed organic matter (humus) is high in nutrients that plants can absorb. Humus stores nutrients so that they are not leached out the soil and they become available to plants over a time. Decomposed organic matter is especially important in sandy soils and in highly weathered/ leached soils.

It is a good source of plant food:

Organic materials provide a wide range of plant nutrients to plants.

It creates healthy living soil:

Organic matter provides nutrients and energy material for the effective functioning of favourable soil organisms (micro and macro).

Nutrient fixing plants

Plants themselves are some of the most important sources of soil nutrients. Plants can either fix nutrients into the soil, like legumes; or they can take nutrients from the sub-soil into the leaves and fruit. When these leaves and fruit then fall onto the ground, the nutrients decompose into the topsoil. The natural farmer uses cycles of plants and animals to build soil nutrients, rather than expensive chemicals which destroy the soil biology.

Below is a table with some common examples of good garden plants that assist with nutrient cycling.



Nodules on the roots that fix Nitrogen

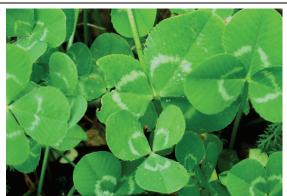
Table 3: Garden plants that assist with nutrient cycling

NITROGEN

Legumes fix nitrogen from the air through their roots into the soil

Clover

This occurs naturally on nutrient rich clay soils.



Lucerne

This is a long living legume. It is good feed for livestock and chickens.



Some plants accumulate nitrogen in their leaves

Stinging nettle

This plant also accumulates silica, calcium, iron and potassium, and is a great all round fertility enhancer.

Grows wild in forests and wet areas.

Can be grown easily, but beware the sting



PHOSPHORUS:

Comfrey

Also accumulates Potassium, Calcium and Nitrogen in their leaves.

This is a great plant for liquid manure.

It is also an important medicinal herb known as knit bone; it also clears chest ailments and skin conditions.



Dock

Generally, this is a rather difficult weed, as it has long, strong roots and seeds prolifically. Keep in check.

It also accumulates Nitrogen and Potassium.



POTASSIUM:

Yarrow

This is a useful garden herb, used liberally in compost, for mulching and for interplanting as it is not too competitive. It is a good ground cover around fruit trees.

It also accumulates Phosphorus.



6.6 Soil building techniques

There are a number of different ways in which soil can be improved or built up to have good depth, fertility and water holding capacity. It does not matter whether you start with a good soil, or a really bad soil – it can be managed to provide optimal growth of your plants!

Some techniques include mulching, using manure, making and using compost, liquid manures/teas, earthworm castings, using legumes and cover crops. These will be discussed below.

Bed design is important also in that organic matter is included in the beds in particular ways to maximise fertility, depth and water holding capacity. A section on bed design follows.

Mulching

Mulching is the spreading of a layer of material over the surface of the soil. It covers the soil and keeps it moist and cool in summer.

Why is mulching important?

Mulching has two main effects:

1. It saves water, because it will stop the sun and wind from drying out the soil. That means that you will need to give less water to your plants, because it is not lost through the effects of sun and wind.

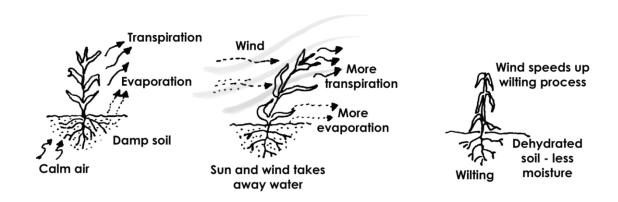


Figure 10: The effect of wind and sun on bare soil

2. It keeps the soil temperature more even. Mulching reduces too much heating and too much cooling of the soil. This makes it easier for plants to grow.

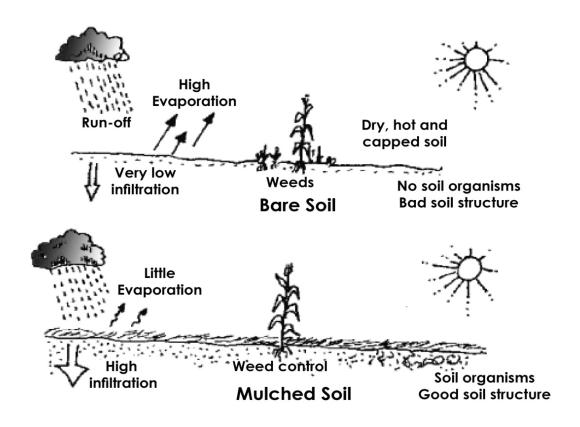


Figure 11: The effect of mulch on evaporation, weed growth and soil temperature (Vukasin, 1995)

From: Production without destruction

Other positive effects of mulching include:

- It stops loss of minerals/nutrients from the soil;
- It encourages soil organisms;
- It reduces weed growth. This is important as weeds compete with your crops for water and nutrients;
- It prevents capping. That is the formation of a hard layer of soil on the surface;
- ❖ A stronger root system develops closer to the soil surface. This makes more nutrients and air available to the roots;
- Break down of mulch will add to soil fertility; and
- It breaks the impact of heavy rains and splashing of soil on plants that can spread diseases.

What to use as mulch

Usually we use the following for mulch:

- Crop residues (stalks and leaves of harvested crops). NEVER use diseased crop residue. You will infect the soil and your new crops!
- ❖ Weeds that have been pulled out and left to dry out.
- Grasses from the veld. Make sure to use DRY grass. GREEN grass will take nutrients from your soil and your crops will have fewer nutrients.
- Flat stones. These will cover but will not add nutrients. They are good around larger plants and fruit trees.
- Newspaper. This will cover and add a little bit of nutrients/ plant food to the soil. Wet the newspaper when you put it on the soil, so that it does not blow away.
- ❖ Manure. Use DRY or OLD manure for this.
- Leaves collected under trees.
- Old thatch grass.
- Black plastic sheeting.

How do we mulch? (Altiere et al., 1984)

It is best to chop up your mulching material (weeds and grass) to be about the length of your hand or slightly longer (10-20 centimetres).

Use a thin layer of mulch for seedlings and small plants – about one finger width (1.5 cm) deep.

For larger plants use much thicker mulch – about 2-3 finger widths (3-4 cm) deep.

For trees, a really thick layer, one whole hand or more (10-20 cm) deep, can be added.

When the mulch has broken down, you need to add more! You will be amazed how quickly this happens. Usually mulch is added at least once a season, or once every 3 months.

In areas with extremely cold winters, it may be an idea to make sure your mulch is compacted or squashed down once the frosts are heavy and the ground starts to freeze. Loose mulch can make the effects of frost more severe.

As a facilitator, you can use Facilitation Tool 5 (see below) to introduce mulching through household experimentation.



Facilitation Tool 5: An experiment to test mulching

Aim:

To assist a homestead food gardener to do an experiment to test the effects of mulching on their soil, water and plant growth.

Instructions:

Start by talking through the issues of mulching with your homestead food gardeners. You can use the information provided above to talk about what mulching is and what the benefits of mulching are.

Then discuss doing a small experiment around mulching. Fill in the Small Scale Experiment Plan below with the food gardener. You will go through the questions, work out the solutions (in this case addition of mulch), and how you will 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 gardening?
- Drawing of the experiment in the field.

The monitoring:

Now the homestead food gardeners will each need to monitor his/her experiment at home. Every week they will need to check specific things such as:

Did they use less water on the mulched plants? (How will they test this?)

Were the plants that were mulched bigger and better than the ones that weren't mulched? (What will they observe and or measure here?)

Time: 6 hours

Manure

The management and use of manure is important in ensuring the productivity of soil and water.

Manure

Most kinds of animal manure can be used. This includes manure from cattle, sheep, goats, pigs and chickens

Handling Manure

The best manure to use is manure mixed with straw and urine, from a kraal. Sweep this into piles at least once a week and then cover these piles with grass or plastic.

Manure can be added to your soil in a number of ways:



• It can be used when you are planting your seedlings, by mixing in two to three handfuls of manure into your planting holes for seedlings.

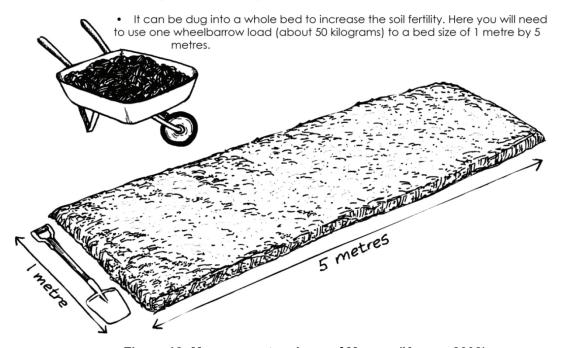


Figure 12: Management and use of Manure (Kruger, 2008)

Use of animal manure in homestead food gardening (Van Averbeke, 1997)



Farmyard manure from cattle, sheep, goats, horses, mules, donkeys and/or pigs consists of two parts – a solid part (faeces) and a liquid part (urine). Most of the phosphorus (P) is found in the faeces, while most of the nitrogen (N) and potassium (K) are found in the urine.

The composition of farmyard manure can vary considerably. A number of factors affect the composition of farmyard manure, including the following:

- The type and age of the animal and the purpose for which it is used: Horse (and mule and donkey) manure and sheep (and goat) manure contain a lot more of the three main plant nutrients (nitrogen, phosphorus and potassium) than cattle and pig manure.
 - Horse and sheep manure are fairly dry, warm manures, whereas cattle and pig manure are moist, cool manures. Thus, when manure is stored for composting, it is good to mix dry, warm manure types with moist cool manure types if both types are available.
- ❖ Young, growing animals use nitrogen and phosphorus for the growth of their bodies, thus their manure contains less of these nutrients than the manure of mature animals. In the case of milk cows, a significant part of the plant nutrients is excreted in the milk and less is found in the manure.

Chemical composition of the feed and fodder:

In the case of mature animals (excluding dairy cows), all the plant nutrients in the feed and fodder are found in the manure. Thus it is logical that the chemical composition of the feed and fodder has a major effect on the mineral nutrient content of manure.

The manure of animals grazing on natural veld (rangeland) on infertile acid soils and sandy soils will be particularly poor in plant nutrients. It could be useful to add some chicken manure to such manure. On the other hand, manure from animals grazing on stalks in well-fertilized maize fields or cultivated pastures will have high plant nutrient contents. Again, the situation with dairy cows will be somewhat less favourable.

The stage of decomposition of the manure:

The older manure becomes the less plant nutrients it will have. Old manure always contains less nitrogen than fresh manure – due to the evaporation of some of the nitrogen. If manure is subject to leaching by rains, and/or if the liquid manure is allowed to flow or drain away, the manure will have much lower amounts of plant nutrients than the original fresh manure.

Amount and type of bedding material:

Bedding materials absorb urine, and thereby increases the nutrient content when mixed in with the manure for composting.

- -Straw, dry hay and dry grass are excellent bedding materials for kraals and sheds where animals are kept.
- -Various types of shrubs can be used where these materials are not available. Shrub materials are less efficient for composting, because they do not decompose easily and are coarse or rough.
- -Sawdust can be used where adequate amounts of other bedding materials are not available. Sawdust is very poor in plant nutrients, but has a very high absorption capacity for liquids. Manure which contains a lot of sawdust must be composted for longer periods, before it can be applied to soil.
- ❖ Storage and handling methods used: Manure should be well mixed with bedding material and stored in piles that remain wet, but that are not open to being leached by rain. Some form of cover for the pile is a good idea.

Fresh manure should never be applied. *Only well-composted well-matured manure should be used*. Fresh manure does not have nutrients in plant-available forms and it must first be decomposed in the soil before the nutrients become available. Manure must be moist when it is spread in the fields or on vegetable beds. It is better to apply it during cool, humid weather (even light rain) – if there is such possibility. It should be worked into the soil immediately after applying it. Well-matured manure can be applied shortly before planting.

For vegetable production, at least 20 tons farmyard manure should be applied per hectare. This means that at least 2 kilograms (one 5 litre bucket) of manure must be applied per square metre. In South Africa, farmyard manure is relatively poor in phosphorus. Natural South African soils are also very poor in phosphorus. Thus, additional phosphorus must be applied together with manure. This can be in the form of superphosphate or bone meal.

Moveable kraals

Moveable kraals are effective. Clear the land where you want to plant your crop and make the kraal on it. Once enough manure has accumulated in the kraal, move the kraal to the next patch on the cleared field – and then to the next, and so on. Then mix the manure into the soil at the site of the abandoned kraal. After allowing for decomposition of the manure, you can then plant on that spot.

Also look at the use of 'Chicken Tractors' for this purpose as described in Chapter 4. See picture overleaf.

Use of chicken manure

In rural areas where chickens roam freely, their manure is often not available, or may be difficult to collect due to the small size of the droppings. However, where these constraints can be overcome, chicken manure is an excellent source of plant food.

Chicken manure contains **high concentrations of nitrogen and phosphorus** and is therefore a good source of these nutrients. It is a "sharp" fertilizer that will damage ("burn") the crop if applied in too large quantities.

Application of chicken manure to a crop should never exceed 2 tons per hectare. Two tons chicken manure per hectare is the same as **200 g (about 500 ml) per square metre.** Thus, for the application of chicken manure to small areas of land or to beds, the following measuring method can be used: Cut the neck off a 500 ml plastic soft drink bottle, at the "shoulder" of the bottle. Apply one such bottle full of chicken manure for every one square metre.

Chicken manure:

- ❖ Is a fantastic nitrogen fertilizer; much better than kraal manure!
- Can provide too much phosphorus, which causes phosphorus to build up to extremely harmful levels in the soil if high levels are applied over too long periods;
- Is deficient in potassium for vegetable and fruit crops (but luckily most of our soils already have a lot of potassium);
- Can be mixed with farmyard manure, to increase the phosphorus levels in the farmyard manure. At the same time, the farmyard manure will increase the potassium level in the chicken manure; and
- Is also an excellent source of nitrogen and phosphorus to add to compost heaps to speed up the composting process.

'Chicken Tractors'

The so-called 'chicken tractor' in the picture below, is a lightweight 'moveable chicken kraal'. The 'chicken tractor' is kept in place for about three weeks in a spot where the gardener wants to start a new planting bed. During this period, the chickens prepare the soil for planting by loosening and fertilising it, and by ridding it of unwanted insects and weeds/seeds. (See Chapter 4 for more detail.)



Compost

Compost is a combination of wet and dry plant material and manure, decomposed together to form a rich plant food. Compost helps to keep plants free from diseases.

What do you need to make a compost heap?

You need to collect a lot of the following:

- Maize stalks or leftovers from other crops. These are called crop residues;
- Grass without seeds it can be green or dry;
- Cabbage leaves;
- Weeds (green or dry) with no seeds;
- Animal manure; and
- Wood ash.

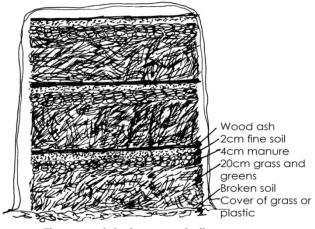
Some other things that can go into the compost heap are: kitchen waste, washing water, yard sweepings, dead animals, bones, wool, horns and feathers. It is a very good idea to add comfrey to compost heaps.

Things not to add:

Plastic, glass, metal, wood, old batteries or anything that can not decompose (break down in the soil).

Where to make a compost heap

- In a shady place but not too close to the trunk of a tree.
- Protected from too much wind.
- · On flat ground.
- Close to your garden and to a source of water.
- Away from animals (especially pigs, goats and chickens).



The completed compost pile

How to make a compost heap



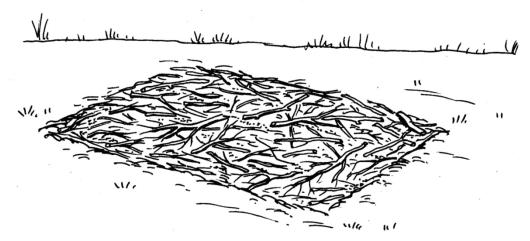
Step 2:

Chop the stalks and leaves of your crop residues, grass and weeds into small pieces. This includes comfrey, cabbage leaves, weeds and maize stalks. They need to be chopped into pieces about 10cm long. This is the width of your closed hand. This will make the composting process go faster.



Step 3

Lay some small branches and twigs on the soil that you have turned over.



Step 4



Figure 13: How to make a compost heap (Kruger, 2008)

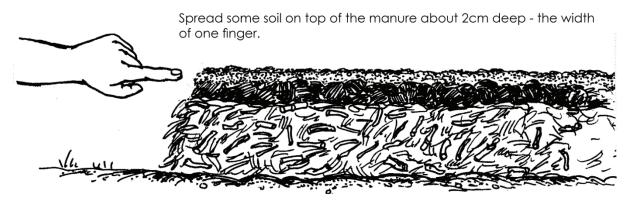
Step 5:

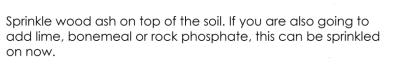
Step 7:

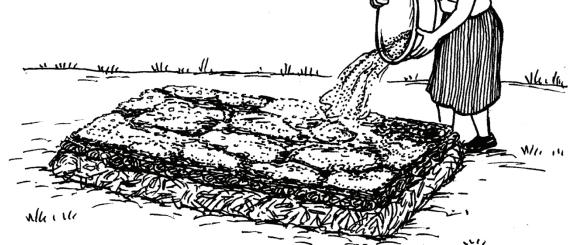
Spread manure on top of this about 4cm deep. This is the width of 2 fingers.



Step 6:









Step 8:

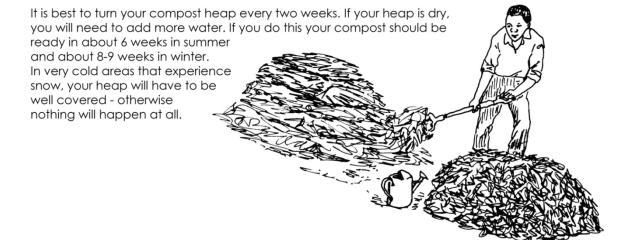
Water these layers until the water soaks through at the bottom of the pile.

Continue to build the heap, repeating the layers as before, until it reaches the height of your chest.

Step 10:

It is best to cover your pile, either with a thick layer of straw or grass or plastic. This helps to keep the water and heat in and it helps your pile decompose. It also stops animals from scratching in your heap and destroying it.





Handling compost

Plant seedlings with two to three handfuls of compost mixed into the planting hole. This can be done if your soil is reasonably fertile already and your beds have a good crumbly soil structure that holds water.

If the soil in your plot/bed is not good, then dig compost into the whole bed. Turn over the soil and loosen it to a depth of at least 30 cm (the length of the head of a spade. Spread four spades full of compost on every square metre of soil. Dig this in lightly and then plant seed or seedlings.

You can also use compost as mulch by spreading it over the surface of your beds.

Liquid manures/teas

One way of improving plant nutrition is to make liquid teas or brews that will add fertility to the soil. This should be used as an <u>additional</u> soil fertility technique rather than the only one! Brews provide extra nutrients in case of small deficiencies, but cannot rectify major nutrient deficiencies.

Liquid manures are a simple way of giving your plants a nutrient boost. They can be made from plant material or animal manures. The aim is to provide plants with natural plant foods quickly during their growing season. It is useful for heavy feeders like cabbages and to give seedlings a boost.

How to make liquid manures from plants (EMBRAPA, 1998)

A good plant for liquid manure is comfrey. Soft green leaves and stems from any other plants can also be used and weeds are ideal. Avoid plants which are very strong smelling.

Plants are made of different quantities of nutrients and take up different nutrients from the soil. So it is best to use a range of plant materials to make your liquid manure/tea.

Method:

Make sure your container is clean before you use it.

Collect the plant material and fill up the container. You must keep on adding material to the container every week.

Place the rock on top of the plant material in the container and put the lid on. Do not add water. The plant material will make its own liquid. If the plant material does not make much liquid, you can add some water – but not too much.

Place it in a sunny position and two weeks later check to see if the leaves have turned black. If you tilt the container you should find a black juice. This is the concentrated plant liquid manure.



This liquid is very strong and should be diluted as follows:

- ❖ **Seedlings**: 1 tin of liquid manure for every 4 tins of water.
- ❖ **Bigger plants**: 1 tin of liquid manure to 2 tins water.

If you make the mixture too strong it can burn the leaves of plants. Every two weeks pour the mixture on the soil around your plants, after you have watered them. You should pour at least one tin of this diluted mixture around each seedling or plant. The tin should be the size of a big jam tin.

Below are some examples of plants that are good for including in plant brews/teas.

Comfrey: This plant has large hairy leaves and grows in wet shady places. The leaves contain a lot of potassium. These can be used to mulch your vegetable beds and also to make liquid feeds for your plants Comfrey is also a good spinach and medicine. A tea made from the leaves is good for high blood pressure and arthritis.



- ❖ Stinging nettle: This is one of the best plants you can use in plant brews. It contains a wide variety of nutrients and trace elements and is a well-balanced plant food. It is best to collect these plants in the natural forests where they occur and plant a few in your garden. They do not survive frost, but otherwise grow almost anywhere.
- ❖ **Banana stems**: These are chopped up and placed in the container with other plants and leaves. The stems have a high concentration of potassium and water and make a good liquid base for the brew.
- ❖ Weeds: Black Jack, Amaranthus, Chickweed, Gallant Soldier. All fast growing weeds, with soft dark green leaves are good. Avoid using grasses and sedges.

A brew made from comfrey leaves can be diluted as mentioned above and sprayed on plant leaves to protect against **downy and powdery mildew**. Mildews are a problem mainly on cucurbits, pumpkins and peas.

A brew made from comfrey and stinging nettle can be sprayed on plants to protect against early and late **blight**, which attacks tomatoes and potatoes. In these cases the brews are sprayed onto the leaves of the plants.

Table 4: Advantages and disadvantages of plant brews

ADVANTAGES of plant brews	DISADVANTAGES of plant brews
Plant brews are easy to prepare and use	Resources such as containers with lids are required
If diluted these brews do not harm plants	Plant brews can burn plants if they are too strong
Plant brews increase disease resistance in crops	Effects of the brews on plant growth are only visible after 3-5 days
Plant brews provide a quick and cheap plant booster food	It is not possible to know exactly which nutrients these brews contain
Plant brews provide mainly potassium, phosphorus and trace elements	Some people do not like the smell of these brews, which can smell very rotten
Nitrogen can be provided if the brew is used early in the fermentation cycle (after 1 week) and care is taken to avoid it's evaporation by keeping the containers closed and cool	Nitrogen is volatile and is lost from the brews quite early in the fermentation cycle

How to make liquid manure from animal manure (Valley Trust, 1996)

Fresh manure from chickens, rabbits, cows, goats and sheep can be used to make liquid manure. A mixture of manures is best.

Method

Put your fresh manure mixture into the bag and tie the top of the bag.

Put the bag in the container and attach it to the stick or the rope. Then fill the container with water. For every 1 kilogram of manure you will need 10 litres of water. This means an orange sack full of manure in a large bucket, or half the bag in a normal sized household bucket.

NOTE: The sack helps to keep the manure and the water separate, because you should not put the wet manure on your plants.

Cover the container with a lid. Stir every few days.

After two weeks the mixture will be ready to be used. It should look like weak tea.

Before using the liquid, stir the mixture well.



You will need:

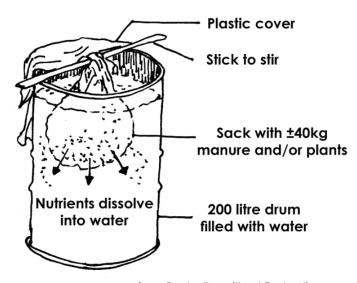
A large container: 100 litre or bigger
A bag of some kind; either an orange sack, a
feed bag or a cloth bag
A strong stick or rope
Something to tie the bag with
Some type of lid for the container, or loose
cover.

Fresh manure.

This liquid will be very strong and should be diluted:

- ❖ **Seedlings**: 1 tin of liquid to 8 tins of water (or buckets or bottles).
- ❖ Bigger plants: 1 tin liquid to 4 tins of water.

If you make the mixture too strong it can burn the leaves of plants. Every two weeks pour the mixture on the soil around your plants, after you have watered them. Again, use at least one big jam tin full for each seedling or plant. Avoid applying your mixture in the middle of the day or on very hot days.



from: Production without Destruction

Figure 14: Making animal liquid manure (Vukasin, 1995)

Below are some examples of different types of manure you can use to make liquid manure.

Kraal manure (Cattle)

Either use fresh manure or use manure that has been collected in a kraal. In this way you can ensure that the manure contains as many nutrients as possible and that the nutrients have not been lost into the air through baking in the sun and drying out. This is especially important if you need your liquid manure to contain some Nitrogen.

Chicken manure

With chicken manure it is important to collect the droppings while they are fresh. Again this keeps the nitrogen and other plant food concentrated in the dry droppings. It is possible to collect the droppings daily and keep them in a sack in a cool dark place, until you have enough to make a brew.

Liquid manure made from chicken manure can burn plants, as it can contain a high level of Nitrogen. It is important to dilute this brew properly before use. If you are unsure, test the brew on a few plants only and come back the next day. If the edges of the leaves have gone brown and crinkly overnight, the brew is too strong and has "burnt" your plants.



Chicken manure can be gathered from chicken enclosures.

Goat manure

This is very mild manure and is well balanced. It is unlikely to "burn" plants, but may also be a little low in phosphorus, depending on the diet of the goats.

Other manures

Manure from rabbits can also be safely used. It is suggested not to use the manure from pigs, due to the possibility of carrying worm eggs that can infect people. Do not use manure from dogs and cats, for the same reason.

Table 5: Advantages and disadvantages of animal liquid manures

ADVANTAGES of animal liquid manures	DISADVANTAGES of animal liquid manures	
Liquid manures are easy to prepare and use.	The liquid manure is only as good as the manure of origin. If the animals are suffering from deficiencies these will be transferred into the manures. As an example, there is likely to be a lack of phosphorus in cattle manure, where cattle have only been grazed on veld. This means the liquid manure made from this source will also lack phosphorus.	
If diluted properly, these liquid manures do not harm plants.	Liquid manures are generally low in nitrogen. Using chicken manure drastically increases the nitrogen content.	
Liquid manures increase disease resistance in crops.	The source manures have to be handled well to retain their nutrients before using as liquid manures.	
Liquid manures provide a quick and cheap plant booster food.	Effects of the liquid manures on plant growth are only visible after 3-5 days.	
Liquid manures provide mainly potassium, phosphorus and trace elements.	It is not possible to know exactly which nutrients these brews contain.	
Nitrogen can be provided if the liquid manure is used early in the fermentation cycle (after 1 week) and care is taken to avoid its evaporation by keeping the containers closed and cool.	Some people do not like the smell of these liquid manures, which can smell very rotten.	

How to make a foliar spray

Foliar spray is brew made from a mixture of plant and animal material. It is used by spraying onto the leaves of plants from where it is absorbed. This brew contains antibiotics, microbes and plant hormones as well as plant nutrients (potassium, phosphate and trace elements) (EMBRAPA, 2001).

Method

- 1. Place the following ingredients in a container with a lid:
- 30 kg of fresh cow manure
- 50-60 litres of water
- 5 litres of milk (without salt)
- 5 litres of sugar cane juice <u>OR</u> 15 kg of chopped sugar cane <u>OR</u> 2 kg of brown sugar (personal variation)
- 4 kg of wood ash (not coal ash!!)
- ❖ 4 kg crushed bones or bone meal (fish bones are ideal if available. If possible do not use chicken bones. (We use bone meal bought from a gardening shop).
- ❖ 3-5 x 20 litre buckets of chopped weeds
- ❖ 2-3 kg of agricultural lime <u>OR</u> crushed eggshells
- 2. Leave this mixture for 10-15 days
- 3. Dilute 2-10 litres of this mixture in 100 litres of water.

This spray is highly effective!! It is possible to keep the brew going for a period of time, by adding more weeds and manure and fermenting the mixture again for about 10 days.

Table 6: Advantages and disadvantages of foliar sprays

ADVANTAGES of foliar sprays	DISADVANTAGES of foliar sprays
Foliar sprays are very effective and act quickly in the plants	Some inputs for foliar sprays need to be bought; such as agricultural lime and potentially wood ash, sugar and milk
If diluted properly, these foliar sprays do not harm plants	This mixture is exceptionally smelly while it is fermenting
Foliar sprays increase disease resistance in crops	Foliar sprays can "burn' plants if they are too strong.
Foliar sprays provide a quick and cheap plant booster food	
Plant hormones and antibiotics are also supplied through the fermentation process in the making of foliar sprays	



A large container: 100 litre or bigger
A bag of some kind; either an orange sack, a
feed bag or a cloth bag
A strong stick or rope
Something to tie the bag with
Some type of lid for the container, or loose
cover.
Ingredients as set out in method.



Facilitation Tool 6: Household experiment on liquid manures

Aim:

To assist a homestead food gardeners to do an experiment to test the effects of using liquid manures/teas on plant growth.

Instructions:

Start by talking through the issues of liquid manures with your food gardeners. You can use the information provided above to talk about what liquid manures are, how they are made and used, and what their advantages and disadvantages are.

Then discuss doing a small experiment with liquid manures. Fill in the Small Scale Experiment Plan below with the food gardener. You will go through the questions, work out the solutions (in this case addition of liquid manure) and how you will 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 gardening?
- Drawing of the experiment in the field.

The monitoring

Now the homestead food gardener will need to monitor their experiment. Every week they will need to check specific things such as:

Were the plants that were treated with liquid manure bigger and better than the ones that weren't? (What will they observe and or measure here?)

An outline of a monitoring sheet is provided in the Resource Packs (Handouts).

Time: 6 hours

Using legumes and cover crops

A cover crop is usually a legume (nitrogen fixer, see earlier section on nitrogen fixing plants) that grows quickly and spreads over the soil.

Cover crops improve the soil in various ways

- They protect the soil from wind and water erosion;
- They prevent the soil from being compacted by heavy rain and so allow rainwater to soak into the soil more easily;
- They catch nitrogen from the air into their roots. This nitrogen remains in the soil when the plants die; and
- When the cover crop is ploughed into the soil, it adds organic matter and improves the soil structure.

Cover crops can either be grown before or after the main crop is planted in a bed/plot/field (i.e. in rotation with the main crop), or it can be grown as an intercrop.

For example:

- In <u>summer</u>, maize can be intercropped with lucerne, cowpeas and beans.
- In winter, cabbage can be intercropped with vetch or clover.

Examples of legumes that we often grow are ground nuts, cowpeas, beans (including soya beans), and peas. There are less common crops and also many long living plants and small trees that fix nitrogen. Some examples are chickpeas, mung beans, lentils, pigeon peas and tree lucernes.



Soya beans

Green manures

Some legumes are grown only as green manures and are not used for food for humans. They make very good animal feeds though! These include lucernes, clover, hairy vetch and lupines. These give lot more nitrogen to the soil than our food plants, because we dig them into the soil when they are still green. This is why they are called green manures.

Introduction to worm farms

DIRECTIONS FOR FARMING EARTHWORMS FOR HUMUS

- Set up a half drum on legs so that drainage from the drum can be collected. Stand the legs of the drum in cans of water to avoid ants and other predators.
- 2 At the bottom of the drum make a few holes to drain the liquid. This will be liquid manure.
- 3 Cover the bottom of the drum with a layer of gravel for drainage.
- 4 Fill the drum with fresh cattle dung.
- 5 Add worms, such as Kariba red, as this variety does not need soil.
- 6 Eggs are laid in the upper 10 cm and this layer can be later used to start a new colony.
- 7 The manure must have a mulch on top using leaves, grass, moss, old cloths, or hessian sack.
- 8 The drum should be covered to avoid predation of the worms by birds.
- 9 Before using the humus remove as many worms as possible. Extra worms are a source of protein for chickens, and batt for fishing.
- The resulting humus rich soil after cleaning out the worms can be used for nursery soil, often a 3 to 1 mixture of river sand and humus. It can also be used as top dressing around plants.
- Collect the liquid manure drained from the bottom. It is not necessary to add water to this byproduct.

The process of decomposition takes about 6 weeks. Breeding of worms is also possible on garden and kitchen waste, although the process is slower.

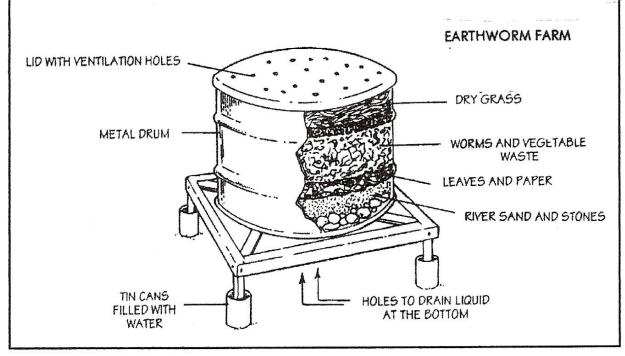


Figure 15: Making earthworm manure/compost (Vukasin, 1995)

6.7 Bed design

It is very beneficial and strongly recommended to lay out your garden in **permanent beds**.

This enables you to keep on improving the soil fertility in the beds with organic matter, compost, mulch and manure. Having permanent beds also helps you to keep the soil nice and soft where your plants are growing, by not walking on the beds and only walking on the pathways. The beds also make it easier to plan crop rotation.

If the ground is **sloping**, make your beds across the slope and not down the slope. In this way, the paths and beds will catch run-off water when it rains.

At the same time, try to lay out your beds in the same direction as the sun passes over your land – in other words, in an **east-west** direction. In this way the sun reaches all your plants, but it does not shine so much on the soil and dry it out.

Long narrow beds are generally a good idea, because you can reach to the middle of the bed from either side without walking on it. These beds are usually 1 metre (one spade length) wide. You can make them as long as you wish.

Deep trenched beds are a way to increase soil fertility and water holding in your beds and garden. It is an intensive way of providing good soil for vegetable production on a small scale; especially, in places where the soil is not good or deep.

You can make trenches in different ways. We are going to focus on deep trenches or 'fertility trenches'. Even though making these beds takes a bit of work, they are also the most rewarding. Plants grow very well and the extra fertility lasts a long time (around 5 to 8 years).

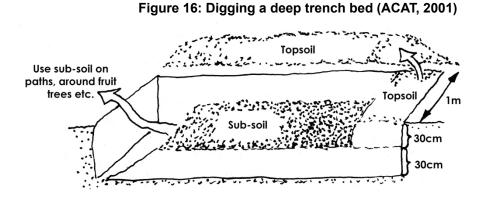


Ground-level keyhole beds are a good way to manage water on sloping ground.

How to make a deep trenched bed (GTZ, 1993)

- 1. **Dig a trench 60 cm or deeper**. It is usually about 1 m wide (to provide easy access without having to step on the bed when you want to work with your plants) and as long as you wish.
- 2. **Separate the topsoil and subsoil** in piles while you are digging.

If your sub-soil is very infertile, it should not be used in the trench. Rather use it to make ridges (berms) where you



need them in your yard to help channel water towards your trench beds.

3. Place a **layer of tins or branches at the bottom of the trench** to help with aeration and also with supply of some nutrients.

The tins need to be squashed before putting them in the hole. Make a layer of about 3 flattened tins deep. If there are no tins, use thin branches instead.



Flattened tins in a trench bed.

- 4. Fill the trench with layers of organic materials and top soil.
- First add dry grass or weeds (about 10 cm deep);
- Then add manure (about 2 cm deep);
- Add some wood ash (a thin layer, less than 1 cm deep); and
- Then add a layer of top soil (about 5 cm deep).



Dry grass and weeds layer in a trench bed

MIX these layers with a fork;

STAMP them down by walking on them;

WATER the mixture well!

Then start the process again with the next layers of organic material and topsoil (step 4 above).

You can also add other organic matter like green and dry weeds and vegetable peelings, card board, paper and bones.

5. Continue to place and mix the organic materials and topsoil (Step 4) into the trench until it has reached **ground level** again.

Mixing a layer in a trench bed



- 6. Now **build up the trench bed to at least 10-15 cm above soil level**. Use a good mixture of topsoil and manure and or compost to do this.
- 7a. The organic material in the trench needs to **decompose for about 2-3 months** before planting.
- 7b. The other option is to **use your trench bed as a seedbed** while it is still decomposing. The roots of the small plants do not go down deep. The materials in the trench can decompose while the seedlings grow on top. In this way, when your seedlings are ready to be transplanted, the trench bed will be ready to be planted. Growing seedlings from seed needs a well prepared bed.
- 8. It is very important that the trenches are **watered well** while they are being made and afterwards. The organic material in the trench cannot decompose if it is dry. Different ways of watering are possible; as long as a lot of water is given initially.

In this picture, drip irrigation is going to be used to water a trench bed.



Below is a case study of research that was conducted into the relationships between soil fertility and water holding using trench beds. This research was done in household food gardens in a community called Potshini (Bergville, KZN) by a team of people consisting of food gardeners, researchers from the University of KwaZulu-Natal (Smallholder Systems Innovation Programme) and the Water Research Commission team (WRC Project on "Participatory development of learning materials for homestead water management for improved livelihoods").

Research finding 1: Deep trenching reduces plant water stress

Plants become water stressed when the water in the soil varies a lot. They prefer to have a constantly moist soil. If the soil becomes very wet and then dries out, just to become very wet again, plants will become stressed. They will wilt easily and will not grow as well as they should.

Tensiometers are instruments that are placed in the soil and can measure the amount of water in the soil. Tensiometers were used to measure soil water and potential plant stress in Potshini, KZN, in Sizakele's garden. The higher the tension that is measured by the tensiometer, the larger is the change in the amount of water. (Note: the tensiometer does not measure the actual quantity of water in the soil, but rather how much the quantity has changed... by how much it has got wetter or drier since the previous measurement).

We compared one of Sizakele's normal beds to one of her trench beds to see what the difference in water holding and water stress was. Readings were taken at soil depths of 20 mm, 40 mm and 80 mm.

The results for Sizakele's trench bed (S2tb) versus a normal bed (S1n) are shown below.

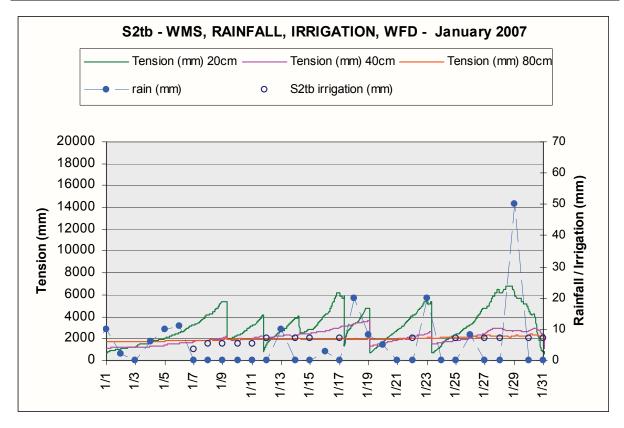


Figure 17: Comparison of soil moisture at different depths in trench beds (JD Sturdy, 2008)

- The green line in the graph shows the tension 20 cm below the ground. This indicates the change in moisture at this depth (read this off the left hand side of the graph).
 - The pink line in the graph shows the tension at 40 cm below the ground. This indicates
 the change in the moisture at this depth (read the value off the left axis of the graph).
- The orange line in the graph shows the tension at 80 cm below the ground. This indicates the change in the moisture at this depth (read off the left axis of the graph).
- The blue line and solid blue dots indicate rain events: how much rain fell (in mm). You read this off the right hand side of the graph. The dates are shown along the bottom of the graph. The little blue circles show Sizakele's irrigations (in mm) on this bed.

Figure 17 shows that the whole profile (depth) of the trench bed remained moist, with no stress periods for the plants. High rainfall events were fully "absorbed" throughout the profile (i.e. the full depth) of the bed and remained there for use by the crops throughout the recording period (one full month).

As the soil dries out, the tension increases. Look at how, on 23 and 29 January, the green line came down (i.e. tension dropped at 20 cm soil depth) when it rained. It rained 20 mm on the 23rd and 50 mm on the 29th. In both cases the tension dropped from about 6 000 mm to below 1 000 mm.

At deeper soil depths (40 and 80 cm), the pink and red lines hardly moved, meaning deeper down, the soil was moist throughout the month of January.

The main conclusion is that in this trench bed, the soil held more water than the plants could use. Still, the bed was well-drained (not water-logged/drowned). These are ideal conditions for plant growth.

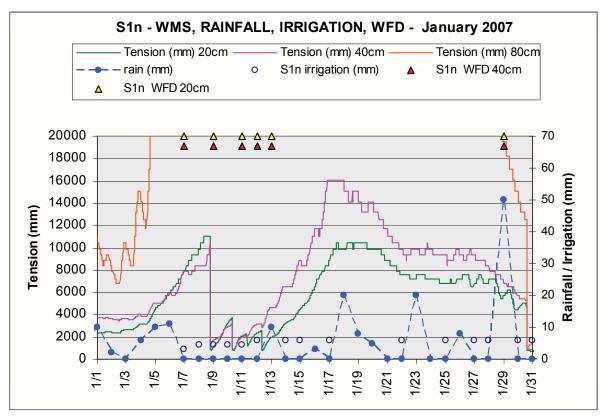


Figure 18: Comparison of soil moisture at different depths in normal beds (JD Sturdy, 2008)

- The green line in the graph shows the tension 20 cm below the ground. This indicates the change in moisture at this depth (read this off the left hand side of the graph).
- The pink line in the graph shows the tension at 40 cm below the ground. This indicates the change in the moisture at this depth (read the value off the left axis of the graph).
- The orange line in the graph shows the tension at 80 cm below the ground. This indicates the change in the moisture at this depth (read off the left axis of the graph).
- The blue line and solid blue dots indicate rain events: how much rain fell (in mm). You read this off the right hand side of the graph. The dates are shown along the bottom of the graph. The little blue circles show Sizakele's irrigations (in mm) on this bed.

In contrast to the results for the trench bed (Figure 17), the normal bed (\$1n, shown in Figure 18 above) was much drier – at all the measured soil depths (20, 40 and 80 cm).

Even though Sizakele used the same irrigation practices and added the same amount of water in this normal bed (Figure 18) as for the trench bed (Figure 17), the soil dried out more – and more quickly – than in the trench bed. At the deepest level that was measured (80 cm), the soil was extremely dry (tension over 20 000 mm) for almost the whole month (5-29 January).

Sizakele's irrigations had no effect at 40 to 80 cm soil depth, and it was only after the 50 mm rain event on 29 January that the soil got wet down deep (red line).

In this normal bed, the tension rose to over 10 000 mm at 20 cm depth (green line on 9 and 17-21 January); in other words, at this depth the normal bed also got much drier than the trench bed.

Trench beds increase the infiltration (more water gets into the soil) and the water holding capacity of the soil (the soil holds back more water that can be used by plants). It reduces moisture stress for crops over a period of time.

Why small-scale deep trenched beds work so well

Trench beds influence the structure of the soil

The most important function of deep trenched beds is to create (or maintain) favourable physical conditions in subsoil layers. The deep, loose, crumbly soil ensures the development of deep and strong plant roots and favourable soil organisms.

Normally, the organic matter content of subsoil is very low. Incorporation of large quantities of organic matter (compost, manure and nondecomposed organic materials) deep into the soil is very important.



MIX THE LAYERS!

Making distinct and alternating layers of decomposed organic material and soil is not advisable. It is better to mix these layers well throughout the profile to enhance the contact between the organic matter and soil particles.

In favourable

conditions earthworms flourish, and help to create a uniform or even mixture of soil and organic matter.

Deep trenching reduces soil acidity

If is difficult when subsoil is acidic, because lime does not leach (or wash down) well from the topsoil into the subsoil to reduce acidity at these deeper soil levels. In the case of trench beds, lime can be mixed into the soil as the trench is made (filled up or 'packed').

.00

How do we measure 'acidity'?

Neutral: Where pH=7 (neither acidic, nor alkaline)

Acidic: Where pH<7 (the lower the pH, the more acidic.

-For example, swimming pool acid is at about pH=3)

Alkaline: Where pH>7
(the higher the pH, the more alkaline
-For instance, liquid ammonia is at about pH=10)

The large quantity of organic matter which is added to the soil when a trench bed is made also helps to reduce acidity.



Research Finding 2: Deep trenching reduces soil acidity

The results below were obtained from measurements at households in Potshini, KZN, and provide some comparison of the effect of deep-trenching and normal planting (i.e. shallow incorporation of manure in the planting holes when seedlings are planted).

In Table 7 below, a comparison is made of the acidity in normal beds and trench beds. Look particularly at the last row, pH (KCI), which shows the pH.

Table 7: Acidity in Sizakele (S), Dladla (D) and Ketiwe's (K) normal and trench beds (JD Sturdy, 2008)

Sample location-depth (cm)	S2tb-30	S2tb-0	S1n-50	S1n-20	S1n-0	D1n-50	D1n-0	K1tb-0	K2n-0
Exch acidity (cmol/l)	0.02	0.03	0.92	1.23	0.01	1.03	0.1	0.05	0.09
Total cations (cmol/l)	13.8	13.77	4.17	6.1	12	3.38	6.68	7.21	6.9
Acid sat %	0	0	22	20	0	30	1	1	1
pH (KCI)	6.67	5.49	4.29	4.09	6.41	4.26	4.99	4.87	5

In the table above, the top row means the following:

52tb-30: Sizakele's 2nd trench bed at 30 cm below the soil surface

52tb-0: Sizakele's 2nd trench bed at 0 cm (i.e. at the soil surface)

51n-50: Sizakele's 1st normal bed at 50 cm below soil surface

51n-20: Sizakele's 1st normal bed at 20 cm below soil surface

51n-0: Sizakele's 1st normal bed at 0 cm (i.e. at the soil surface)

D1n-50: Dladla's 1st normal bed at 50 cm below soil surface

D1n-0: Dladla's 1st normal bed at 0 cm (i.e. at the soil surface)

K1tb-0: Ketiwe's 1st trench bed at 0 cm (i.e. at the soil surface)

K2n-0: Ketiwe's 2nd normal bed at 0 cm (i.e. at the soil surface)

In the 'normal beds', where manure is incorporated into the topsoil (S1n, D1n, K2n), the pH was almost neutral on the soil surface (e.g. pH=6.41 for Sizakele's normal bed), but pH was quite low (acidic) deeper down in the soil (e.g. pH=4.09 at 20 cm depth; and pH=4.29 at 50 cm depth for Sizakele's normal bed). The soil was acidic deeper down where the manure (organic matter) did not reach.

In the trench beds, pH was close to neutral throughout the profile (i.e. at all depths) after one production season. This is due to the large quantity of organic matter that is packed into a trench bed when it is made (see p53 above).

The dark yellow columns in the table above show the trench bed results, and the light yellow highlights the effect of manure at the soil surface in the normal beds. The white columns are the normal beds deeper down, where the manure did not reach.

Deep trenching increases phosphorus in the soil

With deep trenching it is possible to incorporate phosphorus deep into the soil, whether it is applied as inorganic fertilizer, or as organic material such as manure.

Phosphorus is the major plant nutrient for which "nutrient capital building" is possible. This means that by applying a high amount of phosphorus fertilizer (or manure), benefits can be obtained for up to 5-10 years. This approach is especially valuable on high phosphorus-fixing acidic clay soils. On the eastern Highveld of Mpumalanga it was found that a once-off phosphorus application gave higher maize yields over a five year period than the same total amount split over five smaller equal portions.

Again, deep trench cultivation is ideal to achieve such a large once-off application. However, such an approach would be less effective on sandy soils with low phosphorus-fixing capacities, and may have to be repeated sooner (e.g. after three years instead of five).



Research finding 3: Deep trenching increases phosphorus in the soil

The following results from Potshini, KZN, shows the effect of organic matter on Phosphate throughout the soil profile in deep-trenched and normal beds. Again, trench beds were compared with the normal planting practices for the area.

Table 8: Phosphorus (P) at different soil depths in normal and trench beds (JD Sturdy, 2008)

Sample location-depth (cm)	S2tb-30	S2tb-0	S1n-50	S1n-20	S1n-0	D1n-50	D1n-0	K1tb-0	K2n-0
P (mg/l)	72	86	8	8	66	1	23	98	42

In the table above, the top row means the following:

S2tb-30: Sizakele's 2nd trench bed at 30 cm below the soil surface

52tb-0: Sizakele's 2nd trench bed at 0 cm (i.e. at the soil surface)

51n-50: Sizakele's 1st normal bed at 50 cm below soil surface

51n-20: Sizakele's 1st normal bed at 20 cm below soil surface

51n-0: Sizakele's 1st normal bed at 0 cm (i.e. at the soil surface)

D1n-50: Dladla's 1st normal bed at 50 cm below soil surface

D1n-0: Dladla's 1st normal bed at 0 cm (i.e. at the soil surface)

K1tb-0: Ketiwe's 1st trench bed at 0 cm (i.e. at the soil surface)

K2n-0: Ketiwe's 2nd normal bed at 0 cm (i.e. at the soil surface)

Phosphorus quantities were very low in deeper soil layers in all non-trenched beds. The lowest phosphorus values are shown in red = the least favourable conditions.

The dark-yellow columns show the results for trench beds. In Sizakele' trench bed the phosphorous was high at the soil surface as well as at 30 cm depth (72 mg/l), and in Ketiwe's trench bed it was also very favourable (98 mg/l). The highest phosphorus is shown in **blue** = favourable.

There was some phosphorous at the soil surface in the normal beds (light yellow highlighting) due to the shallow manuring, but extremely low phosphorous (8 mg/l) at deeper levels, where no manure reached.

Deep trenching gives good potassium levels in the soil

With deep trenching it is possible to ensure good potassium levels in the soil. Research (see below) shows that incorporating organic matter into the subsoil could ensure good potassium levels.



Research finding 4: Deep trenching gives good potassium levels in soil

Table 9: Potassium (K) at different soil depths in normal and trench beds (JD Sturdy, 2008)

Sample location-depth (cm)	S2tb-30	S2tb-0	S1n-50	S1n-20	S1n-0	D1n-50	D1n-0	K1tb-0	K2n-0
K (mg/l)	595	602	309	484	595	223	323	470	452

In the table above, the top row means the following:

52tb-30: Sizakele's 2nd trench bed at 30 cm below the soil surface

52tb-0: Sizakele's 2nd trench bed at 0 cm (i.e. at the soil surface)

S1n-50: Sizakele's 1st normal bed at 50 cm below soil surface

S1n-20: Sizakele's 1st normal bed at 20 cm below soil surface

51n-0: Sizakele's 1st normal bed at 0 cm (i.e. at the soil surface)

D1n-50: Dladla's 1st normal bed at 50 cm below soil surface

D1n-0: Dladla's 1st normal bed at 0 cm (i.e. at the soil surface)

K1tb-0: Ketiwe's 1st trench bed at 0 cm (i.e. at the soil surface)

K2n-0: Ketiwe's 2nd normal bed at 0 cm (i.e. at the soil surface)

It can be seen from the table above that the incorporation of organic matter in the trench beds have a favourable outcome on the amount of potassium (K) available in the soil.

In summary, for the three main plant nutrients (N, P and K), the results from Potshini have shown that:

- deep trenching has provided high phosphorus (P) throughout the soil profile, which should be enough for a 5-10 year period. This is an important advantage, because phosphorus does not move through the soil profile and cannot be added later.
- deep trenching has improved the levels of potassium (K), probably mainly through the incorporation of wood ash during trench packing/construction. Potassium dissolves readily and can therefore move through the soil profile, but is not as volatile as nitrogen, and can therefore accumulate in the soil for use over longer periods.
- Nitrogen (N) is highly mobile in soils, and is quickly lost, both through leaching deep into the soil, and through evaporation into the air. Fortunately, nitrogen can be easily added to deep trenches (e.g. through application of chicken manure or liquid teas once a year).

Alternative bed designs

Garden beds can also be designed and built up in other ways, besides digging trenches. All of them involve incorporating organic matter and managing water. Below a few more examples are given (Kruger, 2008):

We will look at another three types of bed design:

- Shallow trenches:
- Double-digging; and
- Key-hole beds.

Shallow trenches

These beds are an easier and shallower version of the deep trenches that we discussed in the section above. They are dug to about 30 cm deep (while deep trenches are 60 cm or deeper). The bottom of the shallow trench is filled with sticks and branches. This is covered by a layer of dead or green leaves and grass. Then the rest of the hole is filled in with compost and finally it is covered with the top soil that was dug out.

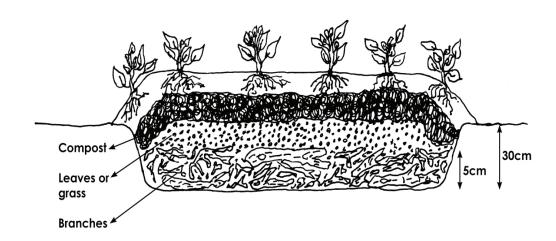


Figure 19: How to make a shallow trench (Kruger, 2008)
From: LIRAPA, 2008

Double digging (Hall, 1987)

Double digging is another way to increase the fertility of your soil. These beds are ready the moment they have been made. You do not have to wait for the organic matter to decompose first.

The method basically involves digging out the top soil (to 30 cm deep) of a section of your bed and placing it in a pile next to the bed. The bottom of the dug out section is loosened. Then manure or compost is mixed into this sub-soil, before the top soil from the next section is placed on top. The sections are dug in a sequence that minimises the amount of soil you have to move. Once this process is complete, manure or compost is dug into the top soil of the bed.

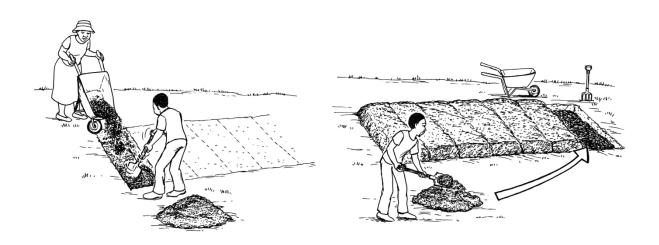


Figure 20: How to do double digging (Kruger, 2008)

Here manure is being added to the loosened sub-soil of the first section of the bed. Note the top soil in a pile Here the topsoil taken from the first section is now placed in the last section, once the manure has been worked into the sub soil. The bed is now almost ready. Manure or compost will have to be dug into the top soil and then planting can be done.

Key-hole beds

- Key-hole beds are built up with rocks. They are a good idea where there is a lot of stone and where the soil is very bad.
- A composting basket is built in the middle of the bed to provide extra and ongoing fertility to the bed.
- It is possible to water these beds with grey water and they are very good at holding water.
- Once they have been built, they are easy to use and maintain.

A photograph of a keyhole bed in Lesotho. The stone walls and grass composting basket in the middle are clearly visible.



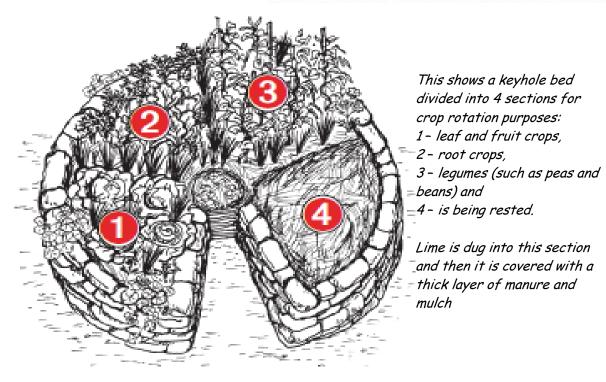


Figure 21: A key-hole garden (Kruger, 2008)

It should now be possible for you to choose a method of bed design that best suits you and the food gardeners you work with.



Facilitation Tool 7: Experiment using bed designs

Aim

To assist a homestead food gardener to do an experiment to test the outcomes of using different designs for their garden beds.

Instructions

Start by talking through the issues of garden beds and different ways to construct them with your homestead food gardeners. You can use the information provided above.

Then discuss doing a small experiment around bed design. Fill in the Small Scale Experiment Plan below with the food gardener. You will go through the questions, work out the solutions and work out how you will 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 gardening?
- Drawing of the experiment in the field.

The monitoring

Now the food gardeners will each need to monitor their own experiment at home. Every week they will need to check specific things such as:

- Are the plants in the new bed growing better than those planted in the normal way? The normal way is the food gardener's control and they will have planted their crop in that bed as they have always done it. (What will they observe and or measure here?)
- Is there a difference between the amount of water that needs to be given to the normal and the new bed designs? (How will the food gardener observe or measure this?)
- Does watering need to happen more often for the normal or the new bed (How will the homestead gardener measure and record this?)

An outline of a monitoring sheet is provided in the Food Gardeners' Resource Packs (Handouts section at the end of this Resource Material).

Summary of principles for good soil management

Below, 10 principles are listed for managing your soil in a sustainable way (Vukasin, 1995):

- Minimize damage to the soil while clearing.
- Disturb the soil as little as possible.
- Support a stable soil structure
- Aerate the soil
- Provide drainage
- Plan for deep and shallow root systems
- Provide ground cover for bare ground to minimize erosion and help retain moisture
- Provide nutrients by recycling minerals in the soil
- Encourage natural areas to develop for pest control and indigenous micro organisms
- Integrate livestock



Activity 2: Practising sustainable soil management

Aim:

To summarise some of the learning in this unit and apply some of the information for your area.

Instructions:

Read through the ten points given above.

For each statement find or give at least one example of how you can fulfil that statement in your garden at home. (<u>Note</u>: All these statements have been discussed in this unit).

Then give at least two examples of what you would use to fulfil this statement, e.g. "Increase organic matter by adding cattle manure to garden beds."

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Index (Chapter 6)

В Ν Bed design 6-52 Nitrogen 6-20, 6-29 Nutrient fixing plants 6-29 C Compost 6-39, 6-40, 6-51 0 Organic matter 6-3, 6-16, 6-28 Cover crops 6-50 D Diversity 6-1 Phosphorous 6-21, 6-30, 6-61 Double digging 6-63 Potassium 6-22, 6-30, 6-60 Ε R Run-off 6-16 Earthworms 6-51 Experimentation (household) 6-18, 6-25, 6-34, 6-49, 6-65 S Soil F - acidity 6-23, 6-59 Facilitation Tools 6-6, 6-11, 6-14, 6-25, 6fertility 6-3 34, 6-49, 6-65 - nutrients 6-19 - structure 6-11, 6-16, 6-58 Foliar spray 6-48 - types 6-6 Т Intensified production 6-1 Trench beds 6-1, 6-17, 6-53, 6-62 K Keyhole gardens 6-64 L Liquid manure 6-43 M Manure 6-35, 6-51 Mulching 6-31

Homestead Food Gardeners'

Resource Pack (Handouts) -

Chapter 6:

Soil fertility management: Optimising the productivity of soil and water

Resource Material for Homestead Food Gardeners

Chapter 6: Handouts (English)

Handout 1 Improving your soil

Handout 2 Mulching

Handout 3 Brews for plant nutrition

Handout 4 How to make a trench bed

Handout 5 Seedling production

1. Improving your soil



The living soil

Healthy soil is living soil. It contains many living organisms. It is deep, loose, easy to dig and full of air and water.

Living soil is a mixture of many things:

- Bits of sand, silt and clay, which are types of soil;
- Bits of organic matter, like leaves, grass, manure;
- Inorganic matter, like rocks and silica;
- Minerals such as potassium;



From: Lessons from Nature

- Air and water;
- Micro-organisms: These are tiny bugs or creatures that are too small to see and live in the soil. They make the soil fertile by eating organic matter and changing it into rich plant food or humus. Small creatures like earthworms, other worms and beetles also live in the soil.

Soil types

Soil is made through the breaking up of the basic elements or minerals of the earth. These are initially found in the form of rocks. Over a very long time, these rocks are broken down into small particles through rain, wind and sun and mixed with air and water. This becomes soil that can support plants and micro-organisms to grow. Like people, plants cannot live and grow without water, air and food.

All soils are a mixture of sand, silt and clay. The difference in the amount of sand, silt and clay will determine how the soil holds water. Examples of types of soil are sandy, sandy loam, loam, clay loam and clay.

Sand makes the soil loose.

Silt is very fine sand. It holds water and plant food better than rough sand, but it is easily washed out of the soil.

Clay is the sticky part of the soil that holds it together. It holds water like a sponge.

The best soils are called loams and they are an equal mixture of sand, silt and clay.

Characteristics of soils:

ŧ	Sandy soil						
	Good things about this type of soil	Bad things about this type of soil					
* * * * * *	It is easy to dig and work with It warms up quickly in spring after winter It is good for root crops Water and air can get into the soil easily	 It gets dry quickly It does not keep much fertility It does not hold water well 					
	Loam soil (Mixture of sand and clay)						
	Good things about this type of soil	Bad things about this type of soil					
* *	Holds water well Best for root growth Contains organic matter, like	This soil can be hard when dry					
	Clay	ıy soil					
	Good things about this type of soil	Bad things about this type of soil					
* *	Holds water well and for a long time Holds fertility well and for a long time	 Hard to work; heavy Slow to warm up in spring Sticky when wet Hard when dry 					

How to tell your soil type

You can tell how much sand, silt or clay is in your soil by how it feels. Wet some soil and roll it into a ball between your hands. Then roll this little ball into a sausage. You can tell what kind of soil it is by looking at the table below.

It is important to know which soil type you have. This will give you some ideas about what you need to do to make your soil crumbly and loose. Crumbly and loose soil holds the most water and the most air, which is what plants need to grow.

To make your soil more crumbly (whether it is sandy, loam or clay) you need to keep adding lots of manure, compost and mulch. Never walk on the planted areas, especially if they are wet.

Sandy soil needs to be given organic matter to increase its ability to hold water and plant food. Clay soil needs to be given organic matter to increase its ability to hold air in the soil and to release the plant foods that are there.

All types of soil need organic matter to increase their fertility, or plant food.

What soil looks like	What soil feels like	When rolled in	nto a sausage	The soil is
Very sandy	Very rough	Cannot be rolled into a sausage		Very sandy
Quite sandy	Rough	Can be rolled into a sausage but it cannot bend		Sandy
Half sandy & half smooth	Rough	Sausage can bend a little		Sandy loam
Mostly smooth	A little sandy, quite smooth but not sticky	Sausage can bend about half way around		Loam or silt loam
Mostly smooth	A little sand quite smooth and sticky	Sausage can be bent more than half way round		Clay loam or sandy clay

Smooth Smooth and sticky	Sausage can bend into a ring		Clay
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Soil fertility

All living things are composed of the basic elements of the earth. Plants consist mainly of hydrogen, oxygen, carbon, nitrogen, phosphorus, potassium and smaller quantities of magnesium, sulphur and calcium as well as many other elements in very small amounts (these are called trace elements).

Plants need three main kinds of food:

- Nitrogen (N) for healthy leaf and stem growth;
- Phosphorus (P) for healthy roots and fruit formation;
- ❖ Potassium (K) for general health and healthy flowers and fruit.

The capital letters in brackets (N, P, and K) are called the chemical symbols. If you buy fertiliser or other chemicals, they may use these letters instead of writing out the name in full.

All three of these foods are found in good compost or manure. You can also increase the amount of these foods in the soil by mulching with leguminous leaves like beans, peas, pigeon peas and Acacia (thorn tree leaves) or comfrey, using liquid manures, earthworm castings and effective micro-organisms. You will need to make the earthworm castings and effective microorganism brews and add them to your soil.

These are different ways of improving fertility that you will need to be shown.

Nitrogen

How do you know if your soil needs more nitrogen?

You will know your plants need nitrogen when the leaves are turning yellowish, instead of a strong bright green.

How can you add nitrogen to your soil?

This element is found in most manures (cattle, sheep, pig, goat, chicken and rabbit). There is more nitrogen in chicken and goat manure. These must be dried before

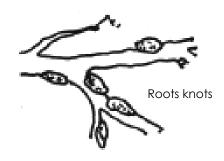


Nodules on the roots that fix nitrogen

being used in the garden. Otherwise they can be too strong and 'burn' the plants.

Nitrogen is also found in legumes

These are plants that form nodules or little knots on their roots. These nodules 'fix' nitrogen from the air, so that the plant can take it up through its roots. There are microorganisms (bacteria) in the roots that help to 'fix' the nitrogen. After the roots of the plant die the nitrogen is released into the soil and can be used by surrounding plants.



The bacteria in the root knots binds free nitrogen from air in the soil and release nitrogen after the plant dies

Examples of legumes that we often grow:

- Ground nuts
- Cow-peas
- Beans (including soya beans)
- Peas

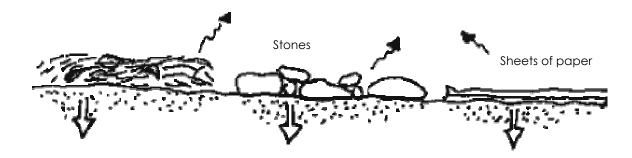
There are less common crops and also many long living plants and small trees that also fix nitrogen. Some examples are chickpeas, mung beans, lentils, pigeon peas and tree lucerne. Some legumes are grown only as green manures, and are not used for food. These include lucerne, clover, hairy vetch and lupins. These give a lot more nitrogen to the soil than our food plants, because we dig them into the soil when they are still green. This is why we call them green manures. We can also plant our food crops in between these legumes.



You can also mulch with the leaves of legumes. This will add nitrogen to your soil.

All reduce evaporation

From: Production without Destruction, Natural Farming Network, Zimbabwe



Phosphorous

How do you know if your soil needs more phosphorous?

You will know your plants need more phosphorous when they do not grow fast, as they should. The leaves may also start to show unusual red or pinkish colours, especially around the edges. If your plants are small and will not grow, even when compost is added, then you almost certainly have a severe phosphorous deficiency. This can also be caused by acidity in the soil.

How can you add phosphorous to your soil?

Many soils are poor in phosphorous. It is also a bit difficult to add phosphorous to the soil in an organic way, as most of the sources of phosphorous are tricky to work with. They include urine, bones, hair, feathers and blood. Usually we add these as ingredients to compost.

Natural rock phosphate can be added directly to the soil. This is also not easily available.

Another good source of phosphorous is bonemeal. You can usually buy this from an agricultural supply store – but it is not cheap.

One other way of adding phosphorous is to place bones in a fire, for a few hours. You can then grind them into a powder more easily. This powder can be spread on your garden beds or your compost heap.



The manure from animals grazing in areas where there is not much phosphorous will also have little phosphorous. You may need to bring in phosphorous in the form of chemical fertilizer. The usual source is called Superphosphate. Another chemical fertilizer known as DAP (Di-ammonium Phosphate) can also be used.

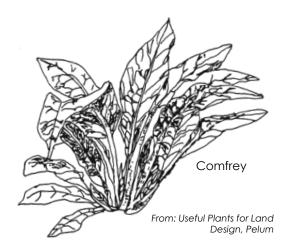
Potassium

How do you know if your soil needs more potassium?

You will know your plants need potassium when the plants become brittle and the leaf edges become brown and dry. When fruit do not form properly, you should also suspect a lack of potassium. Other signs can be hard to distinguish. One of these is a yellowing around the veins of the leaves. This could also be caused by diseases – so it is difficult to know.

How can you add potassium to your soil?

Good sources of potassium are chicken manure and fresh woodash. Never use ash from coal, as this is very poisonous to the soil and plants. Another good source of potassium is a plant known as comfrey. This plant has large hairy leaves and grows in wet shady places. The leaves contain a lot of potassium. These can be used to mulch your vegetable beds and also to make liquid feeds for your plants (We will look at liquid feeds later in this section).



The other elements or minerals needed in smaller quantities, such as Magnesium, Zinc and Iron, are found in most manure and in compost.

Comfrey is also a good spinach and medicine. A tea made from the leaves is good for high blood pressure and arthritis.

Soil acidity

What is soil acidity?

The minerals or nutrients needed by plants to grow are dissolved in the water inside the soil. This is a bit like salt or sugar dissolved in a glass of water.

Soil acidity is when the soil is sour. It is a bit like a glass of water that has vinegar dissolved in it. In places where it rains a lot, some of the minerals can be washed out of the soil. The soil then becomes acidic. The use of chemical fertilizers over a long period of time, can also make the soil acidic.

If there is too much acid in the soil, some minerals or plant food will dissolve too quickly and the plants cannot use them. Other minerals will not dissolve at all, so again, the plants cannot use them. Phosphorus is one of the minerals that cannot be used by plants when the soil is acidic – even if it is in the soil.

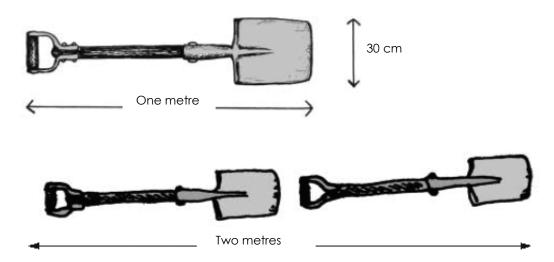
How do you know if your soil is acidic?

You will know your soil is acidic if you provide compost or manure and water for your plants, but they do not grow. The plants remain small and stunted. This is a common problem.

How will you solve the problem of acidity?

The only practical way of dealing with soil acidity is to add lime to the soil. Lime can be bought and is a white powder, or grey granules.

It needs to be dug into your soil, at least as deep as the roots of the crop you are growing. For vegetables this is between 30 - 60 cm. This is the width of 1 or 2 spades. You will need to add 1 kg of lime for every square metre of soil. 1 Kilogram of lime is a spade full. It needs to be heaped high.



For field crops like maize and sorghum that have deep roots this is from 60 cm to 1 metre deep. 1 metre is the length of a spade.

Usually Lime is added 2 or 3 months before planting, as it is slow acting in the soil. If you add Lime at the same time as you are planting your crop, you will only see the main effect of the Lime in the next season.

Other ways of improving your soil

Manure

Most kinds of animal manure can be used. This includes cattle, sheep, goats, pigs and chickens.

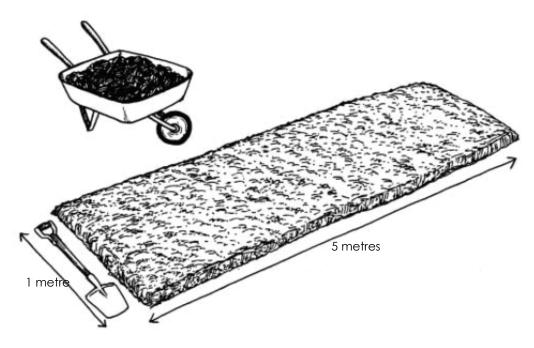
Handling manure

The best manure to use is manure mixed with straw and urine, from a kraal. Sweep this into piles at least once a week, and then cover it with grass or plastic.



Manure can be added to your soil in a number of ways:

- It can be used when you are planting your seedlings, by mixing in two to three handfuls of manure into your planting holes for seedlings.
- It can be dug into a whole bed to increase the fertility. Here you will need to use one wheelbarrow load (around 50 kilograms) to a bed size of 1 metre by 5 metres.



- It can be used in hotbeds. Here the bed is dug out to a depth of about 30 cm, which is the width of a spade. It is then filled with a layer of fresh manure about 10 cm deep at the bottom. This is about the same as the width of your closed hand. Some grass, weeds and organic matter can be placed on top of this before filling your trench with top soil only. Some manure or compost can be mixed into this soil before planting. These are called HOTBEDS because the manure heats up as it decomposes in the ground. This will heat up the soil in your bed. This is very good for cold winter areas.
- Manure can be spread over the surface of the ground as a mulch. It then has the added advantage of providing food to plants.
- Manure can be added to compost heaps to make the best compost.

Compost

Compost is a combination of wet and dry plant material and manure that has decomposed together to form a rich plant food. Compost also helps the soil to hold water and keep plants free from diseases.



More advantages

- Compost is ready as plant food, without the need to be broken down by soil micro-organisms first.
- Compost does not cause a lot of weed growth, like most animal manures do.
 - You can get good crops without spending lots of money on fertilizers.



Some disadvantages

- Compost requires a lot of work to prepare and use.
- The value of compost depends on how it is made and what you used. If it is not made well, it will not be a good plant food.
- It may be difficult to find the organic material you need to make compost.

What do you need to make a compost heap?

You need to collect a lot of the following:

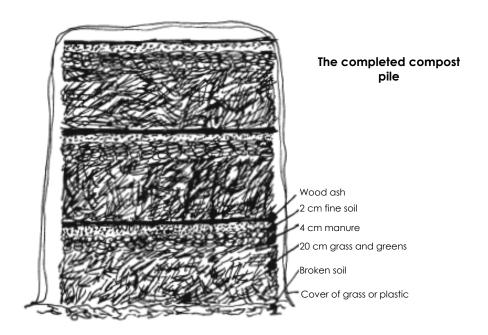
- Maize stalks or leftovers from other crops. These are called crop residues;.
- Grass (without seeds!) it can be green or dry;
- Cabbage leaves and weeds (green or dry) with no seeds;

Animal manure;

❖ Wood ash.

Some other things that can go into a compost heap are: kitchen waste, washing water, yard sweepings, dead animals, bones, wool, horns and feathers. It is a very good idea to add comfrey to compost heaps.

THINGS NOT TO ADD: Plastic, glass, metal, wood, old batteries or anything that cannot decompose (that means to break down in the soil).



Where to make a compost heap

- In a shady place but not too close to the trunk of a tree.
- Protected from too much wind.
- On flat ground.
- Close to your garden and to a source of water.

Away from animals (especially pigs, goats and chickens).

How to make a compost heap

Step 1:

Choose your site and turn the soil over with a fork or a hoe. The area should be about 1 metre by 2 metres (1 spade length wide and 2 spade lengths long).



Step 2:

Chop the stalks and leaves of your crop residues, grass and weeds into small pieces. This includes comfrey, cabbage leaves, weeds and maize stalks. They need to be chopped into pieces about 10 cm long. This is the width of your closed hand. This will make the composting process go faster.



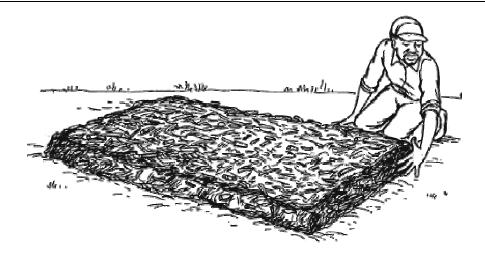
Step 3:

Lay some small branches and twigs on the soil that you have turned over.



Step 4:

Cover these with a layer of your chopped mixture, about 30 cm deep. This is one open hand deep. If you have kitchen wastes, they are added in this layer.



Step 5:

Spread manure on top of this about 4 cm deep. This is the width of 2 fingers.



Step 6:

Spread some soil on top of the manure about 2 cm deep – the width of 1 finger.



Step 7:

Sprinkle wood ash on top of the soil. If you are also going to add lime, bone meal or rock phosphate, this can be sprinkled on now.



Step 8:

Water these layers until the water soaks through at the bottom of the pile.

Step 9:

Continue to build the heap, repeating the layers as before, until it reaches the height of your chest.

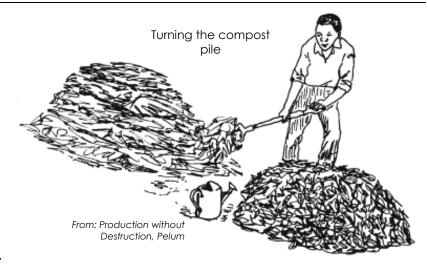


Step 10:

It is best to cover your pile, either with a thick layer of straw or grass or plastic. This helps to keep the water and heat in and helps your pile decompose. It also stops animals from scratching in your heap and destroying it.



It is best to turn your compost heap every two weeks. If your heap is dry, you will need to add more water. If you do this your compost should be ready in about 6 weeks in summer and about 8-9 weeks in winter. In very cold areas that experience snow, your heap will have to be well covered – otherwise nothing will happen at all.

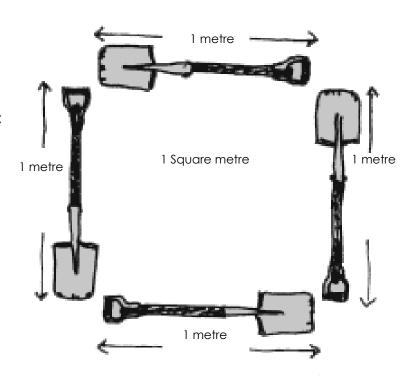


When is compost ready to use?

When there is still steam coming out of your heap it is VERY busy decomposing. The compost will be ready when it has turned blackish in colour and looks like moist soil. It will have almost no smell. (If it is smelly and warm, it is definitely NOT compost!).

Handling compost

- Plant each seedling with 2-3 handfuls of compost.
- Dig compost into the soil:
 Turn over the soil and
 loosen it to a depth of at
 least one spade head.
 Spread 4 full spades of
 compost in an area of 1
 square metre. Dig this
 lightly and then plant.
- Use compost as a mulch by spreading it over the surface of your beds.



From: Vikela, May 2003, FSG



Experimentation

An experiment to test whether your soil has enough lime and phosphate

In this experiment, you will need to measure out 4 plots of the same size. Make these plots about 1 metre long and 1 metre wide. This is the length of one spade. Be sure to mark your plots out with sticks, so that you will know throughout the season where your plots are. You will then be able to do your experiment.

Plot 1:

Prepare and plant in your normal way

Plot 2:

Prepare the soil in your normal way and then add 2 big spoon fulls of Superphosphate. This is spread evenly over your soil and then dug into the soil. Then plant in your normal way.

Plot 3:

Prepare the soil in your normal way and then add one big tin (jam tin) full of Lime. This is spread evenly over the soil and then dug into the soil. Then plant in your normal way.

Plot 4:

Prepare the soil in your normal way and then add 2 big spoonfuls of Superphosphate and one big tin of Lime. This is spread evenly over your soil and then dug into the soil. Then plant in your normal way. Below is picture of what your experiment could look like.

Now you will monitor or look at this experiment. Every week you will check and write down which plants look better. You will look at the plants' growth, their colour (whether they are green or yellowish), and their health (whether they are healthy or diseased). Here is an example of how you can record your results: You can start with this table and write in your results from week 3 onwards. Or use this table to draw your own table on a piece of paper.

	Control	Phosphate	Lime	Lime & Phosphate
Experimental plot	1	2	3	4
		Garden plantec	with cabbages	

	Plot 1 Control	Plot 2 Phosphate	Plot 3 Lime	Plot 4 Lime+ Phosphate
Week 1	Seedlings look good	Seedlings look good	Seedlings look good	Seedlings look good
Week 2	Seedlings growing, but yellowish. No disease	Seedlings growing; not yellow. No disease	Seedlings growing well. No disease	Seedlings growing well; dark green. No disease

Week 3		
Week 4		
Week 5		
Week 6 etc		
Final result Growth		
Colour		
Health		
Number of plants that look good		

You can use the Small Scale Experimentation Plan to think about how the phosphorous and lime experiment will help you improve your soil fertility.

Small scale experimentation plan				
What is the problem?	My plants are not growing well, even when I add compost or fertilizer			
What is a solution to this problem?	I will add phosphorous and lime to see if that makes a difference			
Why will this solution solve the problem?	My soil may need phosphorous or lime, or it may need both of these things			
How will I test this solution?	I will add phosphorous to one experimental plot, I will add lime to another experimental plot, and I will add phosphorous and lime to my third plot. I will also keep one plot free, as a control, to make sure that what I am adding is really making a difference			
How will I check my results? What will I look for?	I will look at the leaves to see if they are a good bright green colour. I will also look to see if my plants look healthy or diseased			
How else will I check my results? What will I measure?	I will measure the growth of my plants using a piece of string			
How will I measure the results or outcomes?	The plants that grow the most, and look the most green or the least yellow, and look the most healthy will be the best plants			
How will I compare my experiment to my usual way of farming?	I will know that where my results were good, I should add that thing to my soil. So if I get the best results by using phosphorous and lime together, then I should add that to all my soil			

In these materials there are many suggestions for improving your soil. You can experiment with any of them to see whether your plants will grow better if you use them.

- You can test what kind of soil you have, and add compost.
- You can add nitrogen, by adding manure.
- You can add nitrogen, by planting legumes.
- ❖ You can add phosphorous (which is called Superphosphate when you buy it).
- You can add potassium, by adding chicken manure.
- You can add potassium, by adding fresh woodash.
- ❖ You can add lime, which you can buy, to make the soil less acidic.
- You can add manure.
- You can add compost.
- ❖ You can add a liquid manure made from comfrey or animal manure.
- You can mulch with leaves of legumes

For each of these suggestions, you can do some experimenting, to see which works best for you. Remember to keep a record of all your experiments, so you can look back on them in a few years time. You should also keep records so that you can share the information with your neighbours and community, and compare your results with other people's results.

2. Mulching



Mulching is the spreading of a layer of material over the surface of the soil. It covers the soil and keeps it moist and cool in summer. It keeps the soil warm in winter.

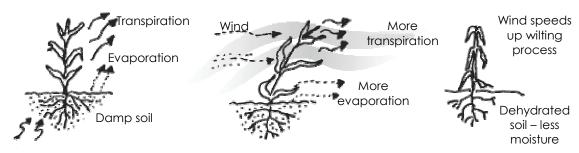
Why mulch?

Mulching has two main effects:

It saves water, because it will stop the sun and wind from drying out the soil. That means that you will need to give less water to your plants, because it is not lost through the effects of sun and wind.

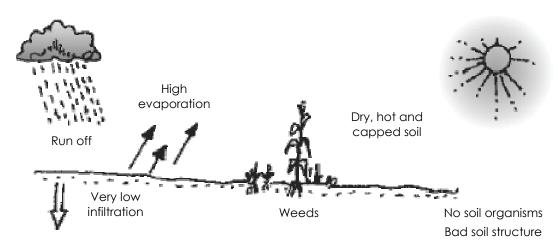
The effect of sun and wind on bare soil

From: Production without Destruction. Natural Farming Network, Zimbabwe

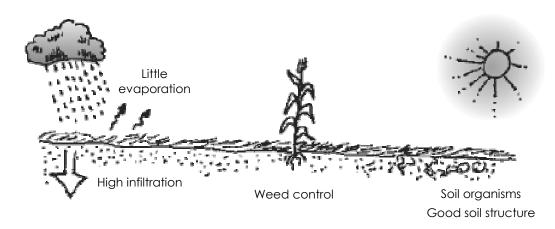


It keeps the soil temperature more even. Mulching reduces too much heating and too much cooling of the soil. This makes it easier for plants to grow.

Bare soil



Mulched soil



From: Production without Destruction. Natural Farming Network, Zimbabwe

More effects of mulching

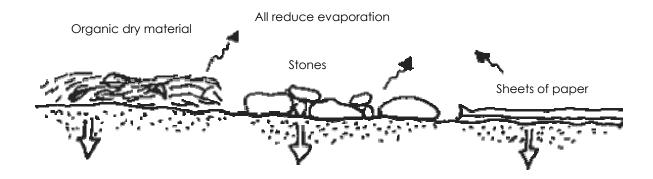
	Negative	Positive		
*	It is sometimes hard to find enough material to mulch with	It stops loss of minerals/nutrients from the soil		
*	Sometimes mulching on seed beds can affect the growth of carrot seedlings. They can	It encourages soil organismsIt reduces weed growth		

become spindly and weak

- Some people think it looks untidy
- Mulch can encourage slugs and snails
- It prevents capping: that is the formation of a hard layer of soil on the surface.
- A stronger root system develops closer to the soil surface. This makes more nutrients and air available to the roots
- Break down of mulch will add to soil fertility
- Breaks the impact of heavy rains and splashing of soil on plants - that can spread diseases

From: Production without Destruction. Natural Farming Network, Zimbabwe

What to use as mulch?



Usually we use:

- Crop residues (stalks and leaves of harvested crops). NEVER use diseased crop residue. You will infect the soil and your new crops!
- ❖ Weeds that have been pulled out and left to dry out
- Grasses from the veld. Make sure to use DRY grass. GREEN grass will take nutrients from your soil and your crops will have fewer nutrients.
- ❖ Flat stones. These will cover but will not add nutrients. They are good around larger plants and fruit trees.
- Newspaper. This will cover and add a little bit of nutrients/ plant food to the soil. Wet the newspaper when you put it on the soil, so that it does not blow away.
- Manure: use DRY or OLD manure for this.
- Leaves collected under trees.
- Old thatch grass.
- Black plastic sheeting.

How do we mulch?

- It is best to chop up your mulching material (weeds and grass) to be about the length of your hand (10-20 centimetres)
- Use a thin layer of mulch for seedlings and small plants about one finger width deep (1.5 cm)





- For larger plants use much thicker mulch about 2-3 finger widths (3-4 cm)
- For trees, a really thick layer, one whole hand or more (10-20 cm) can be added One finger =
 1.5 cm

Two fingers = 3 - 4 cm

When the mulch has broken down, you need to add more! You will be amazed how quickly this happens. Usually mulch is added at least once a season, or once every 3 months. In areas with extremely cold winters, it may be an idea to make sure your mulch is compact or squashed down once the frosts are heavy and the ground starts to freeze. Loose mulch can make the effects of frost more severe.



Experimentation

Remember to use your experimentation plan for every new thing that you try.

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?
- How will I check my results? What will I look for?
- ♦ How else will I check my results? What will I measure?
- ❖ How will I measure the results or outcomes?
- How will I compare my experiment to my usual way of farming?
- Make a drawing of the experimentation in the field.

Here are some questions that you can use to experiment with adding mulch

- ❖ Did you use mulch on all of your plants, or only some?
- Were the plants that you mulched bigger and better than the ones that had no mulch?
- Did you use less water on the plants that were mulched?
- ❖ What did you use for mulch? Was it good? What will you use for mulch in future?

3. Brews for Plant Nutrition

One way of improving plant nutrition is to make liquid teas or brews that will add fertility to the soil. This should be used as an additional soil fertility technique rather than the only one! Brews provide extra nutrients in case of small deficiencies, but cannot rectify major nutrient deficiencies.

Liquid manures/brews/ teas are a simple way of giving your plants a boost. They can be made from plant material or animal manures. The aim is to provide plants with natural plant foods quickly during their growing season. It is useful for heavy feeders like cabbages and to give seedlings a boost.

How to make liquid manures from plants

A good plant for liquid manure is comfrey. Most soft green leaves and stems can also be used and weeds are ideal. Avoid plants which are very strong smelling. Plants are made of different quantities of nutrients and take up different nutrients from the soil. It is best to use a range of plant materials to make your liquid.

- ❖ Make sure your container is clean before you use it.
- Collect the plant material and fill up the container. You must keep on adding material to the container every week
- Place a rock on top of the plant material in the container and put the lid on. Do not add water. The plant material will make its own liquid. If you are only using weeds, and no comfrey or banana stems, you may need to add a little water, to just cover the compressed plant material.
- Place it in a sunny position and two weeks later check to see if the leaves have turned black. If you tilt the container you should find a black juice. This is the concentrated plant liquid manure.
- This liquid is very strong and should be diluted as follows:

Seedlings: 1 tin of liquid manure for every 4 tins of water.

Bigger plants: 1 tin of liquid manure to 2 tins water. If you make the mixture too strong it can burn the leaves of plants.

Every two weeks pour the mixture on the soil around your plants, after you have watered them. You should pour at least one tin of this diluted mixture around each seedling or plant. The tin should be the size of a big jam tin.

Good plants for liquid manures

Comfrey

This plant has large hairy leaves and grows in wet shady places. The leaves contain a lot of potassium. These can be used to mulch your vegetable beds and also to make liquid feeds for your plants Comfrey is also a good spinach and medicine. A tea made from the leaves is good for high blood pressure and arthritis.



ComfreyFrom: Useful Plants for Land Design,

Pelum



A brew made from comfrey leaves can be diluted as mentioned above and sprayed on plant leaves to protect against downy and powdery mildew. Mildews are a problem mainly on cucurbits, pumpkins and peas.

A brew made from comfrey and stinging nettle can be sprayed on plants to protect against early and late blight, which attacks tomatoes and potatoes.

In these cases the brews are sprayed onto the leaves of the plants.

Stinging nettle

This is one of the best plants you

can

use in plant brews. It contains a wide variety of nutrients and trace elements and is a well balanced plant food. It is best to collect these plants in the natural forests where they occur and plant a few in your garden. They do not survive frost, but otherwise grow almost anywhere.

Banana stems

These are chopped up and placed in the container with other plants and leaves. The stems have a high concentration of potassium and water and make a good liquid base for the brew.

Weeds

Black Jack, Amaranthus, Chickweed, Galant Soldier. All fast growing weeds, with soft dark green leaves are good. Avoid using grasses and sedges.

Advantages and disadvantages of plant brews

ADVANTAGES of plant brews	DISADVANTAGES of plant brews
Plant brews are easy to prepare and use	Resources such as containers with lids are required
If diluted these brews do not harm plants	Plant brews can burn plants if they are too strong
Plant brews increase disease resistance in crops	Effects of the brews on plant growth are only visible after 3-5 days.
Plant brews provide a quick and cheap plant booster food	It is not possible to know exactly which nutrients these brews contain.
Plant brews provide mainly potassium, phosphorus and trace elements.	Some people do not like the smell of these brews, which can smell very rotten
Nitrogen can be provided if the brew is used early in the fermentation cycle (after 1 week) and care is taken to avoid it's evaporation by keeping the containers closed and cool	Nitrogen is volatile and is lost from the brews quite early in the fermentation cycle

How to make liquid manure from animal manure

Manure can be used from chickens, rabbits, cows, goats and sheep. A mixture of manures is best.

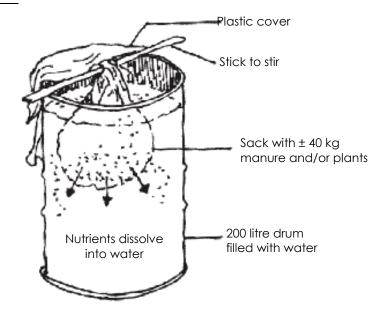
- ❖ Put your fresh manure mixture into an orange packet and tie the top of the bag.
- Put the bag in the container and attach it to a stick or a rope. Then fill the container with water. For every 1 kilogram of manure you will need 5 litres of water. This means an orange sack full of manure in a large bucket (501), or half the bag in a normal sized household bucket (201). This is a way of keeping the manure and the water separate, because you should not put the wet manure on your plants.
- Cover the container with a lid. Stir every few days.
- After two weeks the mixture will be ready to be used. It should look like weak tea. Before using the liquid, stir the mixture well.
- This liquid will be very strong and should be diluted:

Seedlings: 1 tin of liquid to 8 tins of water (or buckets or bottles)

Bigger plants: 1 tin liquid to 4 tins of water

If you make the mixture too strong it can burn the leaves of plants.

Every two weeks pour the mixture on the soil around your plants, after you have watered them. Again, use at least one big jam tin full for each seedling or plant. Avoid



applying your mixture in the middle of the day or on very hot days.

Good sources for animal liquid manures

Kraal manure (cattle):

Either use fresh manure or use manure that has been collected in a kraal. In this way you can ensure that the manure contains as many nutrients as possible and that the nutrients have not been lost into the air through baking in the sun and drying out. This is especially important if you need your liquid manure to contain some Nitrogen.

Chicken manure:

With chicken manure it is important to collect the droppings while they are fresh. Again this keeps the nitrogen and other plant food concentrated in the dry droppings. It is possible to collect the droppings daily and keep them in a sack in a cool dark place, until you have enough to make a brew.



Liquid manure made from chicken manure can burn plants, as it can contain a high level of Nitrogen. It is important to dilute this brew properly before use. If you are unsure, test the brew on a few plants only and come back the next day. If the edges of the leaves have gone brown and crinkly overnight, the brew is too strong and has "burnt" your plants.

Goat manure:

This is a very mild manure and is well balanced. It is unlikely to "burn" plants, but may also be a little low in phosphorus, depending on the diet of the goats.

Other manures:

Manure from rabbits can also be safely used. It is suggested not to use the manure from pigs, due to the possibility of carrying worm eggs that can infect people. Do not use manure from dogs and cats for the same reason.

Advantages and disadvantages of animal liquid manures

ADVANTAGES of animal liquid manures	DISADVANTAGES of animal liquid manures
Liquid manures are easy to prepare and use	The liquid manure is only as good as the manure of origin. If the animals are suffering from deficiencies these will be transferred into the manures. As an example, there is likely to be a lack of phosphorus in cattle manure, where cattle have only been grazed on veld. This means the liquid manure made from this source will also lack phosphorus.
If diluted properly, these liquid manures do not harm plants	Liquid manures are generally low in nitrogen. Using chicken manure drastically increases the nitrogen content.
Liquid manures increase disease resistance in crops	The source manures have to be handled well to retain their nutrients before using as liquid manures.
Liquid manures provide a quick and cheap plant booster food	Effects of the liquid manures on plant growth are only visible after 3-5 days.
Liquid manures provide mainly potassium, phosphorus and trace elements.	It is not possible to know exactly which nutrients these brews contain.
Nitrogen can be provided if the liquid manure is used early in the fermentation cycle (after 1 week) and care is taken to avoid it's evaporation by keeping the containers closed and cool	Some people do not like the smell of these liquid manures, which can smell very rotten

How to make a foliar spray

This is brew made from a mixture of plant and animal material. It is used by spraying onto the leaves of plants from where it is absorbed. This brew contains antibiotics, microbes and plant hormones as well as plant nutrients (potassium, phosphate and trace elements). (from :EMBRAPA; Brazilian Agriculture Research Institute)

- Place the following ingredients in a container with a lid:
 - 30kg of fresh cow manure
 - 50-60liters of water
 - 5litres of milk (without salt)
 - 5liters of sugar cane juice/ 15kg of chopped sugar cane/2kg of brown sugar (personal variation)
 - 4kg of wood ash (not coal ash!!)
 - 4kg crushed bones or bone meal (fish bones are ideal if available. If possible do not use chicken bones) (We use bone meal bought from a gardening shop)
 - 3-5x 20l buckets of chopped weeds
 - 2-3kg of agricultural lime/ crushed eggshells
- Leave this mixture for 10-15 days
- Dilute 2-10litres of this mixture in 100 litres of water.

This spray is highly effective!! It is possible to keep the brew going for a period of time, by adding more weeds and manure and fermenting the mixture again for about 10 days.

Advantages and disadvantages of foliar sprays

ADVANTAGES of foliar sprays	DISADVANTAGES of foliar sprays	
 Foliar sprays are very effective and act quickly in the plants. If diluted properly, these foliar sprays do not harm plants Foliar sprays increase disease resistance in crops Foliar sprays provide a quick and cheap plant booster food Plant hormones and antibiotics are also supplied through the fermentation process in the making of foliar sprays 	 Some inputs for foliar sprays need to be bought; such as agricultural lime and potentially wood ash, sugar and milk This mixture is exceptionally smelly while it is fermenting Foliar sprays can "burn" plants if they are too strong 	

4. How to Make a Trench Bed

Introduction

A trench bed is a way to increase soil fertility and water holding in your beds and garden. It is an intensive way of providing good soil for vegetables production on a small scale. It involves digging a hole and filling it with organic matter, so that your bed can be fertile for a long time (around 5 years).

The method

- 1. Dig a hole 60cm or deeper. It is usually about 1m wide (to provide easy access, without having to step on the bed) and can be as long as one likes.
- 2. Separate the topsoil and subsoil in piles while you are digging.

If your sub-soil is very in fertile it is not used in the trench. Spread this soil around the garden to help channel water towards your bed.

3. Place a layer of tins or branches at the bottom of the trench to help with aeration and also with supply of some nutrients.



Mandla (in Phuthadjithaba) is digging his trench bed and placing the topsoil on one pile (darker soil with more organic matter) and the subsoil on another (usually lighter soil with little or no organic matter).

The tins need to be squashed before putting them in the hole. Make a layer of tins about 3 tins deep. If there are no tins use thin branches instead.

- 4. Fill the trench with a range of organic materials and topsoil.
- First add dry grass or weeds (about 10 cm deep)
- Then add manure (about 2 cm deep)
- Add also some wood ash (a thin layer, less



Layer of tins at bottom of trench

than 1cm deep).

- Then add a layer of sop soil (about 5cm deep)
 - Mix these layers with a fork
 - Stamp them down by walking on them
 - WATER the mixture well!
 - Then start the process again.

You can also add other organic matter like green and dry weeds and vegetable peelings, card board, paper and bones.



A trench bed in Potshini being filled and mixed. Here the top soil is being added back into the trench Notice the yellow subsoil on the one side. It is not being used.

5. Continue to place the organic materials into the trench until it has reached ground level again.



A trench bed in Phutaditjhaba being filled, mixed and stamped down. Notice the mixture of manure, grass and soil.

6. Now build up the trench bed to about 10-15cm above soil level. Use a good mixture of topsoil and manure and or compost.

The organic material in the trench needs to decompose for about 2-3 months before planting.

7. The other option is to use your trench bed as a seed bed. In this way, when your seedlings are ready to be transplanted, the trench bed will be ready to be planted.

Growing seedlings from seed needs a well prepared bed. The roots of the small plants do not go down too deep. The materials in the trench



A recently completed trench bed.

can decompose while the seedlings grow on top.



Above, Carrot and onions seeds are being planted in a seed bed in Potshini. This trench has just been prepared.

Note; Fine soil is being used to cover the seeds in the rows. This is because the seeds are small and in this way they can germinate better.



In this picture carrot seeds were planted in the smaller trench bed in the far corner. There are also two tubs of seedlings being produced. In the foreground is a recently completed trench bed into which bought cabbage seedlings have been planted. Again these grew well and did not show any negative effects from the decomposing material in the trench.



In this picture a number of trench beds have been prepared in a garden in Potshini. The owner has used two of his trenches as seed beds. They are covered with grass to hold the moisture in the soil while the seeds are germinating. This grass will be removed when the seeds come up.

The middle bed is shaped like a horse shoe. This is a nice design that makes it easy to reach all sides of the bed. It also allows run-off water to run into the middle of the shoe and soak into your bed. Here the owner has planted swiss chard seedlings. They grew well; despite our fears that the decomposition of the organic matter in the trench bed may interfere with their growth.

8. It is very important that the trenches are watered well while they are being made and afterwards. The organic material in the trench can not decompose if it is dry.

Different ways of watering are possible; as long as a lot of water is given!!!



In this picture, drip irrigation is going to be used to water a trench bed.



Later in the season the cabbages in the trench bed with drip irrigation are growing well. And so are all the other crops planted in trench beds and watered with buckets; the swiss chard and beetroot in the foreground.

5. Seedling production



Above is an example of a seedbed. The cover of reeds that are tied together provides wind and sun protection for the seedlings.

To start

- Make sure you have good, fresh seed
- Make sure you have clean water close by (really muddy water is not good)
- Make sure you have fertile, soft, smooth soil (see also the Improving your Soil leaflet in this series).
- Make sure you have some shade.



Golden rules with water

- Water must be close by
- Water must be clean very muddy and dirty water will make it hard for seedlings to grow.



Golden rules with seed

- Seed must be fresh: Keep seed for only 1-2 years. Look on the packets you buy for a date. You can do a germination test on seeds to see how well they grow, before planting them (see below)
- Seed must be kept cool, dark and dry. If you buy from a shop, look to see whether the seeds are kept in a cool, dry place. If the packets are in the sun – do not buy them
- If you keep your own seed, make sure you plant seed without any mould, scratches or holes
- If you buy seed, write the month and year you bought it on the packet, so you can check the dates later

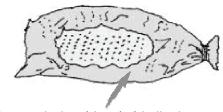


Experimentation

GERMINATION TEST - you might want to try this if you are unsure

of the quality and freshness of your seeds

Before planting seeds they can be tested for germination. You will test how many of your seeds will grow.

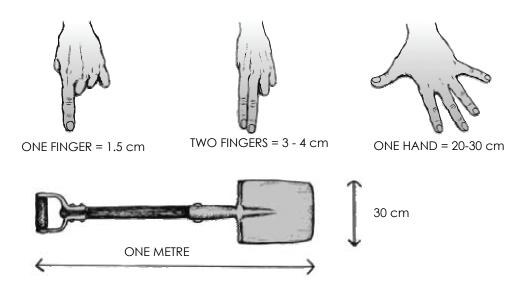


Evaporated moisture inside the bag from the damp cloth

- Take 50 seeds and place them on top of some damp paper, cloth or toilet tissue. Do not let the seeds stand in water or dry out.
- Place the paper or cloth with the seeds inside a plastic bag and blow air into the bag, before closing it.
- Check the seeds regularly to see how many germinate. This should take 3-10 days.
- Then count the seeds that have germinated.

Here for example 40 out of 50 seeds germinated. This is a germination rate of 80% (80/100). This means that only 80 out of 100 seeds that you plant will start to grow.

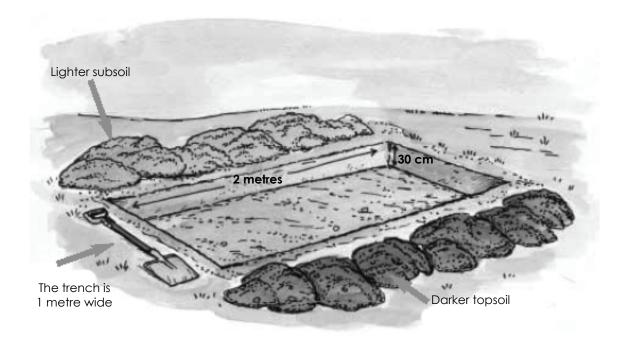
Measurements



Preparing the seed bed

A seedbed is a small part of the garden with very rich soil and a roof to shade the growing seeds. The roof also provides frost protection.

Dig a trench about 30 cm deep (about as wide as a spade) and 1 metre wide (about as long as a spade). The trench can be 1 or 2 metres long.



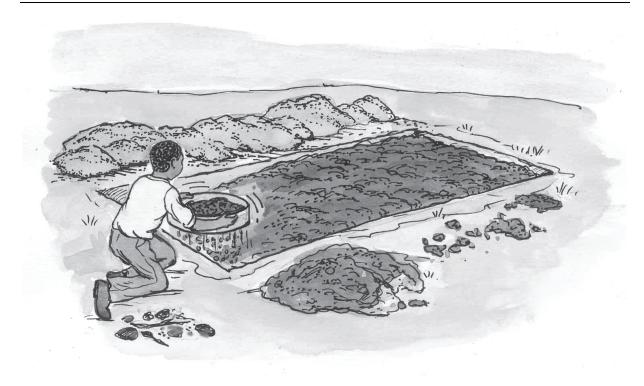
Separate the more fertile soil on the top (which is usually darker) from the rest of the soil. Loosen the bottom of the trench with a fork or a spade.



Then mix the topsoil with an equal part of manure and ash mixture or compost.



Sieve this as you put the mixture back into the hole. If you can not sieve the mixture, make sure it is free of anything that can stop the seedling from growing, such as sticks, leaves, stones, pebbles and hard clods of soil. It is important never to step on your bed once you have prepared it.



The width of the seed bed should be about 1 metre (or the length of a spade). This is because it makes it possible for you to reach the middle of the bed from both sides, without having to walk or step on your seed bed. Stepping on soil especially when it is wet, will spoil its soft, smooth texture, and make it hard. This hardness will make it difficult for seeds to grow.

An inexpensive shade structure for the seedbed can be made with poles / reeds /bamboo and thatch grass.



Planting seeds

Different seeds need to be planted in different ways.

1. Direct sowing

Some seeds need to be planted where the crop will grow, as the small plants do



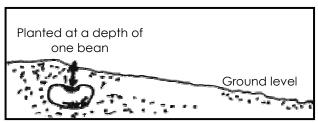
not like being moved. This is known as direct sowing.

This includes beans, beetroot, carrots, cucumbers, garlic, maize, peas, potatoes, pumpkins, radishes and turnips. The furrows / holes into which seed will be planted need to be fully watered beforehand.

Planting furrow is 1.5 – 2 cm deep

Small seeds like carrots, radishes and turnips are not planted very deep. Make a furrow about 1.5 cm deep (1 finger width) Sow the seed carefully with your finger and thumb into the furrow. Make sure you do not sow the seeds too thickly. Seeds need to be spaced one finger width in the furrow. Spread the seeds out as evenly as possible. Cover the seeds with a layer of fine compost, manure or soil. Press down with your fingers.

Larger seeds such as beans are planted at a depth of 1-2 times their size. If they are planted too deep, they will not grow. If they are too shallow, the small plants will fall over.



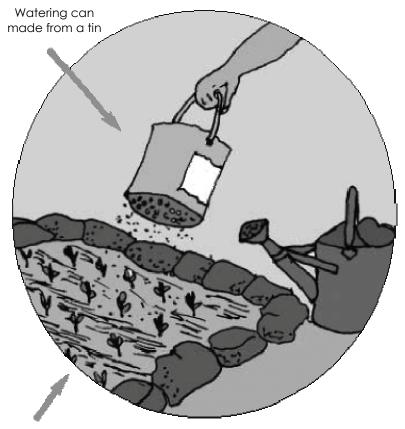
2. Sowing into seedbeds first

Some plants grow a lot better if they are first planted in seedbeds and then transplanted when the seedlings are strong. This includes broccoli, cabbages, cauliflower, chilies, eggplant, green peppers, leeks, lettuce, okra, onions, spinach and tomatoes.

Some plants can be sown directly or in seedbeds and here it is your choice which works best for you. This includes spinach, onions, garlic and potatoes.

3. Caring for seedlings in the seedbed

For small seeded vegetables like cabbages, kale, tomatoes, turnips and onions, do not plant the seed so thickly that they emerge as a dense mass. Seedlings will be weak and diseased. They need to compete for space and light. Sow thinly and evenly. Sow the seeds about one finger width apart.



Seedbed mulched with stones and grass

Once seed has been sown, it is important to keep them moist at all times. It may be necessary to water twice a day in hot weather. It is better to water in the evenings in summer and in the mid-mornings in winter.

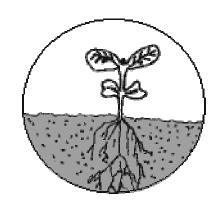
Water carefully, with a soft spray. Otherwise you can wash your seed out of the planting furrows, or compact the soil. You can use a home made watering can. You punch very small holes in the bottom of a tin with a nail and a hammer.

Mulch the seedbed. Here you can mulch between the rows of planted seeds. Or you can cover the whole bed and then remove the mulch as soon as seedlings start to appear. If you do not take the mulch off the seeds it can make it hard for them to grow well. It is also possible to mulch the edges of your seedbed with flat stones. This ensures that the water stays inside the bed and does not evaporate out the sides.

- It is important to weed well and often in a seedbed.
- Thinning is taking out some of the plants so that others will grow better. When the plants come up, you will see which ones are stronger and which ones are weaker. Take out the weak plants. Make sure each strong plant has enough space around it, about 3-4 cm (2 fingers wide).

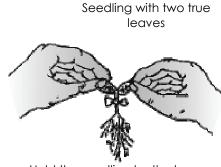
4. Transplanting seedlings

Before transplanting your seedlings it is a good idea to harden them. This will make the shock of being transplanted less. Hardening means that you make the conditions for the seedlings a bit more difficult. The shading is removed and watering is reduced. This is done 3-5 days before



transplanting.

The time to transplant a seedling is when it has 2-6 true leaves, a well developed root system and a nice strong stem. The first two leaves that pop out of the ground are usually not true leaves – so wait for the plant to develop.



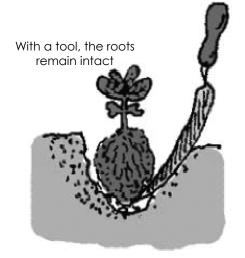
Hold the seedling by the leaves

Transplant in the late afternoon or on an overcast day. This gives the seedlings a bit of time to recover before the next warm day. If it is really cold, plant them mid-morning, once the soil has warmed up a little.

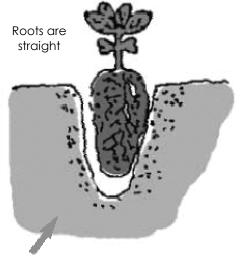
- Prepare and water your planting holes
- Make sure the soil is soft and contains some organic matter, like manure and ash or compost.
- Lift the seedlings carefully, using a tool (DO NOT PULL THEM OUT BY HAND) and try to leave as much soil around the roots as possible. Handle the seedlings by their leaves and not their stems.

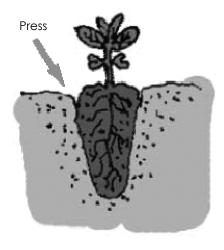


Pulling up seedlings without a tool is not good



When planting, the roots should be kept straight and not be squashed into the hole. The hole must then be filled with soil, which should be packed firmly around the roots. Press the soil down around the seedling, so that there is no air around the roots.



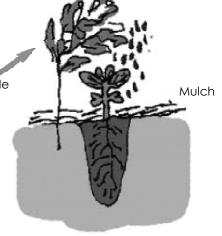


No air around the roots

Moistened soil

- Water the seedlings as soon as they are planted.
- Mulch them in their bed.

Provide some shade for the seedling, using a leafy branch or a piece of cardboard. This can be removed after 4-5 days, once the seedling has settled in.
Branch for shade Water after transplanting



Resource Material for Homestead Food Gardeners

Chapter 6: Handouts (seSotho)

Handout 1 Ntlafatso ea mobu (Improving your soil)

Handout 2 Ho koahelamobu hore u se lahleheloe ke mongobo (Mulching)

Handout 3 Mokeli-keli Oa Mononts'a (Brews for plant nutrition)

Handout 4 Thlahiso ea sethopo (Seedling production)

1. Ntlafatso ea mobu



Mobu o nang le bophelo

Mobu o matlafetseng ke o phelang. Ke mobu o nang le li kokoanyana tse ngata tse o ntlafatsang. Ke mobu o tebiling, o seng thata, o bile o bonolo ho o cheka, ona le moea le metsi.

Mobu o nang le bophelo ke motsoako oa lintho tse ngata joalo ka:

- Lehlabathenyana, "silt" le letsopa, tseo e leng mefuta ea mobu.
- Lintho tse putileng joalo ka makhasi, joang le moiteli.
- Lintho tse sa puting joalo ka majoe.
- Matsoai a kang "potassium".
- ❖ Moea le metsi.



From: Lessons from Nature

Likokoanyana tse nyenyane tse phelang mobung tseo ho seng bonolo ho li bona ka mahlo ka lebaka la bonyanyane ba tsona. Li ntlafatsa mobu ka ho ja makhasi/ mahaba, joang le tse ling. Ke likokoanyana tse kang manyoha ka mefuta ea tsona le tse ling.

Mefuta ea mobu

Mobu o etsoa ha liminerale tse fumanoang haholo-holo majoeng li thueha/ likumeha hanyane ka hanyane ka lilemo tse telele. Ka nako ena e telele, majoe ana a thueha/ kumeha ho fihlela eba makoete a manyenyane. Makoete ana a thuuoa ke lipula, meea le letsatsi. Kamorao ho liketsahalo tsena, re ba le ho bitsoang ka hore ke mobu moo re ka tsebang ho lema, lijalo li hole le likokoanyana tsa mobu li phele ka teng. Joalo ka batho, lijalo li ke ke tsa phela ntle le metsi, moea le lijo.

Mobu kaofela ke motsoako oa lehlabathe, "silt" le letsopa. Hore na mobu o tseba ho tšoara metsi nako e kae, ho ea ka hore na mobu o jolao o na le lehlabathe, letsopa kapa "silt" e kae. Mehlala ea mefuta ea mobu ke: mobu o lehlabathe (sandy soil), mobu oo karolo boholo eleng lehlabathe 'me ho boetse ho ena le selokoe (sandy loam) selokoe, (loam) mobu o letsopa ebile o kopane le selokoe (clay loam) le letsopa (clay).

Lehlabathe le etsa mobu oo metsi a fetang feela. Mobu o bitsoang "silt" ke mobu o senang lehlabathe le lengata. Mobu ona o tšoara metsi le lijo tsa lijalo hantle ho feta lehlabathe le khorofo, le ha hole joalo, o tsamaea ha bobebe le metsi.

Letsopa ke karolo ea mobu e khoramelang. Le tšoara metsi joalo ka ha eka ke seponche. Mobu o nepahetseng ke selokoe, hobane o na le likaroloana tse le kanang tsa lehlabathe, "silt" le letsopa.

Libopeho tsa mobu:

	Mobu o lehlabathe						
Tse ntle ka mobu ona			Tse seng ntle haholo ka mobu ona				
* * * * *	Ho bonolo ho o sebetsa Futhumala kapele hang ha mariha a tsoa O motle bakeng sa lijalo tse holelang ka mobung Moea le metsi li kena ha bonolo	* * *	O oma ka pele Ha o boloke manoni a mobu haholo Ha o tšoare metsi hantle				
Selokoe (Motsoako oa lehlabathe le letsopa)							
	Tse ntle ka mobu ona		Tse seng ntle haholo ka mobu ona				
* *	Tšoara metsi hantle Motle sebakeng sa lijalo tse holelang ka mobung Ona le liputisuoa tse ntlafatsang mobu	*	Mobu ona o thata ha o omme				
Letsopa							
Tse ntle ka mobu ona			Tse seng ntle haholo ka mobu ona				
*	Tšoara metsi hantle nako e telele Tšoara manoni a mobu hantle nako e telele	* *	Ha ho bonolo ho o sebetsa hobane o boima Lieha ho futhumala kamora mariha Oa khoramela ha o le metsi Ha o omme o thata.				

Mokhoa oa ho tseba mofuta oa mobu

Ho bohlokoa ho tseba hore na mobu oo u nang le oona ke oa mofuta o fe. Ka tsela e na u tla tseba hore na u etse joang hore mobu oa hau o sebe thata o lule o qhalakane ka nako tsohle. Mobu o qhalakaneng e bile o se thata o tšoara metsi le moea haholo, e leng tse hlokoang ke sejalo hore se hole.

Hore mobu oa hau o qhalakane (E bang ke o lehlabathe, selokoe kapa letsopa), u lokela ho lula u ntse u tšela moiteli, mosuela hape u ntse u o koaela (mulch) ka litlamatlama kapa joang. U se ke oa tsamaea holima moo ho jetsoeng teng haholo ha mobu o le metsi.

Mobu o nang le lehlabathe le lengata, o lokela ho tšeloa liputisoa(organic matter), e le ho nyolla ho tšoara metsi hoa oona, hammoho le ho tšoara lijo tsa sejalo. Mobu o letsopa oona o lokeloa ho tšeloa liputisoa e le hore o tsebe ho tšoara moea le ho lokolla lijo tsohle tsa sejalo tse ka bang teng moo mobung.

Mefuta eohle ea mobu e hloka liputisoa e le ho nyolla manoni a mobu.

Chebahalo ea mobu	Mobu o utloahala joang ka letsohong	Ha mobu o bopiloe joalo ka boroso		Mobu O:
O lehlabathe le lengata	O khorofo haholo	Ha o bopehe		Lehlabathe le lengata
O lehlabathe	Khorofo	O oa bopeha, feela ha o kobehe		Lehlabathe
Halofo ke lehlabathe ha engoe e le mobu o boreleli	Khorofo	O oa bopeha, ebile o ka kobeha hanyenyane		Mobu o kopantseng lehlabathe le selokoe
Boholo ba mobu o boreleli	Lehlabathenyana le teng, o boreleli empa ha se letsopa	O oa bopeha ebile o ka kobeha halofo		Selokoe kapa selokoe se kopantseng le "silt"
Boholo ba mobu bo boreleli	Lehlabathenyana le teng, o boreleli, ebile ke letsopa	O ka kobeha ho feta halofo		Letsopa le kopaneng le selokoe kapa lehlabathe le kopaneng le letsopa
Mobu o boreleli	O boreleli ebile o letsopa	Boroso e ka kobeha hore e tse lebeli/lesale		Letsopa

Matsoai a mobu

Lintho tsohle tse phelang li bopiloe ka lerole la lefatse. Lijalo tsona lina le matsoai a latelang: "Hydrogen", "oxygen", "carbon", "nitrogen", "phosphorous", "potassium", "magnesium", "sulphur" le "calcium".

Lijalo li hloka mefuta e meraro ea matsoai:

- ❖ Nitrogen (N) Ba keng sa mahaba a phetseng hantle le kholo ea lehlaka;
- Phosphorus (P) Ba keng sa methapo e phetseng hantle;
- Potassium (K) Ba keng sa sejalo se phetseng hantle ka kakaretso, hammoho le ho thunya le ho beha ha sejalo.

Lithlaku tsena NPK li bitsoa matšoao a lik'hemikale (chemical symbols). Ha u reka monontša u tla fumana hangata ho sebelisitsoe ona e seng mabitso ka botlalo.

Boraro ba mefuta ena ea lijo tsa lijalo e ka holimo, e fumanoa mosueleng kapa moiteling. U ka boela oa eketsa lijo tsena ka ho koaela mobu ka makhapetla a lijalo tse kang lierekisi, semela se bitsoang "comfrey", le ka ho tšela mokeli-keli.

Hona le mekhoa e fapakaneng e ka sebelisoang ho ntlafatsa matsoai (fertility) a mobu eo u tlang ho e bontšoa.

Nitrogen

U tla tseba joang haeba mobu oa hau o hloka ho ekeletsoa nitrogen?

U tla tseba hore lijalo tsa hau li hloka nitrogen ha mahaba/makhapetla a tsona a fetola 'mala a eba masehla, a sa be matala joalo ka ha ho tšoanela.

U ka eketsa nitrogen joang mobung oa hau?

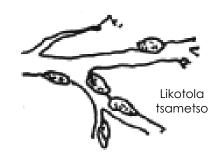
Nitrogen e fumanoa mefuteng e mengata ea moiteli(oa likhomo, linku, lipoli, likhooho, likolobe le li mmutlanyane). Le ha hole joalo, nitrogen e ngata haholo moiteling oa likhooho le lipoli. Moiteli o lokela hore o be o omme pele o ka tšeloa serapeng. Ha o le metsi, o matla haholo ebe o chesa lijalo tsa hau.



Likotolana metsong ea semela tse nkang letsoai nitrogen

Nitrogen e fumaneha lijalong tse behang ka mekotlana

Nitrogen e boetse e fumanoa ho mofuta oa lijalo o bitsoang "Legumes". Tsona ke lijalo tse etsang likotoloana metsong ea tsona, 'me likotoloana tsena ke tsona tse nkang nitrogen moeeng hore sejalo setle se e sebelise. Hona le likokoanyana tse nyenyane tse kang baketheria(bacteria) tse fumanoang methapong ea sejalo tse thusang ka ho nka nitrogen bakeng sa sejalo.



Akokonyana e bitsaong bacteria e teng likotoleng tsa metso e boloka letsoai nitrogen le tsoang moeeng ka mobung, e be e le lokolla hang ha semela se shoa

Ha methapo ea sejalo e shoa, nitrogen e tsoela mobung e be e sebelisoa ke lijalo tse ling tse haufinyane le seo se shoeleng.

Mehlala ea li "legume" tseo re ka lilemang ke:

- Makotomane
- Lierekisi
- Linaoa (Le tsa soya)
- Makotomane a sitsoang "Bambara"

Ho ntse ho ena le lijalo tse ling tse sa tloaelehang le lifate tse nyenyane tse thusang ho nka nitrogen. Mehlala ea tsona ke "chick peas", "mung beans", "lentils", li "legume" tse ling le tsona li kanna tsa lengoa le ha feela li ke ke tsa sebelisoa e le lijo tse hlokoang ke sejalo. Tsona ke tse kang; lesere, "clover", "hairy vetch" le "lupins". Li fana ka nitrogen e ngata mobung ho feta lijalo tse jeoang. Lijalo li kanna tsa lengoa lipakeng tsa li "legume" tsena.

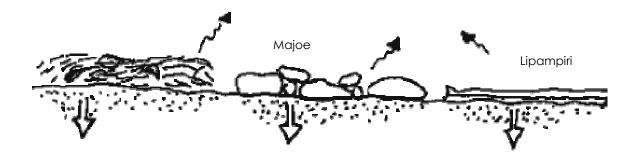


From: Food from the Veld, 1982.

Mahaba a li "legume" a ka sebelisoa ho koahela mobu (mulch) e le ho o tšireletsa letsatsing le lengata. Ketso ena e tla eketsa nitrogen mobung.

Li fokotsa tahleho eamongobo mobung

From: Production without Destruction, Natural Farming Network, Zimbabwe



Phosphorous

U tla tseba joang ha mobu oa hau o hloka phosphorus?

U tla tseba hore lijalo tsa hau lihloka phosphorous ha lisa hole ka pele joalo ka ha li tšoanela. Mahaba le oona a tla qala ho bontša bofubelu kapa bo pinkinyana ba sa tloaelehang haholoholo qetellong ea oona. Ha eba lijalo tsa hau li sa hole hantle li le nyenyane, le ha u tšetse mosuela, hona ho bontša hore ehlile lijalo tseo li na le khaello e kholo ea phosphorous. Hona ho ka etsahala haeba mobu o ena le bolila bo bongata. Re tla qaqisa tsena haholoanyane ha morao.

Phosphorous e eketsoa joang mobung?

Boholo ba mobu Lesotho ha bona phosphorous. Ho batla hole thatanyana ho ekatsa phosphorous mobung ka tsela ea ho e kopanya le lijalo le mobu hobane boholo ba lintho tse nang le phosphorous li se bonolo ho sebetsana le tsona. Lintho tse joalo ke; mosese, masapo, moriri, masiba le mali. Hangata lintho tsena li kenyelletsoa ha ho etsoa mosuela.

Ntho e bitsoang ka hore ke "Natural Rock Phosphate" kapa setene sa phosphate e ka kopangoa e le joalo le mobu, empa le eona ha e fumanehe ha bonolo.

Phosphorous a ka fumanoa hape masapong a sitsoeng (bone meal). E ka rekoa moo ho rekisoang li sebelisoa tsa temo, feela e theko e phahameng. Mokhoa o mong oa ho kopanya phosphorous ke ho besa masapo lihoranyana li se kae. Ha a se a chele, u ka tseba hoa a sila ha bonolo. Ha a se a le phofo, u ka a fafatsa serapeng sa hau kapa holima mosuela (compost).



Moiteli oa likhomo tse fulelang sebakeng seo phosphorous e fokolang le oona o ke kebe oa ba le phosphorous e ngata. U ka eketsa phosphorous ka ho reka monontša. E tloaelehileng e bitsoa ka hore ke "superphosphate". Engoe ke DAP (Di-ammonium Phosphate) le eona u ka e sebelisa.

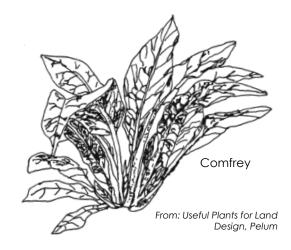
Potassium

U tla tseba joang ha mobu oa hau o hloka Potassium?

U tla tseba hore lijalo tsa hau li hloka potassium ha lirobeha ha bobebe le mahaba a e ba sootho ho ea qetellong a bile a omella. Ha li tholoana li sa behe hantle, u ka sola bosieo ba potassium. Matšoao a mang oona ha a bonahale ha bobebe. Le ha hole joalo a mang a oona ke bosehlanyana ho pota-pota methapo ea lehaba (hona ho kanna hoa bakoa ke lefu le itseng, joale ho ba thata ho tseba hantle hore na ho o eleng hona hantle ke hofe).

Potassium e eketsoa joang mobung?

Lihlahisoa tse ntle tsa potassium ke moiteli oa likhooho le molora o ntseng o le mocha oa patsi. U seke oa sebelisa molora oa mashala kaha o kotsi mobung le lijalong. Sehlahisoa se seng sa potassium ke sejalo se bitsoang "Comfrey". Sejalo sena se na le makhasi a maholo a boea. 'me se mela moo ho leng metsi. Makhasi a sona a na le potassium e ngata. Makhasi ana a ka boela a sebelisoa ho kaohela mobu (mulch) serapeng kapa e le mokeli-keli sebakeng sa lijalo. (Re tla shebana le lijo tse metsi hamorao).



Liminerale (matsoai) tse ling tse hlokahalang hanyenyane joalo ka "magnesium", "zinc" le "iron", li fumanoa mefuteng e mengata ea moiteli le mosuela.

Mobu o bolila

Mobu o bolila ke o joang?

Liminerale le lijo tse hlokoang ke sejalo hore se hole li qhebelisoa ke metsi a teng mobung. Ketso ena e batla e tšoana le ha letsoai kapa tsoekere e qhebiliha ka metsing a khalaseng.

Mobu o bolila o batla o tšoana le metsi a kopantsoeng le vinegar. Libakeng tseo pula e leng ngata haholo, tse ling tsa liminerale li ka tsamaea le metsi, ebe joale mobu o sala o le bolila.

Ha mobu o le bolila haholo, tse ling tsa liminerale le lijo tsa sejalo li tla qhibiliha ka pele haholo hoo lijalo li tla sitoa ho li sebelisa. Athe tseling tsa liminerale tsona li ke ke tsa qhibiliha ho hang, e be hape lijalo ha li tsebe ho lisebelisa. Phosphorous ke engoe ea liminerale tsoe sejalo se ke keng sa e sebelisa ha mobu o le bolila, le haeba e le teng mobung.

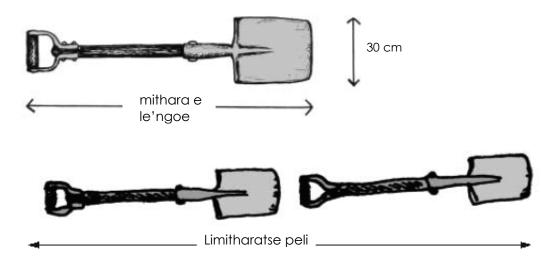
U tla tseba joang ha mobu oa hau o le bolila?

U tla tseba sena ha u bona lijalo tsa hau li sa hole feela u ntse u tšela mosuela kapa moiteli, e bile u ntse u li tšella. U tla bona lijalo li sa hole li le nyenyane. Hona ke bothata bo tloaelehileng.

U tla fenya bothata boo ba mobu o bolila joang?

U ka bofenya ka ho tšela kalaka mobung. Kalaka ke phofshoana e tšeou ka 'mala, u ka e reka mabenkeleng.

E tšoaneloa ho chekelloa, bonyane botebo bo lekanang le metso/methapo ea sejalo sa hau. Bakeng sa meroho, e ba lipakeng tsa 30 – 60 cm. Hona ke bolelele ba hloho ea kharafu kapa tse peli. U lokela ho tšela k'hilokrama e lengoe (1kg) ea kalaka ho leoto bophara le leoto bolelele (square metre). 1 kg ea kalaka e lekana le kharafu e tletseng. E hle e tlatsoe haholo.



Empa bakesang sa lijo tsa masimong joalo ka poone le mabele, tse nang le metso e tebileng, cheka licentimitara tse mashome a tseletseng (60cm) hoisa ho mithara e lengoe (1 m). Mithara e lengoe e lekana le bolelele ba kharafu.

Hangata kalaka e tšeloa khoeli tse peli hoisa ho tse tharo (2 - 3) pele ho jaloa kaha e sebetsa butle ka mobung. Ha u ka oa tšela kalaka ka nako eo u jalang ka eona, u tla tseba feela ho bona phapang selemong se hlahlamang ha u jala hape.

Mekhoa e meng ea ho ntlafatsa manoni a mobu oa hau

Moiteli

Mefuta e mengata ea moiteli oa liphoofolo e ka sebelisoa. Eona ke oa likhomo, linku, lipoli, likolobe le likhooho.

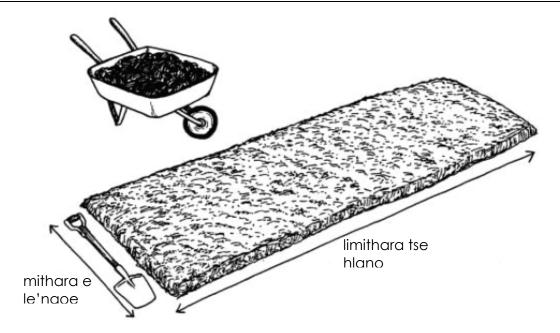
Tšebeliso ea moiteli

Moiteli o ka sebelisoang ke o tsoang sakeng o kopaneng le lehlaka le mosese. Bokeletsa moiteli ona bonyane ha ngoe ka beke ebe u koahela ka joang kapa polasitiki.



Moiteli o ka kopangoa le mobu ka mekhoa e fapaneng:

- U ka o sebelisa ha u jala sethopo ka ho kopanya liatla tse peli hoisa ho tse tharo tsa moiteli ka hara mekotjana eo u tlong ho lema sethopo ka teng.
- ❖ Moiteli hape o kanna oa lengoelloa serapeng ho ntlafatsa manoni a mobu. Sebelisa kiribae e lengoe e tletseng bakeng sa serapa sa boholo ba mithara e lengoe ho tse hlano-1m x 5 m(kharafu e lengoe ho tse hlano).



- ❖ Moiteli o ka sebelisoa hape le ho leifo. Leifo lena le chekoa botebo bo ka etsang licentimithara tse mashome a mararo (30cm), e leng bolelele bo ka etsang hlooho ea kharafu. Ha u qeta ho le cheka, tšela moiteli o ntseng o le mocha oa botebo ba licentimithara tse leshome (10cm) (e batlang e lekana le bophara ba feisi). Kamorao ho moo, tšela joang, lehola, ebe u koahela ka mobu ola o ileng oa u ntša ka hona ka sekoting sena. Pele u jala, u kanna oa kopanya tsena tsohle le mosuela. Setšoantšo sena se ka holimo se bitsoa "hotbed" hobane ha moiteli o ntse o puta, o ntse o futhumala 'me o ntša mocheso. Ketso ena e etsa hore mobu o chese, 'me hona ho nepahetse haholo libakeng tseo mariha a batang haholo.
- Moiteli o ka aloa serapeng, ka tsela ena o ntse o boetse o eketsa lijo tse hlokoang ke sejalo.
- Moiteli o ka tšeloa sebakeng seo ho entsoeng mosuela ho etsa hore e hle ebe MOSUELA OA SEBELE.

Mosuela

Mosuela ke motsaoko oa litlama tse metsi le tse ommeng le moiteli, tse ileng tsa puta 'moho hore li qetelle e le lijo tse matlafatsang tse hlokoang ke sejalo. Mosuela o boetse o thusa mobu hore o tsebe ho tšoara metsi hantle le ho tšireletsa lijalo mafung.



Tse seng ntle haholo ka mosuela

- Mosuela o hloka nako e ngata ho o etsa le ho o sebelisa.
- Boleng ba mosuela bo ipapisitse le hore na o entsoe joang le hona ka eng. Haeba o sa etsoa ka nepo, o ke ke oa eba lijo tse ntle tse hlokoang ke sejalo.
 - Ha ho bolono ho fumana masalla a bolileng kapa a ntseng a le macha a lijalo kapa liphoofolo tse shoeleng a (organic material) hlokahalang ho etsa mosuela.



Tse ntle ka mosuela

- Mosuela ke lijo tse hlokoang ke sejalo tse seng li le malala a laotsoe, tse sa hlokeng hore li sebetsoe ke likokoanyana tsa mobu pele.
- Mosuela ha o bake lehola le lengata, joalo ka moiteli o mong oa liphoofolo.
- U kaba le lijo tse ntle u sa sebelise chelete e ngata ho reka menontša.

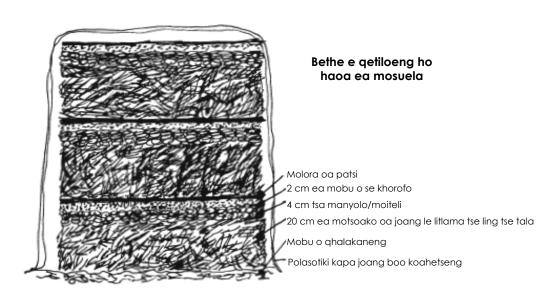
Ke eng eo u e hlokang ho haha bethe ea mosuela?

U hloka ho bokelletsa tse latelang:

- Lithlaka kapa masalla ohle a lijalo tse ling. Tsona ha li atlameha hoba le peo, empa ha ho tsotellehe hore na li metsi kapa li omme.
- ❖ Makhapetla a k'habeche le lehola (le le metsi kapa le omme), li se kebe tsa ba le peo.
- ❖ Moiteli
- Molora oa patsi

Lintho tse ling tse ka sebelisoang ho etsa mosuela e kaba lijo tse setseng ka kichining, metsi a hlatsoang lijana, lithole, liphoofolo tse shoeleng, masapo, boea, manaka le masiba. Ho bohlokoa hore u tsoake mosuela oa hau le sefate se bitsoang "comfrey".

LINTHO TSE SA TŠELOENG MOSUELENG: Polasitiki, likhalase, tšepe, patsi, libeteri tsa khale, eng kapa eng e ke keng ea puta hore e qetelle e le karolo ea mobu.



Sebaka sa ho etsa bethe ea mosuela

- ❖ Moo ho tšireletsehileng letsatsing, feela e seng haufi haholo le sefate.
- Moo ho tšireletshileng moeeng o mongata.
- Moo ho senang maqhutsu.

- Haufi le serapa le metsi.
- ❖ Moo liphoofolo li ke keng tsa fihlela habonolo (haholo kolobe, likhoho le lipoli).

Mokhoa oa ho etsa bethe ea mosuela

Mokhoa oa pele:

Khetha sebaka seo u tlang ho se sebelisa, ebe u se phethola/lema ka mohoma oa letsoho kapa ka foroko (digging fork). Sebaka sena se lokela hoba boholo ba mithara e lengoe ka tse peli (1 x 2 m), e leng bolelele ba kharafu tse peli le bophara ba e lengoe.



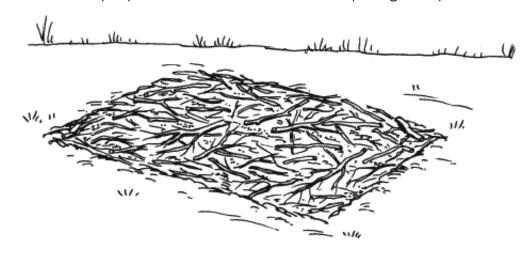
Mokhoa oa bobeli:

Khabela lithlaka, makhapetla/joang, lehola hore li be likaroloana/ liphisi tse nyenyane. Kopanyelatsa le comfrey le makhapetla a k'habeche. Tsena li lokela ho khaoloa bolelele ba licentimithara tse leshome (10 cm). Ka tsela ena li tla puta kapele.



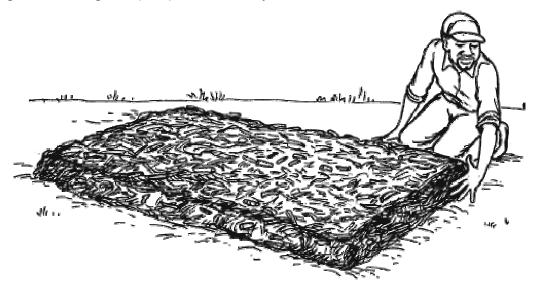
Mokhoa oa boraro:

Ala makala a manyenyane a lifate holima mobu o u getang ho u phethola.



Mokhoa oa bone:

Koahela ka motsoako ola oa litlama-tlama, botebo bo ka e tsang licentimithara tse mashome a mararo (30 cm), e lekana le botebo ba seatla. Haeba u na le lintho tse tsoang ka kichining, li kopanyeletse hona joale.



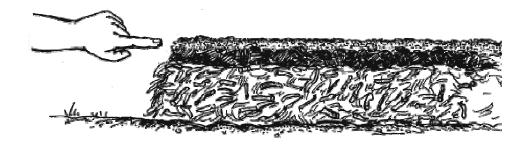
Mokhoa oa bohlano:

Tšela moiteli ka holimo ho tsena kaofela, o be botebo ba licentimithara tse 'ne (4 cm) / bophara ba menoana e 'meli.



Mokhoa oa botšelela:

Tšela mobu holima moiteli, botebo ba licentimithara tse peli (2 cm). Bophara ba monoana.



Mokhoa oa bosupa:

Fafatsa molora oa patsi holima mobu (haeba u sebelisa kalaka, phofshoana e entsoeng ka masapo a sitsoeng, u ka hla oa li tšela hona joale).



Mokhoa oa borobeli:

Tšella ho fihlela metsi a monyela fatše.

Mokhoa oa borobong:

Tsoela pele ho haha bethe u ntse u pheta mekhoa e ka holimo ho fihlela bethe e khutla sefubeng sa hau.

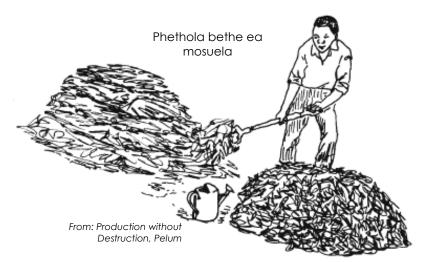
Mokhoa oa leshome:

Koahela bethe ea hau



ka lehlaka le lengata, joang kapa polasitiki. Hona ho thusa hore metsi le mocheso li se lahlehe le hore li pute kapele. E thusa hape le hore liphoofolo li se ke tsa tanakella moo li be li getelletse li e sentse.

Ho bohlokoa hore u lule u ntse u phethola bethe ena ea mosuela beke tse ling le tse ling tse peli.
Haeba mosuela o omeletse, u tšelle. Ha u latela tsena tsohle hantle, mosuela oa hau o tlabe o lokile ka morao ho libeke tse tšeletseng haele hlabula kapa libeke tse robeli ho isa ho tse robong haele mariha.
Libaka tseo ho batang



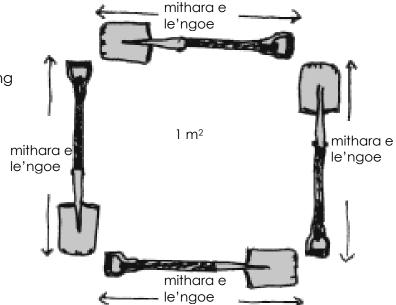
haholo ebile li ratoa ke lehloa, bethe e lokela ho koaheloa haholo, eseng joalo, ha hona letho le tla etsahala, ka mantsoe a mang e ke ke ea puta.

Mosuela o loketse hore o sebelisoe ha o le joang?

Ha mosuela o ntse o thunya, ho bontša hore o ntse o puta KA MATLA/HAHOLO. Mosuela o tlabe o lokile haeba o se o fetotse 'mala o le motšonyana e ka mobu o mongobo. Hape mosuela oa 'nete ha o na monkho (haeba o ena le monkho e bile o le mofuthu HA SE MOSUELA HOHANG!).

Tšebeliso ea mosuela

- Jala sethopo se seng le se seng ka mosuela o ka e tsang liatla tse peli hoisa ho tse tharo.
- Lemella mosuela tjena: Phethola mobu botebo ba hlooho ea kharafu, e tsa bonnete ba hore ha o na makoete. Hasanya kharafu tse nne (4) tse tletseng tsa mosuela sebakeng sa leoto bophara le leoto bolelele (1 square metre). U le melle hanyenyane e be u oa jala.



U ka sebelisa mosuela ho koahela mobu (mulch) ka ho o hasanya serapeng sa hau.

From: Vikela, May 2003, FSG



Liteko tsa hobona hore na mobu oa hau o Na le kalaka le phosphate e lekanengu

Tekong/ patlisisong ena u tla lokela ho sebelisa lirapa tse 'ne (4) tse lekanang. Lirapa tsena li lokela ho lekana le mithara e lengoe mahlakore kaofela (mithara e lekana le bolelele ba kharafu). E tsa bonnete ba hore lirapa tseo li tšoae ka lithupa hore u se ferekane ha u ntse u tsoela pele ka teko.

Serapa sa 1:

Lema serapa ka tsela e tloaelehileng e be oa se jala

Serapa sa 2:

Le sona se leme joalo ka sa pele, ebe u tšela likhaba tse kholo tse tletseng tsa "superphosphate". E tšele hore e anele serapa kaofela, ebe u oa e phetholela. Jala ka tsela e tloaelehileng.

Serapa sa 3:

Lema serapa ka tsela e tloaelehileng, ebe u tšela lekolokoti/botlolo e lakanang le ea jeme e tletseng kalaka. Le eona e tšele hore e lekane serapa kaofela, ebe oa e phetholela. Jala ka tsela e tloaelehileng.

Serapa sa 4:

Lema serapa ka tsela e tloaelehileng, ebe u tšela likhaba tse peli tse kholo tse tletseng tsa "superphoshate" le lekolokoti le le leng le leholo la kalaka. Li tšele hore li anele serapa ebe oa li phetholela. Jala ka tsela e tloaelehileng. Sena ke setšoantšo se bontšang hore na teko/patlisiso ea hau e tšoanela ho shebahala joang.

Joale u tšoanela ho lula u ntse u lekola teko/patlisiso ea hau. Beke engoe le e ngoe u shebe le ho ngola fatše hore na ke lik'habeche life tse ntle hofeta tse ling. Hape u shebe hore na li hola joang, 'mala oa tsona (hore na litala kappa litšehlanayna) le bophelo ba tsona ka kakaretso (hore na li shebahala li phetse kapa li na le mafu). Mohlala oa ho ngola liphetho tsa hau ke o latelang. U ka etsa melana (table) e be kahare ho eona u ngoala liphetho tsa hau, ho tloha bekeng ea boraro.

Lirapa tse tekong/patlisisong	Tse sa kenang tekong 1	Phosphate 2	Kalaka 3	Kalaka le Phosphate 4
	Serapa se lengoeng kh'abeche e le mohlala			

	Serapa 1 Se seng tekong patlisisong	Serapa 2 Phosphate	Serapa 3 Kalaka	Serapa 4 Kalaka le Phosphate
Beke 1	Kh'abeche e	Kh'abeche e	Kh'abeche e	Kh'abeche e
	shebahala	shebahala	shebahala	shebahala
	hantle	hantle	hantle	hantle

Beke 2	Kh'abeche e ntse e hola feela e se e ena le bosehlanyana. Empa ha ena mafu.	Kh'abeche e ntse e hola, haena bosehla, hape haena mafu.	Kh'abeche e ntse e hola hantle. Hape haena mafu.	Kh'abeche e ntse e hola hantle hape haena mafu, e se I bile e le motala se I bo lefifi.
Beke 3				
Beke 4				
Beke 5				
Beke 6 etc				
Liphetho tsa ho qetela. Kholo:				
'mala:				
Bophelo:				
Nomoro ea li kh'abeche tse shebahalang hantle				

Ha re khutleleng morao sehlohong se sa tsoa feta se neng se bua ka liteko tse e tsoang ke sehoai. U ka sebelisa moralo o tšoanang ho bona hore na teko ea kalaka le phosphorous li tla u thusa joang ho ntlafatsa mobu oa hau.

Moralo o ka sebelisong tekong ea meroho e fokolang ka palo				
Bothata ke bofe?	Kh'abeche ea ka ha e hole hantle, le ha ke se ke tsetse mosuela kappa fethalisara/manyolo.			
Bothata boo nka bo fenya joang?	Ke tla tsela kalaka le phosphorous ho bona hore na ho tlaba le phapang.			
Hobaneng ha ke sebelisa mokhoa oo?	Mohlomong mobu oa ka o hloka ho tseloa phosphorus, kalaka kapa bobeli ba tsona.			
Mokhoa oo ke tla o leka joang?	Ke tla tsela kalaka polotong e ngoe, ke tsele phosphorous ho e ngoe, ho ea boraro ke tla li tsela li le peli. Ke tla siea poloto e ngoe ea bone (4) ke sa e tsela letho e le hobona hore na ehlile kalaka le phosphorous li etsa phethoho li kh'abecheng tsa ka.			
Ke tla fumana likarabo joang? Ke tlabe ke shebile eng?	Ke tla sheba mahaba a kh'abeche hobona hore e fela a le matala joalo kaha a tsoanela. Ke tla sheba hape hore na lik'habeche tsa ka li feela li phetse hantle li sena mafu.			

Mokhoa o mong oa ho fumana likarabo ke ofe?	Ke tla metha ho hola ha likh'abeche tsa ka ke sebelisa khoele.	
Ke tla sebelisa eng ho bona hore na likarabo tsa ka li nepahetse?	Likh'abeche tse holang hantle haholo, li le tala, lisena bosehla bo bongata, ebile li shebahala li phetse hantle ho feta tseling, e tlaba tsona tse ntle hofeta.	
Ke tla bapisa joang teko e le mokhoa o ke tloaetseng ho o sebelisa tsebetsonh e ea ka ke le sehoai?	Ke tla tseba hore polotong eo ke fumaneng liphetho tse ntle/ tse khotsofatsang, ke lokela ho sebelisa ntho eno mobung oa ka. Mohlala, sebelisa kalaka le phosphorous 'moho, ke tla lokela ke ho li tsela mobung/ lipolotong tsohle tsa ka.	

Le ha ho le joalo, kahara bukana ena ho na le mekhoa e mengata e khothaletsoang ho ntlafatsa mobu oa hau. U ka etsa teko ka mokhoa ofe kapa ofe ho bona hore na lijalo tsa hau li tla atleha na ha u e sebelisa.

U ka etsa hlahlobo ea hobona hore na mobu o u nang le oona ke oa mofuta ofe, ebe u tšela mosuela.

- U ka eketsa monontša o bitsoang nitrogen ka ho tšela moiteli.
- U ka eketsa nitrogen ka ho lema li legumes
- U ka eketsa phosphorous (Ha u e reka e bitsoa superphosphorous).
- U ka eketsa monontša o bitsoana potassium ka ho tšela moiteli oa likhooho.
- U ka eketsa potassium ka ho tšela molora o mocha oa patsi.
- ❖ U ka eketsa kalaka , hore e felise bolila ba mobu.
- U ka eketsa moiteli.
- U ka eketsa mosuela.
- U ka eketsa mokeli-keli oa comfrey kapa oa liphoofolo.
- U ka koahela (Mulch) mobu u sebelisa makhasi a "legumes". Bakeng sa e ngoe le e ngoe ea likhothaletso tse ka holimo, u ka etsa teko ho bona hore na ke efe etla sebetsa ho feta tse ling. Hopola ho ngola liphetho tsa liteko tsohle tseo u li etsang, e le hore u tle u ikhopotse lilemong tse tlang ha ho hlokeha. Ha u bolokile kapa u ngotse liphetho tsa hau, u tla tseba hore u liarolelane le baahisane hammoho le motse kaofela le hore le bona ba tle ba arolelane tsa bona le oena.

2. Ho koahelamobu hore u se lahleheloe ke mongobo



Ho koahela mobu ho bolela ho ala eng kapa eng e tla etsa hore mobu o lule o le mongobo o bile o pholile sebakeng sa lijalo. Hona ho futhumetsa mobu nakong ea mariha.

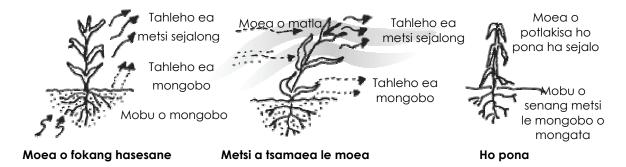
Mobu o koaheloa hobaneng?

Ho koahela mobu hona le melemo e 'meli (2):

Ke ho boloka metsi. Ho thibela mocheso oa letsatsi le moea ho nka mongobo, 'me ka tsela e joalo, lijalo li ke ke tsa noesetsoa khafetsa hobane metsi a sa lahlehe kapele, ho tloha lijalong ka botsona le mobung.

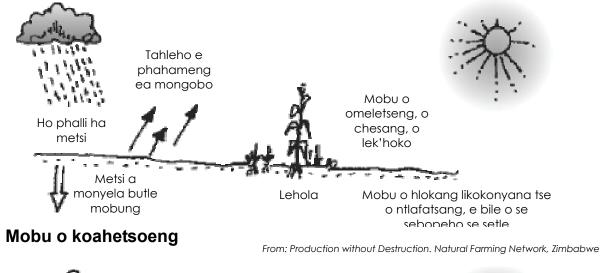
Seo lebatama la letsatsi le moea o fakang ka matla li se etsang mobung o hlobotseng

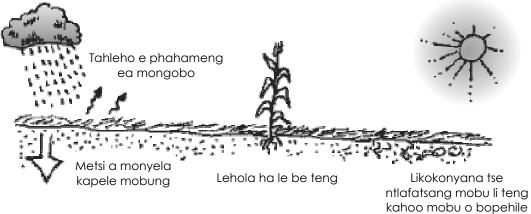
hantle



❖ Ho koahela mobu ho etsa hore mofuthu le mohatsela oa mobu e be o lekaneng. Ho boetse ho thusa hore mobu o seke oa chesa kapa oa phola haholo, ele hore lijalo li tle li hole hantle.

Mobu o lepala-paleng



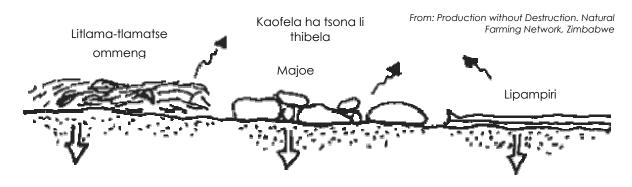


Linthla tse ling mabapi le ho koahela mobu

	Mathatanyana	Tse molemo
*	Ha ho bonolo ho fumana lisebelisoa sebakeng sa ho koahela mobu	 Ho thusa hore mobu o se lahleheloe ke matsoai

- Ka nako engoe, ho koahela leifo la lihoete ho ka etsa hore lihoete tseo li liehe ho hlaha
- Batho ba bang ba bona moo ho koahetsoeng ho le bohlasoa
- Ho koahela mobu ho ka baka likhofu
- Ho fokotsa lehola
- Ho atisa likokonyana tse ntlafatsang mobu
- Ho thibela mobu hoba le Lek'hoko le qetellang le le thatha
- Ho bola hoa lisebelisoa ho eketsa matsoai mobung
- Ho sireletsa mobu khahlanong le marotholi a pula le ho jaleha hoa mafu a fumanehang mobung
- Ho fana ka bolokolohi bakh?lo ea methapo ka mobung. Hona ho etsa hore methapo e fumane litlhoko tsohle ka mobung

U ka sebelisa eng ho koahelamobu?

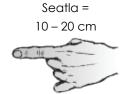


Hangata ho sebelisoa tse latelang:

- Lithlaka, makhasi, makhapetla, joala-joalo. U SEKE oa lisebelisa haeba li bonahala li ena le matšoao a mafu, hobane li tla tšoaetsa lijalo tsa hau, le mafu ao a tla kena mobung
- Lehola le ommeng
- Joang. Etsa bonnete ba hore o sebelisa joang bo ommeng, hobane ha bo le metsi, bo tla monya matsoai a mobung ebe lijalo ha li fumane letho.
- Majoe a sephara. Majoe oona a koahela feela ha a fane ka matsoai. A loketse lijalo tse seng li le kholo le lifate tsa litholoana.
- Likoranta. Li fana ka tšireletso hape li eketsa matsoai mobung . Fafatsa koranta ka metsi pele u koahela mobu ka eona hore e se fefoloe ke moea.
- Sebelisa joang bo ommeng kapa manyolo a seng a putile.
- Makhasi a tlhotlhorehileng lifateng.
- Mohlomo oa khale.
- Polasitiki e ntšo.

Re koahela joang?

- Khaola lisebelisoa tsa hau, haholo joang le litlama-tlama hore libe bolelele ba seatla kapa licentimitara tse leshome ho isa ho tse mashome a mabeli
- Koahela mobu ha sesane moo sethopo se hlongoeng se le seng kappa ha lijalo li sale nyenyane. Koahela ka botebo bo ka etsang bophara ba monoana



- Bakeng sa lijalo tse kholo, koahela haholo. U ka lekanya ka bophara ba menoana e 'meli ho isa ho e mararo (3-4 cm)
- Bakeng sa lifate, koahela haholo ho feta. Lekanya ka seatla kapa ho feta. (10-20 cm)

Monoana = 1.5 cm



Menoana e'meli = 3 – 4 cm

Ha sesebelisoa, mohlala joang, se putile, eketsa se seng hape. U tla makatsoa ke ka moo bo putang kapele ka teng. Ho kanna ha etsahala hore joang kapa se sebelisoa se seng feela se eketsoe bonyane hangoe selemong kapa hangoe khoeling tse ling le tse ling tse tharo. Libakeng tseo ho batang haholo mariha, khothaletso ke hore se sebelisoa se koahetseng mobu se tlosoe hang ha serame se lala. Lebaka ke hobane se sebelisoa seo se tla etsa hore serame se lale le ho feta.



Liteko

Hopola ho etsa teko ea ntho e 'ngoe le e 'ngoe eo u qalang ho e sebelisa.

Lethathamo la teko

- Bothata ke bofe?
- Tharollo e kaba e fe?
- Hobaneng ha ekaba tharollo ea bothata boo?
- Mokhoa oo ke tla o leka joang?
- Ke tla fumana likarabo joang? Ke tlabe ke shebile eng?

- Mokhoa oa ho bekha litholoana tsa mosebetsi oo ke o fe?
- Ke tla bapisa joang teko ee le mokhoa oo ke tloaetseng ho o sebelisa bohoaing ba ka?
- ❖ Bontša moralo oa hau oo u tla o latela tšimong?

Lipotso tsoe u ka ipotsang tsona tekong ea ho koahela mobu

- Na u koahetse lijalo tsohle tsa hau kapa che?
- Na lijalo tse neng li koahetsoe li bile kholo le hona ho atleha ho feta tse neng li sa koaheloa?
- ❖ Na u sebelisitse metsi a fokolang lijalong tse neng li koahetsoe?
- U sebelisitse eng ho koahela mobu? E bile molemo? Kamoso u tla sebelisa eng ho koahela mobu?

3. Mokeli-keli Oa Mononts'a

Tšebeliso ea mokeli-keli ke tsela e bobebe ea ho fa lijalo tsa hau matla. Mokeli-keli o ka etsoa ka manyolo a semela kapa a liphoofolo. Sepheo mona ke ho fa lijalo tsa hau lijo tsa thlaho ka pele nakong eo lintseng li hola. Mokeli-keli ona le bohlokoa haholo ho lijalo tse hlokang lijo tse ngata joalo ka k'habeche.



U tla hloka tse latelang:

- Moo u tlang ho tšela teng- Nkho e kabang lilithara tse hlano hoisa ho tse leshome (5 - 10L).
 - Sekoahelo.
 - Lejoe le leholo.

Mokhoa oa ho etsa mokeli-keli ka semela

Semela se setle bakeng sa ho etsa mokeli-keli ke se bitsoang comfrey. Hape u ka sebelisa mahaba/makhasi a matala, lehola le lehlaka. Qoba ho sebelisa limela tsenang le menkho e bohale. Ka ha limela ka ho fapana li entsoe ka likaroloana tse sa lekaneng tsa matsoai, hape le tsona linka matsoai a sa lekaneng mobung, khothaletso ke hore u sebelise mefuta e sa tšoaneng ea limela, hoetsa mokeli-keli.

- Hlatsoa nkho ea hau pele u e sebelisa.
- ❖ Bokelletsa limela ebe u li tšela ka nkhong. U tšoanela ho lula u ntse u eketsa limela tsena beke le beke.
- ❖ Beha lejoe holima limela ebe u kaohela nkho ea hau. Se ke oa tšela metsi. Limela tsena li tla iketsetsa metsi ka bo tsona.
- Beha nkho ea hau letsatsing ebe u e hloela kamorao ho libeke tse peli ho bona hore na limela ha li eso fetole 'mala li be ntšo. Ha u ka oa sekamisa nkho u tla bona metsi a matšo. Metsi a matšo a no ke oona mokeli-keli o etsoang ke limela, feela o loile haholo o batla ho kopangoa le metsi.
- Kopanya mokeli-keli le metsi ka tsela ena:

Sethopo: Lekolokoti le le leng la mokeli-keli ho a mane a metsi **Lijalo tse kholo:** Lekolokoti le leng la mokeli-keli ho a mabeli a metsi

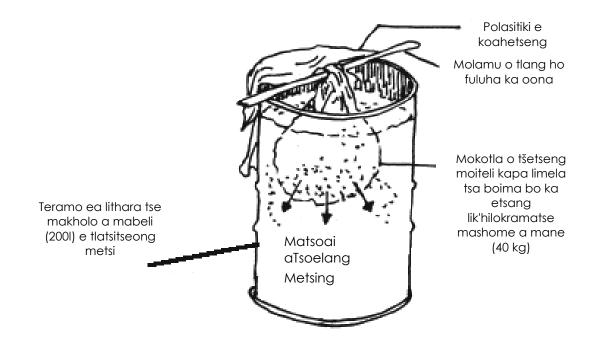
Ha mokeli-keli o loile haholo, o tla chesa lijalo tsa hau. Beke tse ling le tse ling tse peli, tšela lekolokoti le le leng la mokeli-keli sejalong ha u qeta ho se tšella. Sebelisa lekolokoti le lekanang le botlolo e kholo ea jeme.

Mokhoa oa ho etsa mokeli-keli ka moiteli

Moiteli oka sebelisoang ke oa likhomo, likhooho, meutlanyana, linku le lipoli. U khothaletsoa ho sebelisa moiteli o kopantsoeng le e meng.

- Tšela motsoako oa moiteli ka mokotleng ebe u oa fasa.
- U hloka tse latelang:
- Moo u tlang ho tšela teng- nkho e
- kholo kapa teramo
 - Mokotlana/'methe
 - Molamo kapa lerapo
- Ntho eo u tlang ho fasa mokotlana ka eona
- Tšela mokotla oo ka nkhong kapa ka teramong, ebe u faselletsa molamung kapa lerapong. Tlatsa nkho/ teramo ka metsi. Ho k'hilokrama e le ngoe ea moiteli, tšela li lithara tse leshome tsa metsi. Ka tsela e na re qoba ho kopanya metsi le moiteli kaha moiteli o metsi ha o oa lokela lijalo.
- ❖ Koahela nkho/teramo. Lula u ntse u fuluha ka mora matsatsinyana.
- Kamorao ho beke tse peli, mokeli-keli o tla be o lokile hore o ka sebelisoa. O tlameha ho shebahala joalo ka tee e sa loeang. Pele o u sebelisa, u fuluhe haholo.
- Ka ha mokeli-keli o tlabe o loile haholo, u kopanye le metsi tjena:
 Sethopo: Lekolokoti le le leng la mokeli-keli ho a robeli a metsi
 Lijalo tse kholo: Lekolokoti le le leng la mokeli-keli ho a mane a metsi.

Ha mokeli-keli o loile haholo, o tla chesa lijalo tsa hau. Beke tse ling le tseling tse peli tšela mokeli-keli sejalong ha u se u qeta ho se tšella. Sebelisa bonyane lekolokoti le le leng / botlolo e kholo ea jeme bakeng sa ho tšela mokeli-keli sejalong se le seng. Qoba ho tšela mokeli-keli motšeare kapa ha ho chesa haholo.



4. Thlahiso ea sethopo



Setšoantšo sena se bontšamokhoa oa ho koahela leifo la sethopo ka matlakala a rokelletsoeng 'moho. Sethopo se sirelelitsoe khahlanong le lebatama la letsatsi le moea o phallang ka matla.

Sethathong

- Etsa bonnete ba hore u na le peo e ntle e sa bolang
- Etsa bonnete ba hore u na le mokhoa oa ho fumana metsi a hloekileng haufinyane, (metsi a seretse ha a hlokahale ho hang!)
- Etsa bonnete ba hore u na le mobu o nonneng o senang lehlabathe. U khothaletsoa ho bala sehloho "Ntlafatso ea mobu".
- Etsa bonnete ba hore ho na le moriti moo u ka sireletsang



Melaonana ea bohlokoa ka metsi

- U tlameha hoba le metsi haufinyane
- Metsi a lokela hore a be a hloekileng. Metsi a litšila, ana le seretse se sengata a tla sitisa sethopo ho hlaha.

Melaoana ea bohlokoa ka peo

- ❖ Sebelisa peo e ncha. Peo e lokela ho bolokoa selemo ho isa ho tse peli (1-2) feela. Ha u reka peo, sheba pakete eo ea peo hore na e na le nako e kae. Le uena u ka iketsetsa tlhathlobo ea ho bona hore na peo eo u nang le eona e ka hlaha na pele u jala serapa kaofela (Talima qetello ea leqhephe)
- Peo e lokela ho behoa moo ho pholileng, moo e sa chabeloeng ke letsatsi e bile ho se mongobo. Haeba u reka peo, e tsa bonnete ba hore peo eo e lutes moo ho pholileng, ha e ea chabeloa ke letsatsi, hape ha ho mongobo. Ha eba lipakete tsa peo li lutse moo li chabetsoeng ke letsatsi, ho hang u seke oa lireka
- Haeba u ipehetse peo lilemong tse feteling, etsa bonnete ba hore ha ena hlobo, mengoapo, likoti le ho peperana.
- Haeba u rekile peo, kamorao ho pakete, ngola selemo le khoeli tseo u e rekileng ka tsona, u tle u tsebe ho ikhopotsa matsatsing a tlang.
- Netefatsa hore peo eo u ikotuletseng eona serapeng u e jala kamo'a nako e itseng. Ha u ka e jala hang kamor'a kotulo, moroho o tla thunya le ho etsa peo kapele.

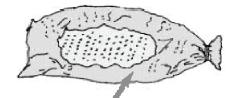
sethopo sa hau.



Liteko

Thlathlobo/teko ea ho bona hore na peo e tla mela. Etsa teko ena haeba u belaella peo ea hau o bona e ka e ke ke ea mela

Pele u jala, uka e tsa teko ea ho bona hore e feela peo eo u nang le eona e tla mela,'me hona ho tla u bontša hore na ke peo e kae e tlang ho mela.

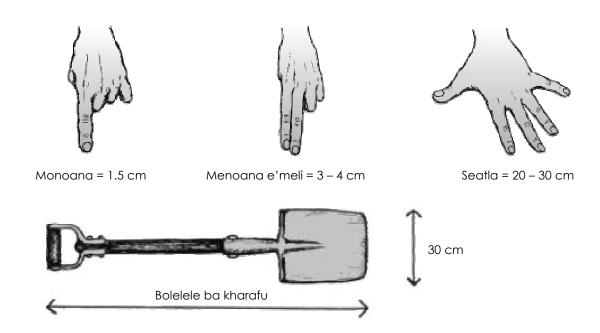


Mocheso ka hara polasitiki o bakiloeng ke lesela le mongobo

- Nka peo tse mashome a mahlano (50), li behe holima pampiri kapa lesela le mongobo. Se ke ua tlohela peo ka metsing kapa ua e omisa haholo.
- Beha pampiri kappa lesela le phuthetseng peo ka hara polasetiki, e butsoele u ntano e koala.
- Hlahloba peo khafetsa ho bona hore na ke tse kae tse metseng. Peo ena e polasetiking e kanna ea nka matsatsi a mararo hoisa ho a leshome (3-10 days) hore e mele.
- Kamora'o ho moo, bala lipeo tse metseng.

Mohlaleng o ka holimo, lipeo tse mashome a mane ho tse mashome a mahlano li eli tsa mela. Hona ho bolela hore ke mashome a robeli lekholong (80%) a peo e metseng.

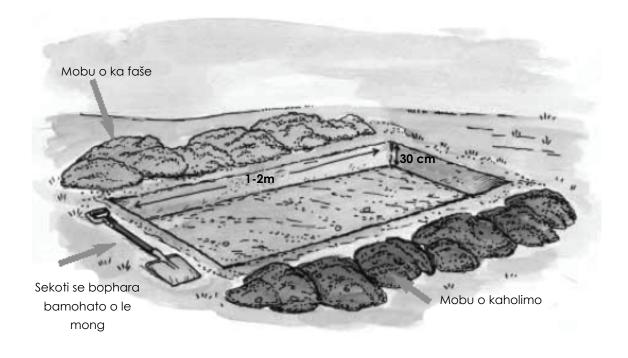
Mokhoa oa ho metha



Tokiso ea leifo

Leifo ke sebaka serapeng se nang le mobu o manoni, ho bile hona le mokhoa oa ho sireletsa sethopo seo letsatsing, le hore sethopo se se ke sa fumana serame.

Cheka sekoti 'me u lekanye ka kharafu, bophara le bolelele ba eona. Sekoti se be bolelele ba mohato kapa mehato e 'meli (1-2m).



Ha u ntse u cheka sekoti, etsa bonnete ba hore u arola mobu o ka holimo (hangata

o tla fumana o le motsonyana tjee) ho o mong. Lema kahare ho sekoti e le ho qhalakanya mobu o se ke oa eba le makoete.



Kopanya mobu o neng o le kaholimo ha u ne u cheka sekoti ka likarolo tse lekanang le manyolo, motsoako oa molora kapa mosuela. Tlasa sehloho sena "Ntlafatso ea mobu", u tla bala ka mekhoa ea ho lokisa manyolo le mosuela.



Ha u qeta ho etsa motsoako ona, u sefe pele u o busetsa. Ha u sena sefe, e tsa bonnete ba hore motsoako ha o na lintho tse kang mahlokoana, makhasi a lifate, majoe, makoete joalojoalo tse ka sitisang sethopo ho hola se atlehile. Qoba ho tsamaea holim'a seratsoana ha u qetile mosebetsi oa hau.



Leifo le lokela hoba bophara ba bolelele ba kharafu. Lebaka ke hore u tle u tsebe ho fihlela bohareng ba leifo u sa le hate. Ho hata ho lima leifo haholo ha mobu o le metsi, ho senya mobu, obe thata ebe o sitisa sethopo hore se hole.

Mokhoa o senang litsenyehelo tse ngata oa ho etsetsa sethopo sa hao moriti ke oa ho sebelisa lipalo, mahlakana kapa mohlomo.



Ho jala

Lipeo tse fapakaneng li lokela ho jaloa ka mekhoa e fapakaneng.

Ho jala o sa etse sethopo/ Ho sunya peo mobung

Mefuta e meng ea lipeo e batla ho jaloa serapeng eo li tlang ho holela teng li sa etsoe sethopo, hobane li ka utloa bohloko ha lintse li hlongoa li hlongolloa.

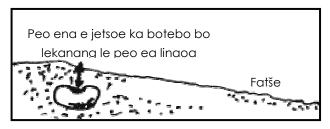


Mefuta e joalo ea lipeo ke ea linaoa,bete, lihoete, cucumbers,garlic, poone, lierekisi, litapole, mokopu, rapa le meroho e meng.

Foro kapa mola otlameha ho ba botebo ba monoana (1.5 – 2 cm)

Lipeo tse sesanyane tse kang tsa lihoete, rapa le meroho e meng lia tebisoa ha li joloa. Etsa foro e kabang botebo ba monoana(1.5cm deep/1 finger width). Tšoara peo pakeng tsa monoana oa bosupa le o motona ebe u e jala ka hlokolosi, u entse bonnete ba hore ha e tebe haholo. Jala peo u ntse u siea sebaka sa botenya ba monoana lipakaeng . Etsa bonnete ba hore e anetse mola hantle kaofela. Koahela peo ka mobu, mosuela kapa manyolo, e be u hatella hantle ka monoana.

Lipeo tse tenya tse kang tsa linaoa, li jaloa ka botebo bo nkang botenya ba tsona. Ha ngoe ho isa bobeling. Ha li ka tsa tebisoa ho feta mona li ke ke tsa mela. Le teng ha li ka phaphamala ka



holimo, e tlare sethopo ha se gala se hlaha e be se a robeha.

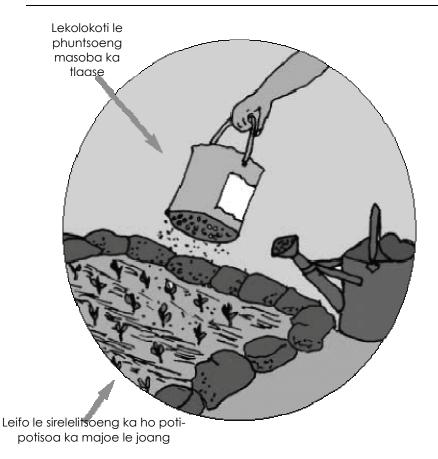
2. Ho etsa sethopo

Lijalo tse ling li hola le ho atleha ha li entsoe sethopo pele li ntano hlomoala li isoe serapeng. Lijalo tse joalo e kaba broccoli, k'habeche, cauliflower, chilisi, eggplant, lipepere, leeks, selae, anyanese, sepinichi le tamati.

Tse ling tsa lijalo tse kaholimo li ka jaloa li le joalo kapa tsa etsoa sethopo, khetho ke ea motho ka mong hore na eena u thabelang. Lijalo tse joalo ke sepinichi, anyanese, garlic le litapole.

3. Tlhokomelo ea sethopo leifong

Lipeo sesanyane joalo ka tsa k'habeche, tamati, anyanese joalo-joalo, ha li jaloe li teteantsoe, hobane sethopo sa teng se tla hlaha se le sesesane, se sa atleha hantle,e bile sena le mafu. Ka tsela ena sethopo se iphumana se tlameha ho tsekisana sebaka sa ho hola hammoho le khanya. Joale, jala peo ha sesane feela e anele leifo lohle. Lipakeng tsa peo, sia sebaka se lekanang le botenya ba monoana. Hang ha u qeta ho kenya peo mobung, ho bohlokoa hore u boloke mobu u le mongobo ka linako tsohle.



Tšella habeli ka letsatsi ha mocheso o le mongata. Nakong ea lehlabula, khothaletso ke hore u tšelle mantsiboea, mariha teng, tšella hoseng ha letsatsi le chabile. Tšella ka hlokolosi.

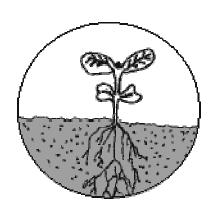
Qoba ho tšela metsi ka sekhahla e sere a hohoba peo kapa a batalatsa mobu 'me oa etsa lek'hoko ka holimo. Ha u sena shitiri e nang le molomo o masoba a masesane, u ka iketsetsa ea hau tjena: nka lekotikoti le kang la pente ebe u le phunya masoba a masesanyane ka fatše u sebelisa sepekere le hamore.

Koahela leifo ka joang. Tlosa joang boo hang ha sethopo se qala ho hlaha, hobane ha usa etse joalo, u sitisa sethopo hore se hole hantle.

- Hlaola leifo khafetsa ka makhethe.
- ❖ Ho arola sethopo ke ho etsa hore se hole hantle se atlehile. Ha se hlaha, tsetolla se sesesane, ebe u jala feela tse atlehileng. E tsa bonnete ba hore lipakeng tsa sethopo u sia sebaka sa botenya ba menoana e 'meli (3-4 cm) e le hore sethopo sa hau se tle se hole hantle se sa petetsana.
- U ka sireletsa bo-kathoko ba leifo la hau ka majoe a sephara. Hona ho thibela mongobo ho lahleha o tsoa mabopong a leifo. Matsatsi a mararo ho isa ho a mahlano pele u hloma sethopo, fokotsa makhetlo ao u tšellang ka ona le ho tlosa sesireletsi sa letsats, e le hore sethopo se tloale mathata a komello le mocheso oa letsatsi

4. Ho hloma sethopo

Nako e nepahetseng ea ho hloma sethopo ke ha sena le makhasi a mabeli hoisa ho a tseletseng(2-6). Le methapo ese e tiile. Makhasi a mabeli a hlahang pele ha a bontše hore u ka tsoela pele



oa hloma sethopo sa hau, joale emela sethopo hore se tietie pele.

Hloma sethopo mantsiboea kapa ha hole maru. Ka tsela ena, sethopo se tla tseba hore se be se tiele pele ho letsatsi le hlahlamang. Haeba ho bata haholo, sethopo se ka hlongoa hoseng ha letsatsi le se le chabile, mobu le oona ose o futhumetse hanyenyane.



Ho tšoara sethopo ka makhasi

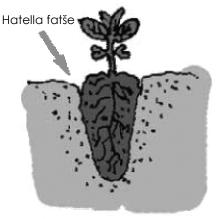
- Lokisa serapa moo u tla jala sethopo teng, u be u se tšelle
- Etsa bonnete ba hore mobu ha ona makoete, e bile ona le manoni a kang manyolo, molora kapa mosuela.
- Hlomolla sethopo ka hlokolosi o sebelisa kharafu e nyenyane ea letsoho (SE KE OA HULA SETHOPO KA MATSHOHO!) Leka hore u hlomolle sethopo se ntse se na le mobu o mongata methapong. Tšoara sethopo ka makhasi eseng kae kapa kae.



ioalo,ha hoa nepahala

Nakong eo u hlomang sethopo, etsa bonnete bahore methapo ea sona ha e ea kobeha. E tšoanela ho otloloha, e se ke ea sobokelloa ka mokoting. Hang ka morao ho moo, tšela mobu ka sekoting e be u paka ka hlokolosi ho pota-pota methapo ea sethopo ele hore ho sebe le moo moea o ka kenang.





Ha ho moea ho pota-pota metso ea sethopo

Tšella sethopo hang ha se qeta ho hlongoa.

Ho qoba hore mongobo o lahlehe ka pele, koahela ka joang.

Sireletsa sethopo letsatsing ka ho sebelisa lekala la sefate kapa k'hateboto Lekala le sirelelitseng (cardboard). Setšireletsi sena se tlosoe Sethopo letsatsing ka mora matsatsi a mane hoisa ho a mahlano, ha ho bonahala hore sethopo se se se tsitsitse. Noesetsa hang ha sethopo se qeta ho hlongoa



Resource Material for Homestead Food Gardeners

Chapter 6: Handouts

(isiZulu)

Handout I	ukutnutnukiswa komniabatni wakno (improving your soii)
Handout 2	Ukwemboza (Mulching)
Handout 3	Umquba wezitshalo wezilwane kanye nongamanzi (Brews for plant nutrition)
Handout 4	Indlela yokuzakhela i - trench bed (Trench beds)
Handout 5	Ukukhiqizwa wezithombo (Seedling production)

Ukuthuthukiswa komhlabathi wakho

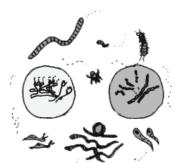


Umhlabathi ophilile

Umhlabathi onempilo umhlabathi ophilile . Unezinto eziningi eziphilayo. Uyashona,uthambile ,kulula ukuwugumba futhi ugcwele umoya kanye namanzi.

Umhlabathi ophilayo uxube izinto eziningi:

- Inxenye encane yesihlabathi, umhlabathi ocosakele nebumba, okuyizinhlobo ezahlukene zomhlabathi.
- Inxenye yezinto ezibolayo, amacebhe, utshani, umquba.
- Okungaboliyo okufana namatshe.
- Amaminerals afana ne(potassium).
- Umoya namanzi.



From: Lessons from Nature

❖ Izibolisi: lezi izilwane ezincane zincane kakhulu ukuthi ungazibona futhi zihlala emhlabathini. Zivundisa umhlabathi ngokuthi zindle okubolayo zikushintshe kube ukudla okunothile kwesitshalo. Izilwanyane ezincane ezinjengo msundu, nezinye izilwane nazozihlala emhlabathini.

Izinhlobo zomuhlabathi

Umhlabathi wakhiwe ngokuvithizeka kwezithako zemvelo kanye nokusansimbi okuvela emhlabeni. Lokhu kutholakala kuyisimo sedwala. Esikhathini eside esandlula amadwala avithizeka aba izinhlayiyane ezincana lokhu kwenziwa izulu, umoya kanye nelanga lihlangene nomoya kanye namanzi. Lokhu kuphenduka kube umhlabathi okwanzi ukusiza izitshalo kanye nezinto ezibolisayo ukuthi zikhule. Njengabantu izitshalo azikwazi ukukhula ngaphandle kwamanzi, umoya kanye nokudla.

Wonke umhlabathi unxube isihlabathi, inzika yodaka kanye nobumba. Umehluko okhona ngenani lesihlabathi, inzika yodaka kanye nobumba yikho okusho indlela umhlabathi obamba ngayo amanzi. Izibonelo zezinhlobo zomhlabathi yilezi isihlabathi, isihlathi esigadenzima, igadenzima, ubumba olugadenzima kanye nobumba.

- Isihlabathi senza umhlabathi ube uthambe.
- Inzika yodaka iyihlabathi esicolisakele. Ibamba amanzi kanye nokudla kwesitshalo kangcono kunesihlabathi esihhayekile, kodwa lugezeka kalula emhlabathi.
- Ubumba inxenye yomhlabathi ebambelelayo ngakho-ke ibamba amanzi iwahlanganise ndawonye. Ibamba amanzi njengesipontshi.
- Umhlabathi omuhle ilowo obizwa ngokuthi igadenzima ngoba uxube izinto ngokulingana isihlabathi, inzika yodaka kanye nobumba.

Izimo zenhlabathi:

	Umhlabathi oyisihlabathi				
	Izinto ezinhle ngalomhlabathi	Izinto ezimbi ngalomhlabathi			
* * *	Kulula ukuwugubha nokusebenza ngawo Uyashesha ukushisa entwasahlobo ngemuva kobusika Muhle ezitshalweni ezimila ngaphansi komhlaba Amanzi nomoya kungena kalula emhlabathini oyisihlabathi	* * *	Uyashesha ukoma Akuyigcini imvundiso yomhlabathi Akuwabambi amanzi kahle		
	Ugadenzima inxube yes	ihlaba	ithi kanye nobumba		
	Izinto ezinhle ngalomhlabathi	lzinto ezibi ngalomhlabathi			
* *	Ubamba amanzi kahle Muhle ekukhuliseni izimpande Unezinto ezibolisayo	*	Lomhlabathi uyaqina uma womile		
	UB	JMBA			
	Tse ntle ka mobu ona		Tse seng ntle haholo ka mobu ona		
*	Ubamba amanzi kahle amanzi isikhathi eside Ubamba imvundiso kahle	* *	Kunzima ukusebenza ngawo; uyasinda Uthatha isikhathi ukuthi ushise entwasahlobo Uyabambelela uma umanzi Uqinile uma womile		

Ungabona kanjani ukuthi unjani umhlabathi wakho

Ungabona kanjani ukuthi singakanani isihlabathi, inzika yodaka kanye nobumba emhlabathini emhlabathini wakho lokhu ungakwenza ngokuwuzwa umhlabathi wakho. Manzisa umhlabathi bese uwenze ibhola phakathi kwezandla zakho. Phendula lelibhola libe njengevoso. Ungakwazi ukubona ukuthi nhloboni yomhlabathi ngokubuka itebula elingenzansi .

Kubalulekile ukwazi ukuthi uwuhlobo lini umhlabathi wakho. Lokhu kungakusiza ukuthi wazi ukuthi kumele wenzenjani uma ufuna ukuthambisa noma ufuna ukucubuza inhlabathi yakho. Ukucubuza inhlabathi noma ukuthambisa inhlabathi yakho kuyasiza ekutheni inhlabathi ikwazi ukubamba amanzi kanye nomoya omningi, okuyilokho izitshalo ezikudingayo ukuze zikhule. Ukwenza inhlabathi yakho icubuzeke kumele uqubeke ufake umquba omningi, ikhomposi kanye nesembozo. Ungalokothi uhambe lapho usutshale khona okukakhulu kazi uma kumanzi.

Isihlabathi sidinga ukuthi ufake izinto ezibolayo ezengeziwe ukuze sizokwazi ukubamba amanzi kanye nokudla kwesitshalo. Ubumba ludinga ukufakwa izinto ezibolayo ezengeziwe ukuzelikwazi ukubamba umoya ngokwengeziwe bese likhulula ukudla kwesitshalo okukulo. Lonke uhlobo lwenhlabathi ludinga okubolisayo ukuze lithuthukise ukuvunda,noma ukudla kwesitshalo.

Ubukeka kanjani umhlabathi	Izwakala kanjani inhlabathi	Uma uyiphendula ivoso		Umhlabathi unje:
Uyisihlabathi kakhulu	Ihhayekile kakhulu	Ayiphenduki ivoso		Uyisihlabathi kakhulu
Uyisihlabathi nje	Ihhayekile	lyaphenduka ivoso kodwa kodwa		Isihlbathi
Inxenye iyisihlabathi inxenye ilolongekile	Ihhayekile	Ivoso liyagobeka kancane		Isihlabathi esiyigadenzima
llolongekile okukakhulu kazi	Isihlabathi esincane ukulolongeka nje kodwa ayinamatheli	Ivoso Ikiyagobeka indlela engangohhafu ojikelezayo		lgadenzima noma inzika eligade nzima
llolongekile okukakhulu kazi	Isihlabathi esincane ukulolongeka nje kodwa iyanamathela	Ivoso lisakwazi ukujika indlela engaphezu kukahhafu		Ubumba olugadenzima noma isihlabathi esiyibumba

Ilolongekile

llolongekile futhi iyanamathela Ivoso liyagoba lifane nelingi



Ubumba

Ukuvunda komhlabathi

Zonke izinto eziphilayo zinezithako zemvelo ezivela emhlabeni lzitshalo zinezinto ezifana ne hydrogen, carbon, nitrogen, phosphorus, potassium nokunye okunciyane okwe magnesium, sulphur kanye ne calcium kanye nezinye izithako zemvelo ezincinyane.

Izitshalo zidinga lezinhlobo ezintathu zokudla:

- ❖ I-Nitrogen (N) Yamacembe kanye nesiqu esiphilile iphinde isize nasekukhuliseni;
- ❖ Phosphorus (P) Yezimpande eziphile kanye nokwakheka kwezithelo;
- ❖ Potassium (K) Yempilo kanye nezimbali eziphilile kanye nezithelo.

Izinhlavu ezinkulu zamagama ezikubakake (N, P, kanye no K) zimbizwa ngokuthi izinkombisa zobuthi. Uma uthenga izivundiso noma obunye ubuthi, kusetshenzisa izinhlamvu esikhundleni samagama aphelele.

Zonke lezinhlobo ezintathu zokudla zitholakala ekhomposini kanye nasemqubeni. Ungakwandisa lokukudla emhlabathi ngokuthi wemboze ngamacembe emidumba (njengo bhontshisi, uphizi, uphizi wamajuba kanye nomgambi (isihlahla esinamacembe anameva) comfrey, usebenzisa umanyolo ongamanzi, umsundu kanye nezinto ezibolisayo. Kumele usebenzise umsundu ube izinto ezibolisayo ngokushesha. Lezi izindlela ezahlukene zokuvundisa umhlabathi wakho.

Ezinye zezindlela zokuthuthukisa umhlabathi wakho

Umquba

Zonke izinhlobo zomquba wezilwane ungasetshenziswa. Lokhu kufaka izinkomo, iziklambu, izimbuzi, izigulube, kanye nezinkukhu.

Ukusebenzisa umquba

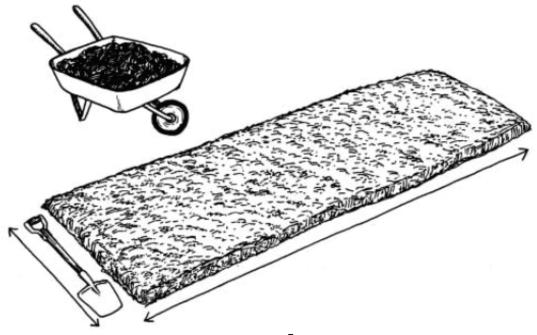
Umquba omuhle ongawusebenzisa ilowo oxutshe notshani kanye nomcamo otholakala esibayeni.



Shanela lokhu ukubeke iqumbi okungenani kanye ngesonto, bese ukwemboza ngotshani noma ngopulasitiki.

Umquba ungafakwa ngezindlela ezahlukene:

Ungawusebenzisa uma utshala izithombo, ngokuthi unxube izandla ezimbili kuya kwezintathu zomquba emgodini lapho utshala khona izithombo.



- Ungambelwa emhlabathini ukuze uthuthukise ukuvunda komhlabathi. Lapha udinga ukusebenzisa ibhala eligcele (okungango 50 kilogram) embhedeni olingana nemitha eliphindwe kahlanu.
- Ungasetshenziswa embhedeni oshisayo. Lapho umbhede umbiwa ushone kangango 30 cm, lokhu kulingana nobubanzi besipeto. Bese kumbozwe ngomquba omusha into elingana no 10cm ukushna ngaphansi. Lokhu kulingana nobubanzi besandla sakho. Utshani, ukhulakanye nokubolayo kungafakwa ngaphambi kokuba uvale umgodi ngenhlabathi yaphezulu kuphela. Omunye umquba noma ikhomposi kungahlanganiswa nomhlabathi ngaphambi kokuthi utshale.
- Lokhu kubizwa ngokuthi imibhede eshisayo ngoba umquba uyashisa ngenkathi ubola emhlabathi. Lokhu kushisisa umhlabathi embhedeni wakho. Lokhu kuyangcomeka ezindaweni ezinobusika obubandayo.
- Umquba ungafufuzelwa phezu komhlabathi kanjenge sembozo. Lokhu kunobuhle bokuthi bandisa ukudla kwezintshalo. Umquba ungafakwa enqumbini yekhomposi lokhu kwenza ikhomposi enhle kakhulu.

Ikhomposi

Ikhomposi inxubevane yezitshalo ezimanzi nezomile kanye nomquba obolile lokhu



Izinto ezinhle ngekhomposi

- Ikhomposi iyisidlo sesitshalo esesilungile, ayidingi ukuvithizwa izinto ezibolisayo kuqala.
 - Ikhomposi ayidali ukhula oluningi, kanjengomquba wezilwane.
 - Ungathola ukudla okuhle ngaphandle kokusebenzisa imali eningi uthena izikhuthazi.



Izinto ezimbi ngekhomposi

- Ikhomposi inomsebenzi omningi wokuyilungisa nokuyisebenzisa.
 - Ubungakho bekhomoposi buncike ekutheni yakhiwe kanjani nokuthi yini esetshenzisiwe. Uma ingakhiwanga kahle, ngeke ibe ukudla okuhle kwesitshalo.
 - Kungaba nzima ukuthola izinto ezibolayo ozidingayo ukuze wakhe ikhomposi.

kwenza ukudla okunothilekwesitshalo.

khomposi iyasiza ukuthi umhlabathi ukwazi ukubamba amanzi uphinde ugcine izitshalo zingenazo izifo.

Ini oyidingayo ukuze wakhe inqumbi yekhomposi?

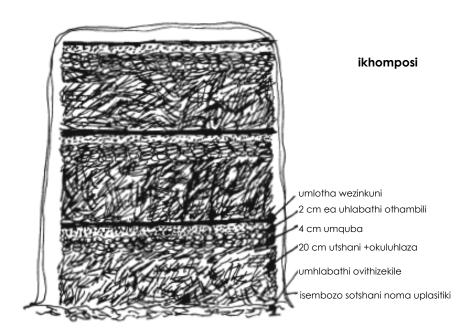
Kumele uqoqe lezintoezilandelayo:

Izinhlanga zommbila noma kwezinye izivuno. Lokhu kubizwa ngokuthi insalela yesivuno.

- Utshani (obungenayo imbewu)-bungaba hlaza noma obomile.
- Amacembe ekhabishi kanye nokhula (aluhlaza noma omile) angenayo imbewu.
- Umquba wezilwane.
- Umltha wezinkuni.

Ezinye izinto ongazifaka equmbini yekhomposi yilezi: umquba wezinkukhu, amanzi okuwasha, izibi ezitholakala ebaleni, izilwane ezifile, amathambo, uboya, izimpondo kanye nempaphe kubalulelike ukuvaka ucomfrey enqumbini yekhomposi.

IZINTO OKUMELE UNGAZIFAKI: Uplasitiki, igilazi, insimbi, ukhuni, amabhulethi amadalanoma enye into engaboli (lokhu kusho into engavithiki emhlabathini).



Ungayakha kuphi inqumbi yekhomposi yakho

- Endaweni esethunzini kodwa hhayi eduze kwesiqu sesihlahla.
- Ivikeleke emoyeni omkhulu.
- Emhlathini ogondile.
- Eduze nengadi yakho naseduze kwamanzi.
- * Kude nezilwane (okukakhulu kazi izingulube, izimbuzi kanye nezinkukhu).

Ungayakha kanjani inqumbi yekhombosi

Isinyathelo sokuqala 1:

Khetha indawo yakho bese uphendula umhlabathi ngeflolongo noma ngekhuba. Indawo kumele ibe ngango 1 mitha uyiphinde ngo 2 mitha (ubude besipeto esisodwa nobubanzi obungangezipeto ezimbili ubude)



Isinyathelo 2:

Qoba izinsalela zamacembe esivuno, utshani, kanye nokhula ukwenze kube kuncane. Lokhu kufaka I comfrey, ikhabishi, amacembe, ukhula kanye neziqu zommbila. Kumele kuqotshwe kube kuncane kube ngango 10cm ubude. Lokhu kukulingana nobubanzi besandla sakho sivaliwe. Lokhu kungenza ikhomposi isheshe ilunge.



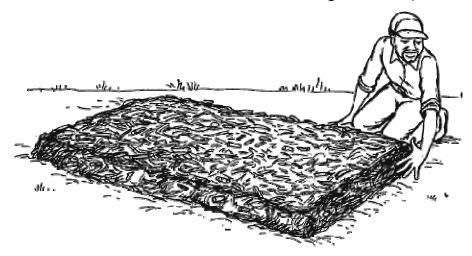
Isinyathelo 3:

Ndlala amahlanvu kanye nezinkunyane phezu komhlabathi owuphendulile.



Isinyathelo 4:

Yemboza lokhu ngenxube oyiqobile, kulingane no 30cm ukushona. Lokhu kuyisandla esisodwa ukushona. Uma unokudala kwasekhishini, kungavakwa lapha.



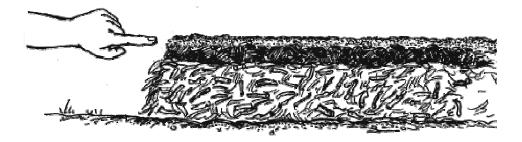
Isinyathelo 5:

Thela umquba phezulu okungango 4cm ukushona. Lokhu kunobubanzi obungangeminwe embili.



Isinyathelo 6:

Thela umhlabathi phezulu komquba okulingana no 2cm ukushona –ububanzi bomunwe.



Isinyathela 7:

Fafa umlotha wezinkuni ngaphezu komhlabathi. Ungafaka ne lime, bonemeal noma tshe lephosphate, lokhu ku ngafafazwa phezulu.



Isinyathelo 8:

Faka amanzi kule nqumbi aze amanzi avele ngaphansi kwenqumbi.

Isinyathelo 9:

Qubeka wakhe inqumbi yakho, ulokhu uphinda ufaka ezinye izinto ngaphezulu, kuze kulingane nesifuba sakho.



Isinyathelo 10:

Kunconyiwe ukuthi uyemboze inqumbi yakho, ungayemboza ngopulasitiki noma amaqungwa noma utshani. Lokhu kusiza ekutheni kugcineke amanzi nokushisa bese kukwazi nokubola. Kuyasiza ekutheni izinkoma zingayihliphizi inqumbi yakho ziyibulale.



Kuhle ukuthi uyiphendule inqaba yakho ngemuva kwamaviki amabili. Uma inqumbi yakho yomile, kumele ufake amanzi. Uma wenza lokhu ikhomposi yakho ingalunga ngemuva kwamaviki angu 6 ehlobo ebusika emavikini angu 8-9 ezindaweni ezineqha, kudingeka uyemboze inqumbi yakho – kungenjalo ngeke kwenzeke lutho.

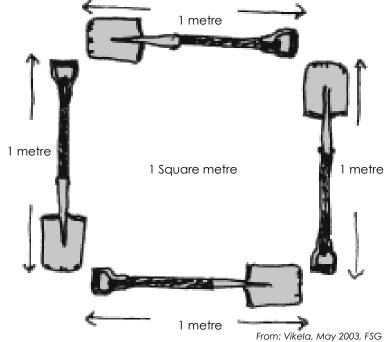


Inini lapho ikhomposi ilunga khona?

Uma kusekhona intushana ephuma emqubeni lokhu kusho ukuthi inqumbi iyabola. Ikhomposi uma isimnyamana lokhu kusho ukuthi isilungile ibukeka ifana nomhlabathi onomswakama. Ngeke libe khona iphunga (uma inephunga futhi ishisa, chabobo akusiyo ikhomposi leyo).

Ukuphathwa kwekhomposi

- Isitshalo isithombo ngo 2-3 izandla ezigcwele zekhomposi.
- Mbela ikhomposi emhlabathini: phendula umhlabathi uthambise ukushona okungangesipeto esisodwa. Fafaza izipeto ezingu 4zekhomposi endaweni engango 1 square metre. Mbana kancane bese uyatshala.



 Sebenzisa ikhomposi njengesembozo ngokuyifafaza yonke indawo emibhedeni.

2. Ukwemboza



Ukwemboza ukundlala into phezu komhlabathi ongaphezulu. Lokhu kwemboza umhlabathi kuwugcine unomswakama futhi upholile ehlobo. Kugcina umhlabathi ufudumele ebusika.

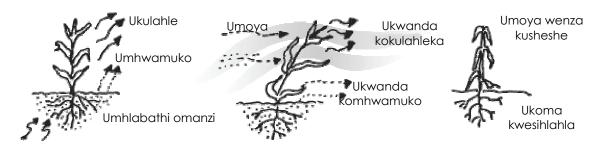
Kungani kumele semboze?

Ukwemboza kunezinto ezimbili okusizisa ngazo:

Konga amanzi ,ngoba kuvikela ekutheni ilanga nomoya kungomisi umhlabathi. Lokhu kusho ukuthi uzodinga amanzi amancane ezitshalweni, ngoba amanzi akho awalahleki ngenxa yokushisa kwelanga noma ngenxa yokuphephetha komoya.

From: Production without Destruction. Natural Farming Network, Zimbabwe

Ukushisa kwelanga kanye nomoya

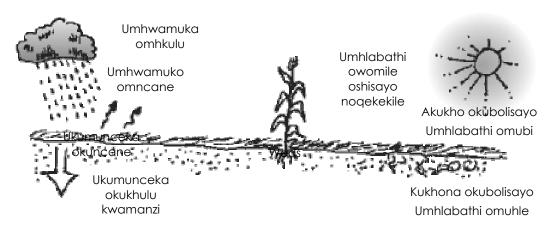


Umoya ongenzima

llanga kanye nomoya kuthatha amanzi

- Kungcina umhlabathi ulingana .Ukwemboza kwehlisa ukushisa okukhulu kanye
- okuphola okukhulu . Lokhu kwenza kube lula ukuthi izitshalo zikhule.

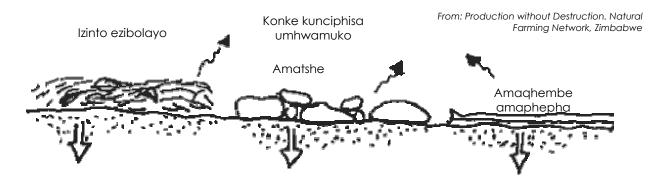
Umhlabathi omboziwe



From: Production without Destruction. Natural Farming Network, Zimbabwe

	Ububi bokwemboza		Ubuhle bokwemboza
*	Kunzima kwesinye isikhathi ukuthi uthole izinto ezanele zokwemboza	*	Kuvikela ekulahlekeni kwama minerals / nama nutrients umsoco emhlabathini
*	wezithombo kungathikameza ukukhula kwezithombo zamakhalothi . Zingaba ntekenteke Abanye abantu bacabanga ukuthi ukwemboza akubukeki Ukwemboza kungabanga iminenke kanye	* *	Kwenza kubekhona ukubola emhlabathini Kunciphisa ukuba khona kokhula Kuvikela ekuqekekeni komhlabathi okwakha uqheqhe oluqinile ngaphezulu
		*	Izimpande eziqinile zimila phezulu eduze kwalapho kuqala khona umhlabathi. Lokhu kweza kube lula ukuthi isitshalo sithole ukudla kwaso eduze kanye nomoya
		*	Ukubola kwesembozo kungasiza ekuvundiseni umhlabathi
		*	Kuvikela imvula eza ngamandla kanye nokusaphazeka komhlabathi ezitshalweni – lokhu kungafafaza izifo

Ini esingayisebenzisa njengesembozo



Ngokujwayelekile sisebenzisa:

- Izinto ezisala emasimini (iziqu kanye namacembe okusala umasesivunile. Ungalingi usebenzise izintshalela zesivuno ebesinesifo. Uzothelela umhlabathi wakho kanye nezitshalo zakho entsha.
- ❖ Ukhula oluzuphuniwe lwase lwabekwa ukuze lome.
- Utshani basemasimini. Qinisekisa ukuthi usebenzisa utshani obomile. Utshani OBULUHLAZA buthatha konke ukudla emhlabathini wakho bese izitshalo zakho ziba nokudla okuncane.
- Amatshe alucwephe. Wona ayemboza kodwa awengezi ukudla emhlabathini. Mahle uma ezungeze izitshalo ezinkulu kanye nezihlahla zezithelo.
- Amaphepha (newspaper) lokhu kwemboza kancane bese kufaka umsoco omncane / ukudla kwesitshalo emhlabathini. Manzisa amanews paper uma uwafaka emhlabathini, ukuze angaphephulwa umoya.
- Umauba, sebenzisa OWOMILE noma OMDALA ukwenza lokhu.
- Amacembe abuthwe ngaphansi kwezihlahla.
- Utshani obudala bokufulela.
- Upulasitiki omnyama.

Semboza kanjani

- Kunconyiwe ukuthi uziqamule izinto owemboza ngazo(ukhula kanye notshani) kulingane nesandla sakho (10-20 centimetres)
- Sebenzisa ucwephe oluncane lwesembozo ezithombeni kanye nasezitshalweni ezincane –kulingane nomunwe owodwa ukubanzi kokushona (1.5cm)
- Ezitshalweni ezithe ukuba zinkulu sebenzisa isembozo esithe ukuba sikhulu –okulingana 2-3 ububanzi bomunwe (3-4)
- Ezihlahleni , isembozo esikhulu impela ,isandla esiphelele noma ngaphezulu (10-20) kungafakwa



10 - 20 cm



1.5 cm



Uma isembozo sesivithikile , kufanele ufake esinye ; kuzokumangaza ukuthi lokhu kwenzeka masinyane kanjani .Ngokujwayelekile isembozo sifakwa kanye ngemuva kwezinyanga ezintathu .Ezindaweni lapho kunesithwathwa esiningi,kuwumqondo omuhle ukuthi ucindizele phansi isembozo uma isithwathwa sinamandla uma umhlabathi usuqala ukuba neqhwa.isembozo esingaqinile sinomthelela omubi eqhweni.



Ucwaningo

Khumbula ukusebenzisa ipulani yakho yocwaningo njalo uma uzama into entsha.

Ipulani yokwenza ucwaningo endaweni encane

- Ini inkinga?
- Isiphi isixazululo kulenkinga?
- Kungani lomphumela uzoyixazulula lenkinga?
- Ngizohlola kanjani isixazululo ngokulandelana?
- Ngizowubheka kanjani umphumela? Yini engizoyibheka?
- Ngingawubheka kanjani futhi umphumela? Yini okumele ngiyikale?
- ❖ Ngingayikala kanjani imphumela noma isiphetho?
- Ngingawuqathanisa kanjani umphumela wami nendlela eyejwayelekile engilima ngayo?
- Yenza umdwebo wocwaningo lakho ensimini yakho.

Nansi eminye imibuzo ongazibuza yona uma wenza ucwaningo ufaka isembozo

- Ingabe usebenzise isembozo kuzo zonke izitshalo zakho,noma kwezinye nje?
- ❖ Ingabe izitshalo ozimbozile bezinkulu futhi zingcono kunalezo ongazimbozanga?
- Ingabe usebenzise amanzi amancane ezitshalweni ozimbozile?

Ingabe yini oyisebenzisile ukwemboza? Ini ebe yinhle? Ini ozoyisebenzisa ukwemboza ngesikhathi esizayo?

3. Umquba wezitshalo wezilwane kanye nongamanzi

Umquba ongamanzi indlela elula yokusiza izitshalo zakho. Ungenziwa ngezitshalo noma ngomquba wezilwane. Inhloso yalokhu ukunikeza izitshalo ukudla kwemvelo ngenkathi zisakhula. Kusiza kakhulu kulezo zitshalo ezidla kakhulu njengekhabishi ukuthi unikeze izithombo uxhaso ngenkathi zisakhulu

Ungawukhanda kanjani umquba wamanzi

Isitshalo esihle ekukhandeni umquba wamanzi u comfrey. Okukakhulu kazi ungasebenzisa amacembe aluhlaza kanye neziqu zakhona kanye nokhula konke kulungile. Ngwema izitshalo ezinephunga elinamandla. Izitshalo zakhiwe ngezinto eziningi zemvelo ezitholakala emhlabathini futhi zithatha lezinto emhlabathini. Kakhoke kubalulekile ukuthi ukuthi usebenzise izinhlobonhlobo zezinto.

- Qinisekisa ukuthi isitsha sakho sihlanzekile ngaphambi kokuthi usisebenzise.
- Qoqa izitshalo uzifake esitsheni sakho usigcwalise. Bese uqubeke ulokhu ufaka njalo ngeviki.
- ❖ Beka itshe ngaphezu kwezitshalo bese uvala ngesivalo. Ungawafaki amanzi. Izitshalo zizozenzela amanzi azo.
- Beka ngaselangeni bese ubheka ngemuva kwamaviki amabili ukuthi amacembe awakabi mnyama yini. Uma ugunqula isitsha sakho kumele kuphume okusamanzana amnyama. Lokhu kungamanzi ashubile angumquba.
- Lamanzi ashube kakhulu kumele ahlanjululwe kanje :lzithombo : 1 ithini lomquba wamanzi emathinini angu 4 amanzi lzitshalo ezinkulu : 1 ithini lomquba wmanzi emathinini angu 3 amanzi. Uma unxube kwashuba kakhulu kungawashisa amacembe akho.

Njalo ngemuva kwamasonto amabili thela lomquba uzungeleze izitshalo zakho, ngemuva kokuthelela.

Kumele uthele okungenani ithini elilodwa lalomquba osuhlanjululiwe ngamanzi esithombeni ngasinye noma isitshalo. Ithini kumele kube ilelo elilingana nalelo likajamu.

Ungawakha kanjani umquba wamanzi ngomquba wezinkomo

Umquba ongasetsheziswa owezinkukhu, onogwaja ,inkomo ,imbuzi kanye namagusha.Umquba oxutshiwe uyancomeka.

- Faka umquba wakho omusha oxutshiwe bese uwufake esakeni bese ubopha phezulu.
- Faka isaka esitsheni bese ulibophela endukwini noma emchilweni. Bese ugcwalisa isitsha ngamanzi . Udinga ukuvaka amalitha angu 10 amanzi ku 1kg womquba .Lokhu kusho ukuthi isaka lamawolintshi eligcwele umquba lingena ebhakedeni elikhulu ,noma uhhafu wesaka ebhakedeni elijwayelekile
 - lasekhaya. Lokhu kuyindlela yokugcina umquba namanzi kuhlukene, akumele ufake umquba omanzi ezitshalweni zakho.
- Vala isitsha sakho ngesivalo.
- Ngemuva kwamaviki amabili umquba uzobe usulungile ukuthi ungasetshenziswa. Kumele kubukeka njengetiye elilula. Ngaphambi kokuba usebenzise lomquba kumelele uwugoqoze kahle.
- ❖ Lomquba unzima kumele uhlanjululwe ngamanzi.

Izithombo: 1 ithini lomquba wamanzi emathinini angu 8 amanzi (ibhakede noma amabhodlela)

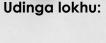
Izithombo: 1 ithini lomquba wamanzi emathinini angu 4 amanzi Uma uxube kwabanzima kungashisa izithombo zakho

Njalo ngemuva kwamaviki amabili faka umquba wamanzi ezitshalweni zakho,

ngemuva kokuchelela.

Futhi, sebenzisa ithini likajamu eligcwele kuleso naleso sitshalo noma isithombo. Qikelela ukuthi awufaki umquba wamanzi phakathi nemini noma elangeni elishisayo.

idilamu elinamalitha angu 200 ligcwaliswe ngamanzi



- Udinga isitsha esngu:
 101itre noma ngaphezulu
- Isaka lelo ungalithola: kungaba elamawolintshi ,elokudla noma isaka lengubo
- Induku eqinile noma indophi
- Into ozobopha ngayo isaka
- Isivalo sokuvala isaka.



From: Production without Destruction

4. Indlela yokuzakhela i - trench bed

Isingeniso

I trench bed yindlela yokwandisa imvundo kanye nomswakama engadini yakho. Lena yindlela ekahle yokulungisa umhlabathi wakho uma ungumlimi osezingeni elincane. Lendlela ibandakanya ukumba umgodi, ukwugcwalisa ngemfucuza ebolayo ukuze ikwazi ukuvunda isikhathi eside (isikhathi esingacishe sibe yiminyaka emihlanu).

Indlela yokuyenza

- Yimba umgodi ube ngu 60cm nangaphezulu ukuya phansi. Ububanzi bujwayele ukuthi bube yimitha ukuze kubelula ukuwusebenza (lokhu kuchaza ukuthi kungenzeki ukuthi umuntu anyathele uma esebenza khona) kanti ubude bungaya ngokuthi owakhayo unamandla angakanani.
- Uma umba thela inhlabathi emnyama ngakolunye uhlangothi, kuthi ebomvu iye kolunye. Kumele ihlukaniswe.

Ngakwesokudla, u Mandla (e Phuthadjithaba) umba umgodi wakhe. Uthela inhlabathi emnyama yangaphezulu nganxanye (lena emnyama iyona enemvundo), kanti lena enye ebomvu yangaphezulu uyithele yayinqumbi kolunye uhlangothi (lena ebomvu ayinayo imvundo noma inemvundo encane).

Uma inhlabathi ingavundile, akufanele ifakwe emgodini. Kufanele isakazwe ngaphandle kunoma iyiphi indawo, nasemiseleni eletha amanzi kuwona lombhede.





Phansi emgodini kufanele wendlale amathini noma amagatsha. Lokhu kuzosiza ukuthi kukwazeke ukubambeka umoya obaluleke kakhulu emsocweni odingwa yizitshalo

Amathini kufanele ukuthi apaqazwe ngaphambi kokuthi afakwe emgodini. Umkhakha wamathini kufanele ujule ngamathini amathathu ukuya phansi. Uma engekho amathini, sebenzisa amagatsha azacile. Gwema amathini ane "aluminium" ngoba iwushevu. Lamathini, ngamathini kabhiya kanye naweziqedakoma (cold drinks)

❖ Gcwalisa inhlabathi yakho ngezinhlobonhlobo zemfucuza kanye

nenhlabathi yangaphezulu.

- Qala ngotshano obomile noma ukhula (kujule ngamacentimetre angu 10)
- Landelisa ngomanyolo (kujule ngamacentimetre amabili)
- Kulandele umlotha wezinkuni (Umkhakha omncane ongaba ngu 1cm).
- Bese kuza umkhakha wenhlabathi yangaphezulu (ijule ngamacentimetre angu 5)



Xuba lemikhakha ngemfologo Uma usuyixubile, yigxishe ngezinyawo ishone phansi

- NISELA lomxube wakho kakhulu!!
- Bese phinda futhi.

Ngaphezulu; I- trench bed yase Phutadjithaba iyagcwaliswa, kuyaxutshwa bese kugandaywa. Qaphela ingxube kamanyolo, utshani kanye nenhlabathi.



Ngakwesokudla; I- trench bed yase Potshini iyagcwaliswa. Lapha inhlabathi yangaphezulu ibuyiselwa phakathi emgodini. Qaphela ukuthi inhlabathi yangaphansi eliphuzi ibekwe engxenye. Ayizukusetshenziswa kulomgodi.

Ungakusebenzisa okokuvundisa okufana nokhula olomile nolusemanzi, kanye namakhasi amaveji avela ekhishini, amakhathoni, amaphepha kanye namathambo.

- Uma usukwenzile lokho qala phansi futhi ngokuthela imfucuza, kuze umanyolo, umlotha kugcine inhlabathi, uxube bese uyanisela. Kwenze lokhu uze igcwale umgodi.
- Manje I trench bed yakho kumele iphakame ngo 10-15cm ngaphezu komhlaba. Phezulu sebenzisa ingxube ekahle yenhlabathi yangaphezulu nomanyolo kanye ne khomposi uma ikhona.

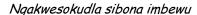


Ngakwesokudla kukhonjiswa I-trench bed esanda kwakhiwa.

Imfucuza efakwe kwi trench bed kumele ilindwe izinyanga ezimbili kuya kwezintathu ize ibole ngaphambi kokuthi kutshalwe.

Omunye umbono futhi ukusebenzisa I-trench bed yakho njengombhede wokutshala izithombo. Uma uqonde ukwenza lokhu, izithombo zakho

ungazitshala ngaso leso sikhathi uma I-trench yakho usuyiqedile. Ukukhulisa izithombo ngokutshala imbewu ngqo enhlabathini kudinga inhlabathi evundiswe yalungiswa ngokupheleleyo. Izimpande zezithombo ezincane azijuli kakhulu. Imfucuza efakwe kwe-trench ingabe iqhubeka nokubola kwayo ngesikhathi izithombo zakho zikhula ngaphezulu.





kakherothi kanye no-anyanisi itshalwa embhedeni wezithombo e Potshini. Lapha sithola ukuthi I-trench bed yayisanda kwakhiwa.

Qaohela; Inhlabathi ecolisakele ivuvuzelwa ngaphezu kwezithombo. Lokhu kwenziwela ukuthi imbewu ingazabalazi ukuhluma ngoba nayo incane kakhulu. Uma inhlabathi ivuvuzelwe ngalendlela, izohluma kangcono.

Kulesisithombe sithola ukuthi ama-trench bed amaningana akhiwe engadini yase Potshini. Umnikazi wawo usebenzisa amabili njengemibhede yokukhulisa izithombo (seed beds) Embozwe ngotshani ukuze umswakama ungahwamuki kalula ngesikhathi imbewu ihluma. Lobutshani buzisuswa ngesikhathi lapho izithombo sezivela..

Umbhede ophakathi nendawo umise okwesicathulo sehhashi. Lendlela lombhede owakhiwe ngayo yenza kubelula ukuthi umuntu afinyelele kuzo zonke izinhlangothi zombhede. Ivumela amanzi ukuthi ageleze aye maphakathi nendawo. Lapha sibona ukuthi umnikazi wendawo itshale izithombo zespinashi. Zlezizithombo zikhule kahle, noma bekukhona ukwesaba bokuthi ukukhula kwaso kuzophazamiseka ngesikhathi imfucuza isabola ngaphansi kwenhlabathi.

Kulesisithombe sibona imbewu ka carrot itshalwa kwi trench encane, laphayana ekhoneni. Kukhona futhi nezinye izithombo ezibonakalayo.

Ngaphambili kukhona I-trench bed esanda kwakhiwa, lapho kutshalwe khona izithombo zekhabishi. Kanjalo nalapha ikhabishi likhule kahle, aliphazanyiswanga ukubola wemfucuzanqaphansi kwi trench.





Kubakulekile ukuthi kuchelisiswe ngamanzi ngesikhathi I trench isakhiwa nakamuva. Imfucuza ngaphansi angeke ibole uma yomile.

Ziningi izindlela zokunisela, inqobo nje uma amanzi efakiwe.

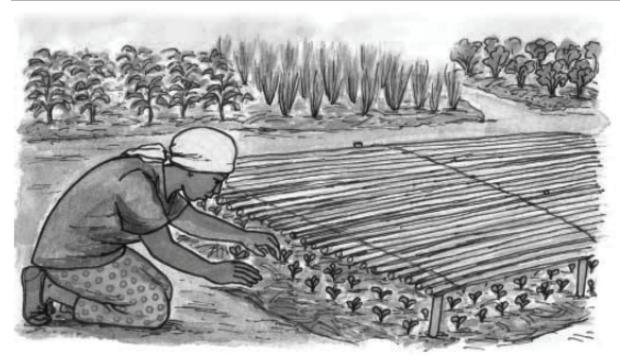
Esithombeni, uhlelo lokunisela olubizwa ngokuthi yi-drip irrigation izosetshenziswa ekuniseleni letrench bed.



Kamuva uma sekuzophela isikhathi sesivuno (isithombe ngezansi) sibona ikhabishi elitshalwe kwi trench bed liniselwa ngohlelo lokunisela olubizwa ngokuthi yi drip irrigation kanti libonakala likhula kahle kakhulu. Sibona nezinye izitshalo ezitshalwe kwi trench bed lapho kuniselwa khona ngamabhakede; njengespinash (swiss chard) kanye ne Beetroot. Esithombeni, kuzosetshenziswa uhlelo lwe Drip irrigation lapha ukunisela I-trench bed.



5. Ukukhiqizwa wezithombo



Ngenhla kunesibonele sombhede ombozwe ngomhlanga oboshwe aqiniswa ndawonye uvikela emoyeni naselangeni ezithombeni.

Ukuqala

- Kumele ugaphele ukuthi ,unembewu enhle nephilile
- ❖ Qaphela ukuthi unamanzi eduze (amanzi anodaka oluningi awamahle)
- Qaphela ukuthi umhlabathi wakho uvundile,uthambile (bona ukuthi ungawunothisa kanjani umuhlabathi wakho ekhasini elikulencwadi).
- Qaphela ukuthi likhona ithunzi.



Imithetho ebalulekile ngembewu

- Imbewu kumele ihlale iphilile:gcina imbewu unyaka owodwa kuyakwemibili kuphela. Bheka idate emaphaketheni ngaphambi kokuthi uthenge.Ungenza ukuhlolwa kokumila kwembewu ngaphambi kokuba uyitshale yonke(bheka ngenzansi)
- Imbewu kumele ibesendaweni epholile, enobumunyama neyomile.Uma uthenga esitolo esincane,bheka ubone ukuthi imbewu ibekwe endaweni eyomile nepholile uma amaphakethe embewu eselangeni –ungawathengi
- Uma uzibekela wena imbewu,qiniseka ukuthi utshala imbewu engenaso isakhuntela,ukuklwebheka noma izimbobo
- Uma uthenge imbewu,bhala inyanga nonyaka othenga ngayo,ukuze ukwazi ukubheka amadate.



Imithetho ebalulekile ngamanzi

- Amanzi kumele abe seduze
- Amanzi kumele ahlanzeke amanzi anodaka oluningi futhi angcolile angenza kubenzima ukuthi zimile izithombo.



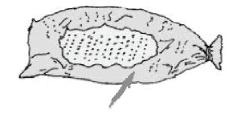
Ucwaningo

UKUHLOLWA KOKUMILA KWEMBEWU- kungenzeka

ufune ukuzama lokhu uqinisekile ngokuthi imbewu yakho isoqophelweni oluphezulu futhi iphila kahle

Ngaphambi kokuba utshale imbewu

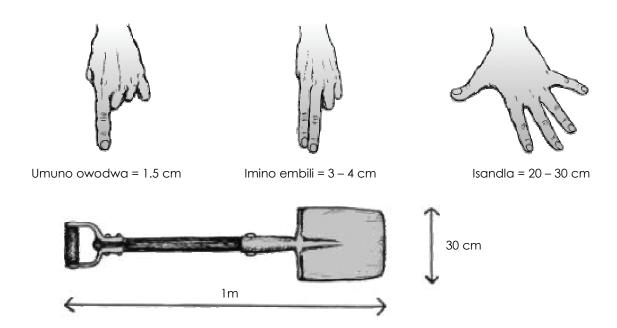
ungayihlola ukuthi izomila yini.Ungahlola ukuthi zingaki izimbewu zakho ezingamila.



- Thatha imbewu engu-50 uyibeke phezu kwephepha elimswakama,indwangu noma ithoiyilethi paper.
- Beke iphepha noma indwangu okunembewu phakathi esikwameni sikapulasitiki bese uphephethe ngomoya esikhwameni sikapulasitiki,ngaphambi kokuthi uvale.
- Bheka imbewu njalo ukuze ukuthi zingaki ezinilayo.Loku kungathatha izinsuku 3-10.
- * Bese ubala izimbewu ezimilile.

Lapha isibonelo 40 kwezingu50 izimbewu zimilile. Lapha izinga lokumila libalelwa ku 80% (80/100). Lokhu kusho ukuthi ezingu 80 kuphela phezu kwezingu 100 izimbewu ozozitshala zizomila.

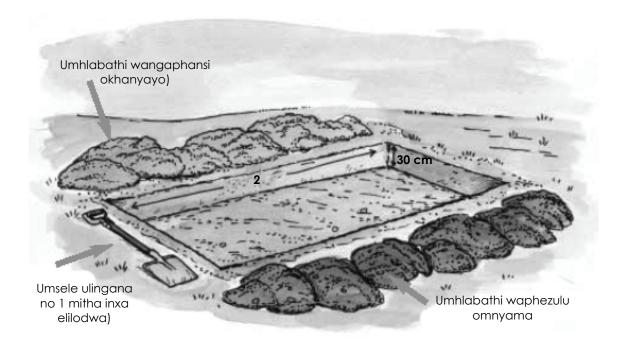
Ukukala



Ukulungisa umbhede wezithombo

Umbhede wezimbewu inxenye encane kakhulu yengadi enomhlabathi onothile futhi enesembozo lapho kumila khona imbewu.lsembozo sivikeka isithwathwa.

Imba umsele ongango 30cm (okulingana nokudla kwesipeto) ukushona nobude (obulingana nobude besipeto) . Umsele kumele ulingane no 1kuya 2 wamamitha (okungangamagxa elilodwa kuyakwamabili).



Hlukanisa umhlabathi onothile ngaphezulu (imvamisa umnyama) komunye umhlabathi. Thambisa umhlabathi ongaphansi ngefolongo noma ngesipeto.



Hlanganisa umhlabathi wangaphezulu kanye nenxenye elinganayo nomquba kanye nomlotha oxutshiwe noma ikhomposi (bheka futhi ukuthi ungawuthuthukisa kanjani umhlabathi ekhasini elikulencwadi ,thola kabanzi ukuthi ungawulungisa kanjani umquba kanye nekhomposi).



Sefa lokhu ngenkathi ukuphindisela emgodini . Uma ungakwazi ukukusefa sekuxutshiwe ,qiniseka ukuthi ayikho into engathikameza ukukhula kwezithobo ,izinto

ezifana nezinduku ,amacembe ,amatshe amangade noma umhlathi oqinile .Kubalulekile ukunganyatheli embhedeni wakho uma usuwulungisile.



Ubude bombhede wezithombo kumele ubengangemitha (1metre) (noma ulingane nobude besipeto). Lokhu kwenza kube lula ukuthi ukwazi ukufinyelela phakathi nendawo nombhede emecaleni womabili, ngaphandle kokuthi uhambe noma unyathele embhedeni wa kho. Ukunyathela umhlabathi okukakhulu uma ummanzi, kungona ukuthamba, ukucoleka, futhi kuwenze uqine. Lokhu kuqina kungenza kubenzima ukuthi imbewu ikwazi ukumila.



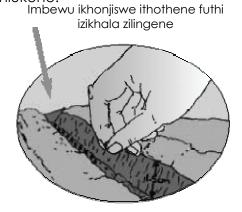
Ungazenzela wena ithunzi lembewu elishibile ungalenza ngezingodo/umhlanga /iqalo kanye notshani.

Ukutshalwa kwembewu

Imbewu ehlukene kumele itshalwe ngezindlela ezahlukene.

1. Indlela yokutshala

Ezinye zezitshalo kumele zitshalwe lapho zizomile khona , izitshalo ezincane azithandi ukuthuthukiswa njalo .Lokhu kwaziwa ngokuthi



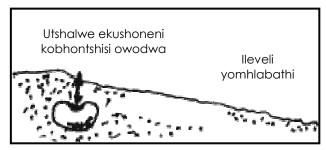
ukutshala ngo (direct sowing).

Ukutshala emseleni kulingana no 1.5 - 2cm ukushona

Lokhu kufaka ubhontshisi, ubhithiludi, amakhalothi ,ukhukhumba, ugaliga, ummbila, uphizi,amazambane, amathanga, ilelishi kanye nothenephu. Imisele kanye nemigodi kumele ibe manzi ngaphambi kokuba utshale.

Imbewu encane njengamakhalothi,ilelishi kanye nothenephu akushoniswa kakhulu .Khanda umsele ongango 1.5cm (ububanzi obungangomunwe). Tshala kahle imbewu yakho ngokucophelela ngomunwe kanye nesithupha emseleni. Kumele ucophelele ukuthi imbewu ayiminyene. Imbewu kumele iqhelelane ubude obulingana nomunwe owodwa emseleni. Faka imbewu indawo elinganayo. Mboza imbewu yakho ngekhomposi encane ,ngomquba noma ngomhlabathi. Cindezela ngomunwe wakho.

Imbewu enkulu imbewu efana nobhontshis i, zitshalwa ngokushona okungango 1-2 kunembewu. Uma zitshalwe zashona kakhulu, ngeke zimile. Uma zishone kancane izitshalo ziyawa.



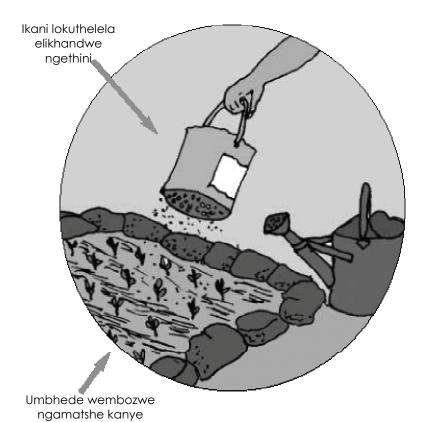
2. Ukutshala embhedeni kuqala

Ezinye izitshalo zimila kahle uma ziqalwe zatshalwa embhedeni wezithombo kuqala bese uma seziqinile izithombo bese uzikhipha uzitshale. Lokhu kufaka ubroccoli, ikhabishi, u cauliflower, upelepele, i eggplant, u green pepper, i leeks, u lethisi, u orka,uanyanisi, isipinashi kanye notamatisi.

Ezinye zezitshalo ungazitshala embhedeni wembewu noma uzitshale nqo lapho zizomila khona kukuwe ukuthi okukusebenzela kahle. I lezi izitshalo ongazitshala isipinashi, uanyanisi, ugaliga kanye namazambane.

3. Ukunakekelwa kwembewu embhedeni wezitshalo

Ezimbewini ezincane njenge khabishi, u kale u tamatisi, uthenephu kanye no anyanisi, ungatshali imbewu ihlangane ndawonye ngoba iyahlangana bese iminyane. Izithombo zizontengantenga ziphinde zihlaselwe izifo. Zifuna ukubangisana ngendawo kanye nelanga. Tshala kancane bese ulinganisa. Tshala izitshalo ububanzi obungangomunwe phakathi kwezitshalo.



Uma izitshalo sezitshaliwe, kubalulekile ukuzigcina zinomswakama sonke isikhathi. Kungadingeka ukuthi ugcelele kabili ngosuku uma libalele. Kungcono ukugcelela ntambama ehlobo, ebusika ugcelele phakathi kwasekuseni.

Gcelela ngokucophelela, ngesipuleyi esigcelela kancane. Ngoba-ke ungashe umukise izitshalo zakho ngamanzi, noma ugandaye umhlabathi wakho.

Ungazenzela ikani lasekhaya lokuthelela. Bhoboza izimbobo ezincane ngaphansi ekanini lakho ngesando.

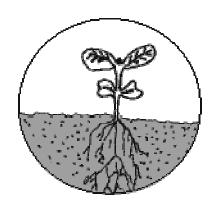
Yemboza umbhede wakho wembewu. Lapha ungemboza maphakathi nolayini lapho utshale khona imbewu. Noma wemboze umbhede wonke bese ususa isembozo uma imbewu isiqalisa ukumila. Uma ungasisusi isembozo singenza kube nzimza ukuthi imbewu yakho ikhule. Kubalulekile ukuthi wemboze ngamatshe ayizipaca emacopheni ombhede wakho. Lokhu kuqinisekisa ukuthi amanzi ahlala embhedeni wakho awahamuki emaceleni.

- Kubalulekile ukuhlakula noma ukugcuphuna ukhula embhedeni wakho.
- ❖ Kumele ukhiphe ezinye zezitshalo ukuze zizoshiya indawo yezinye ukuze zikhule kahle. Uma izitshalo zivela uyabona ukuthi iziphi ezizinzile nalezo ezibuthakathaka. Khipha lezo ezibuthakathaka. Qinisekisa ukuthi izitshalo ezinzile zinendawo eyanele ukuthi zikhule ,okungango 3-4 cm (noma ububanzi beminwe emibilie).

4. Ukutshalwa kwezithombo

notshani

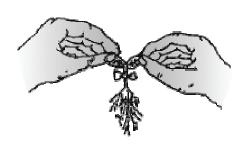
Ngaphambi kokuthi uzikhiphe izithombo zakho kubalulekile ukuthi uziqinise. Lokhu kuzokwenza ukuthi abemancane amathuba okuthuka kwazo uma sowuzitshala. Ukuziqinisa kusho ukwenza isimo esesitshalo sibenzima kancane. Ithunzi uyalisusa uphinde unciphise amanzi othelela



Isithombo esinamacembe amabili

ngawo. Lokhu kwenziwa isikhathi esingangezinsuku ezintathu kuya kwezine ngaphambi kokuba uzitshale.

Isikhathi sokutshala izithombo ilapho sezinamacembe angempela amabili kuya kwamathathu, uma izipande sezikhule ngokwanele nesiqu esizinzile. Amacembe okuqala amabili aphuma emhlabathini akusiwo awangempela – ngakhoke uyalinda isitshalo sikhule.



Bamba isithombo ngamacembe

Tshala izithombo mantambama noma uma kunesimo esiguqubele sezulu. Lokhu kunikeza izithombo isikhathi sokuthi zilulame ngaphambi kokuthi kufike ukushisa. Uma kubanda kakhulu, zitshale maphakathi nasekuseni, lapho umhlabathi usufudumele kancane.

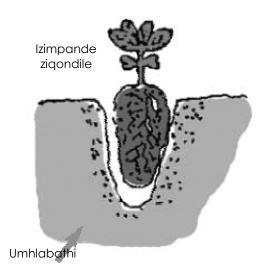
- Lungisa bese uchelela imigodi lapho uzotshala khona
- Qiniseka ukuthi umhlabathi wakho uthambile futhi unezinto ezivundisayo, njenge khomposi kanye nomquba noma umlotha.
- Phakamisa isitshalo ngokucophelela, usebenzisa ithuluzi (UNGALINGI UZIKHIPHE NGEZANDLA) wenze ngokusemandleni ukuthi ushiya umhlabathi omningi ozungeze izimpande. Bamba izithombo ngamacembe azo hhayi ngesiqu.

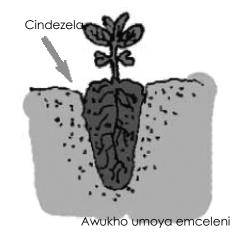


Ukukhipha izithombo ngaphandle kwethuluzi akukuhle



Uma utshala, kumele izimpande zimeziqonde zingampitsheki emgodini. Umgodi kumele ugcwaliswe ngomhlabathi, okumele uqinise ngokuzungeleza isitshalo. Cindezela umhlabathi phansi ujikelezele isitshalo, ukuze kungabikho umoya ongena zimpandeni.





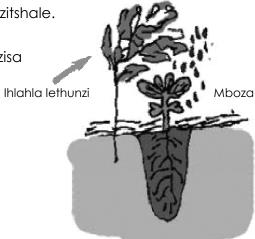
Chelela ngemuva kokutshala

❖ Chelela izithombo ngemuva nje kokuba uzitshale.

Zemboze emibhedeni yazo.

lapho isitshalo sesizinzile.

Nikezela ithunzi ezithombeni, ngokusebenzisa amahlahla noma amakhalibhodwe. Lokhu kungasuswa ngemuva Ihla kwezinsuku ezine kuya kwezinhlanu,



Agricultural Water Use for Homestead Gardening Systems

Resource Material for Facilitators and Food Gardeners

Chapter 7
Income Opportunities from
Homestead 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 (π 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)

Chapter 7 Table of Contents:

Income opportunities from homestead food gardening

	Chapters: Resource Material	iii
	Table of Contents: Income opportunities from homestead food gardening	y v
	List of Tables	vi
	List of Activities	vi
	List of Case Studies & Research	vi
	Aims	
	What am I going to learn?	
	Icons	ix
7.1	Moving on from food to income from home food production	. 1
	Incentives for homestead gardening (ISO Farming)	1
	The 'first brick': Food security and resilience through diversification	
	Second-phase: Income opportunities from home food production	2
	Key questions on income opportunities from homestead farming	2
7.2	Starting to sell and avoiding pitfalls	. 3
	Mobilising action: motivating people to start	3
	Three basic principles to get started	
	Ongoing commitment to income activities: Incentives and disincentives.	
	Three basic principles for marketing	7
7.3	Potential financial benefits from homestead agriculture	13
7.4	Marketing ideas and appropriateness	17
	Appropriateness for cash-scarce households	.17
	How to identify how risky a venture is?	
	Income generation ideas for home food gardeners	
7.5	References	
		30

List of Tables

Table 1: Summary of incomes produced through vegetable production, 2009
Table 2: Cata Water for Food households: value of production, 20051
Table 3: Cata Water for Food households: five year extrapolation of production value
Table 4: Mma Tshepo Khumbane, Cullinan: Food grown in Winter 2002(De Lange, M. 2003)1
Table 5: List of income generation ideas1

List of Activities

List of Case Studies & Research

Case study 1:	Start by selling locally	.6
Case study 2:	Continuity in selling locally	ع.
•	Think ideas, not problems	
Case siday 5.	THIRK IDEAS, HOLDIODIETTS	ı

Aims

This chapter aims to introduce you to some of the basic concepts of market gardening. We will look at incentives and disincentives for marketing and appropriate strategies of marketing for various situations. We will consider local marketing, pricing and niche marketing in different areas. We will look at some of the principles of marketing by using case studies and examples. These include the principles of supply and demand, the principle of continuity and the principle of innovation.

We will then look at the potential financial benefits from homestead agriculture, again using examples and case studies and finally we will introduce a range of potential marketing ideas that could be considered.

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 <u>do</u> after completing this unit?	Done √ Can't do ×
Starting to sell surplus vegetables	Start with where we are and what we have Know your product and price Have some ideas how to diversify your production to be able to sell more	
Incentives and disincentives to marketing	 Gauge supply and demand of a crop to be sold Grow crops for which there is a local demand Grow and sell new crops for which a local demand is likely and experiment with selling these. 	
The Seven Cs of marketing	Use the principles to think through marketing ideas	
Potential financial benefits from homestead agriculture	Compare the incomes generated by homestead farmers using different marketing techniques and ideas Know what financial gain you can expect from homestead agriculture	
Ideas for value adding, processing and marketing	Assess different income generation ideas for homestead food gardeners	

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.

7.1 Moving on from food to income from home food production

Incentives for homestead gardening (ISO Farming)

The 'first brick': Food security and resilience through diversification

In Chapter 1 – "Rural realities", we looked at recorded impacts of homestead food production, and concluded that:



The impact of home food gardening is of greatest value to households in the lower income categories and generally is of less direct interest to households in higher income categories.

For households in low-income categories, affordable and high-yielding home food production brings significant benefits. It enables them to:

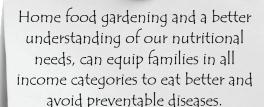
- Diversify their diets and enjoy better health, in spite of their shortage of money;
- Save money on food that they otherwise would have had to buy; and
- ❖ Earn some cash income from selling vegetables and fruit, in some cases. Typically, households could earn about R50-150 per month extra (in 2006), which was an increase in family income of 10-30% for households that were dependent on a single old-age pension.

We also considered "Mobilisation for homestead farming" in the Introduction to this manual. We looked a bit deeper into the incentives and disincentives for homestead farming. To recap, we looked at:

- Food and income as the two 'pull factors' for production with food being the primary driver for food insecure households;
- The different incentives for different households, from basic survival to income generation, and a range of ways in which households' specific objectives differed. Farmer typologies were described as a way to categorise people with similar objectives; and
- We also looked at various theories of motivation, like human needs, the ten 'human capabilities' and the Life Model, to help us understand better:
 - How to mobilise households into production; and
 - How to help them stay in production.

In Chapter 3 – "Living and eating well", we developed a good feel for the health benefits of more diversified diets, and saw how homestead production made it easy and affordable for households to have a continuous flow of good food throughout the year.

We also saw that the economic benefits of overcoming the high levels of malnutrition in South Africa, extends well beyond the individual to the national



economy, through ensuring a better intellectual capacity of a wider cross-section of the population and thus better building blocks for a thriving economy. The savings on the national health system could also be substantial.

Second phase: Income opportunities from home food production

In the Introduction to this manual, we saw that the income earned from home production of vegetables, could push up the family income of low income households by 10-30%, sometimes already in the first season of production.

As people's gardens expand and their diversity of production increases, the income potential also grows significantly. The following aspects can enhance the overall income and the stability of income streams from homestead farming:

- Expansion and further intensification of production, for instance, by planting a specific bed three or more times per year;
- More fruit production, through planting a variety of fruit trees with different harvesting dates;
- Diversification of production by including a variety of livestock, poultry and fish, and using waste from each component of the homestead farming system to feed into other components (for instance, chicken manure to fertilise vegetable beds and feed fish, and vegetable scraps to feed chickens); and
- Processing, preserving and value adding of food, so that it keeps longer and can be used and/or sold throughout the year.

This Chapter looks in more detail at income opportunities from homestead farming.

Key questions on income opportunities from homestead farming

- 1. What gets people into selling products from their homestead farming activities, and conversely, what keeps them from starting to sell?
- 2. How can one compensate for the inherent scarcity of cash?
- 3. What motivates people to keep on selling, and what are the typical events, processes and disincentives that result in abandonment of income activities? Can these be avoided or counteracted?
- 4. What is the role of the local interest/learning groups in income generation opportunities? What are the pitfalls?
- 5. Is it achievable to save and even earn significant money from homestead farming in South Africa? And are there opportunities for value-adding which are achievable for resource-poor households?
- 6. Can one easily recognise and avoid seemingly attractive possibilities, but which carry too much risk for already food insecure households?

7.2 Starting to sell and avoiding pitfalls

Mobilising action: motivating people to start

Many people have never sold anything to other people, and are shy or uncertain how to go about it. Like riding a bicycle, once you have taken the plunge, it becomes much easier the second time! From then on, one can try new things and get better and better at it.

A Limpopo development worker told the story of the woman who asked him: "But how can I sell my vegetables?" He responded: "Take this wheelbarrow of yours, fill it with those vegetables, and go and stand over there next to the road. Then wait for someone to come and buy." This sounds incredibly simple, but to that woman, it was all the advice (and encouragement) she needed. It worked. He didn't tell her anything she didn't know already, but it got her across the hurdle of uncertainty and resistance, and she was able to do much more later on.

The facilitator should also realise that some individuals will never grow to like selling, while others love it.

Three basic principles to get started

Principle 1: Start with where we are and what we have

We have some land, some water, some expertise in growing vegetables and food, knowledge of what we like to eat and when, knowledge of how much we are prepared to pay for food, and knowledge of how we like to be sold food. This is all we need as a start to get going with marketing.



Sizakele Mduba sells mustard spinach to a neighbour and friend in Potshini, KZN, April 2007. Photo: E Kruger.

Principle 2: Know your product; know your price (supply and demand)

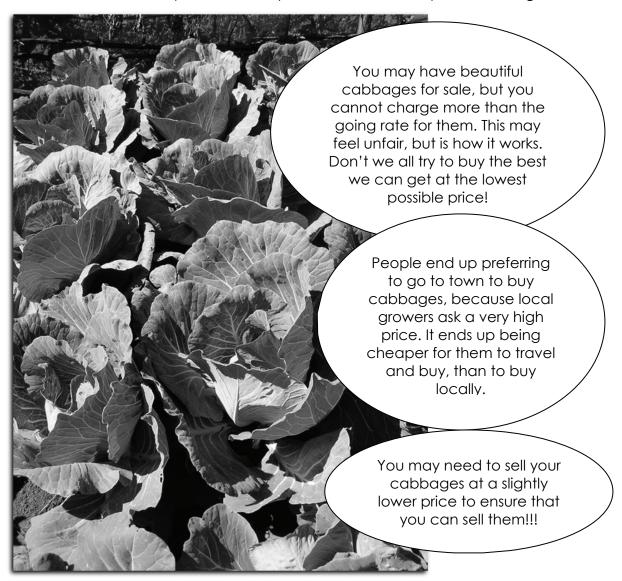
We can always start by growing the crops that we know people will always want and need. In the case of vegetables these are likely to be cabbage, tomatoes and onions.

But we should try not to grow and sell EXACTLY the SAME things as everyone else is growing and selling, because there may be oversupply and we may battle to sell ours.

If, for example, you can sell cabbages in your village and the cabbages in town are scarce and expensive, you can ask a much higher price than when there is a plentiful supply of cheap cabbages in town.

This is the concept of SUPPLY and DEMAND. If there is too much supply, the demand is low and prices are low. If the demand is high and the supply is low, prices are high.

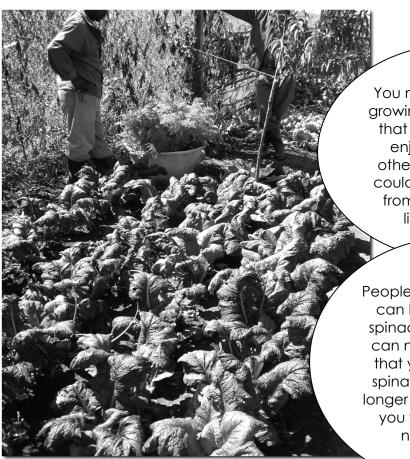
The prices of vegetables change all the time and you need to keep yourself informed of the current prices, so that you know how much you can charge.



Principle 3: Diversify (Niche marketing)

If people know that you sell something that others in the area do not, they will come to you for that product.

It can be many different things. Here it is important rather to make up your own ideas. If you copy the ideas of others nearby, it will no longer be a niche... If you sell something different that people want, this is a niche or speciality.



You may for example be growing a type of spinach that people in the area enjoy, but not many others are growing. You could have got the seed from a family member living elsewhere.

People will learn that they can buy this "special" spinach from you. If you can now work in a way that you can have this spinach available for a longer period of the year, you will have a good niche product.

Following these three basic principles will provide a good start to marketing your produce. Many homestead gardeners found that they make a good income by just starting something. This is already a good incentive to continue.



Case study 1: Start by selling locally

Bongiwe Hlongwane is a young single mother living in Potshini and responsible for managing the home. Her father also lives there and has some cattle. He grows maize and beans, but has no further income. She receives two child grants. They need to augment their incomes and livelihoods. Through their involvement in the gardening learning groups in Potshini, they started a homestead vegetable garden and now have a large underground water storage tank.

Initially Bongiwe grew a beautiful garden for household supply of extra food (2006-2007). However, their situation became more desperate with the impact of the world fuel and food crises beginning to show in dramatically higher food prices from town and increased taxi fares. Bongiwe went to Gauteng to look for work. She, however found nothing and came back home, to garden with serious intent.

In her first season of growing after her return she sold spinach and cabbage: and earned R150.00 from spinach and R350.00 from selling cabbage. She quickly found that it was better for her to take the taxi to town and sell her produce there. People were more willing in town to pay the price she was after.

As Bongiwe's income from grants is around R230/month, the amount she earns from selling her vegetables is very significant for her. She can make twice as much in a month selling vegetables than she earns from her grants.

Bongiwe learnt that there is a higher demand for vegetables now, both locally and in town, and that she can sell her vegetables in both places. Issues for her are: -Transportation as people in the taxis complain when she takes her vegetables; and -Availability of enough water to expand her garden from its present size of 5 m x 20 m.



Bongiwe's garden in January 2009, when she was selling spinach and cabbages. It was well tended and almost fully planted.



Bongiwe's garden in April 2009. It was quite overgrown and clearly not well kept.

Bongiwe still needs to cultivate the ability to **keep up her efforts**, **so that she can keep the continuity of income from her vegetable garden going**. At the moment she is still going through cycles of having and selling, and then not having anything – this can be de-motivating.

Ongoing commitment to income activities: Incentives and disincentives

Three basic principles for marketing

Principle 1: Continuity

Once a gardener is able to sell vegetables the next step is to start planning to ensure that they have vegetables to **sell at all times**. They have to make sure that they plant more regularly and plant different varieties for different seasons. Basically, gardening becomes more of a focus for them and they spend more time on it. They may also need to expand their garden, to make sure they have **enough to sell and enough variety to sell**.



Case study 2: Continuity in selling locally

Mr Zondo

Mr Vimba Zondo from Potshini has been selling vegetables for a few years now. He has a reasonably sized garden of 20 m x 20 m and grows and sells a range of crops throughout the year. He sells to the local community only. He made R920 between January-March 2009 selling tomatoes, carrots, chillies, beetroot and cabbages. Other income in the family consists of his pension of R1 010/month.

He feels that he has no challenges selling his vegetables, as there is a high local demand. Areas of improvement for him are farm management and bookkeeping.

Mrs Gumbi

Mrs Gumbi from Phuthaditjaba has a garden of 6 plots in her yard and another 3 plots at the crèche across the road = $1,864 \text{ m}^2$.

She grows a variety of crops:

- Potato, green beans, carrot, cabbage, tomato, onion and pumpkin in summer;
 and
- Carrot, beetroot, cabbage, mustard spinach, turnip, spinach, peas, onions and rape (mustard green) in winter.

She sells mostly to neighbours who come and buy when they need, especially on Fridays for funerals on Saturdays.

She also says: "We sell our surplus to Pick 'n Pay. Pick 'n Pay doesn't pay as much [R5/kg]*, but they will buy our beetroot as long as the beetroot aren't too big (they like them small). Pick 'n Pay has also bought our spinach [R5/kg]. They also bought 1000kg of potatoes from us. We only sold to Pick 'n Pay once [Feb 2009] when the Department of Agriculture transported our crop for us. If we want to sell to Pick 'n Pay again, we take a sample to them and then they place an order. We then would have to deliver to them in town".

*NOTE: Pick 'n Pay pays R5/kg for beetroot, which is approx R0.20 per beetroot, versus R1.40 per beetroot made selling to neighbours. This is a difference of R1.20 per beetroot (or a R30/kg difference).

Mrs Gumbi and the local facilitator for her village stand in her vegetable plots at the crèche. Photo: J. Wright April 2009.



Mrs Gumbi also sells to the local Department of Agriculture Extension Officer who takes bundles to fill orders from staff at the main office once a month when she's not too busy.

Further, Mrs Gumbi sells to hawkers who sell at the clinic. They take about R145 worth of spinach every month.

Selling vegetables is a main source of income for Mrs Gumbi and her husband. They save R200/month in a bank account. She also receives a pension (~R1,000/month).



Mrs Gumbi in her extensive home garden. Photo: J Wright, April 2009.

Issues are:

- Not enough water;
- Inadequate fencing;
- Shortage of garden tools; and
- Too little land.

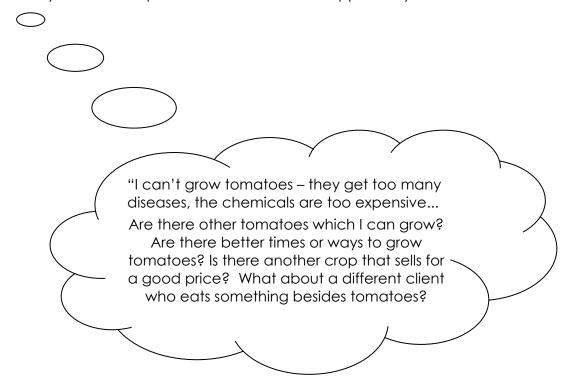
To improve she would like a bigger garden, as there is a high local demand. She also feels that there is not a lot of local competition, because she communicates with other people who are selling so that everyone can grow different things. She sends people to other growers if she cannot supply.

Principle 2: Think different. Think ideas, not problems

Here, different ideas start to present themselves in the process of marketing. You might start to wonder for example whether:



You may also have a problem that is in fact an opportunity:

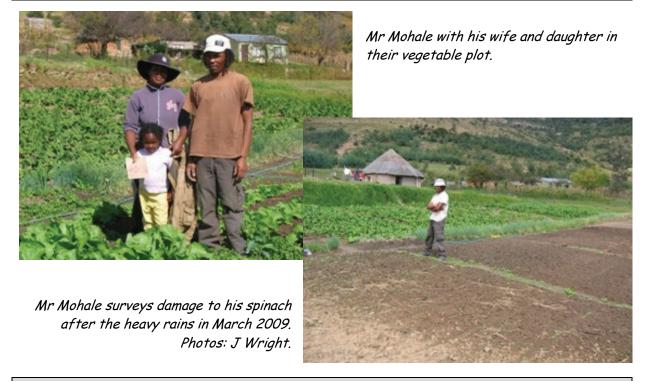




Case study 3: Think ideas, not problems

Mr Thetela Mohale from Qwa-Qwa grows vegetables as a full time concern and it is his family's primary source of income.

Their garden is 3000 m² and fully planted. They grow carrot, beetroot, cabbage, lettuce, green beans, maize, pumpkin and tomatoes in summer and spinach, chicken wing, lettuce, mustard spinach and rape in winter.



Their income in the last few months was as follows:

- For February: R1400 (Tomatoes: R35/crate x 40 crates)
- For April: R2400 (Spinach: R6/bunch [1 bunch = 20-25 leaves] x 400 bunches)
- Rain destroyed crops in March.
- They also earn three child grants (R720/month).

Mr Mohale employs two labourers (R400/month each) to assist in his garden.

Mr Mohale says: "I park my bakkie in town every Friday. Everyone knows my bakkie so they come and buy from me. I don't have to pay any sort of fee or get any sort of permission to sell there."

He also mentioned that he owns a bakkie which he bought after winning an agricultural competition several years ago. He did have a verbal contract with Pick 'n Pay, but he quit after a month because it wasn't enough money. He had to deliver his spinach to town for only R2.50/bunch (20 leaves).

There is a high demand for vegetables and the family could earn more if they produce more. Labour is however a limiting factor. He feels that having a tractor would enable him to expand his production to five more fields that he has access to.

Principle 3: The seven Cs

Careful:

Think before I start – not just I want to grow vegetables; but.....

Clear:

Which vegetables, for whom;

Calculate:

How much of it, to sell at which price and how much will it cost.

Courageous:

Do it!!! Mostly we fail our ideas; our ideas do not fail us!!!

Compete:

So, someone else is doing the same thing – will I give up, do them in, or come up with a way that my product is more appealing to a buyer?

Co-operate:

And if all else fails, why not try to work together...

Control:

Do not trust anyone that says: "sure I will sell your produce for you..." Ask them questions: "for how much?", "to whom?" Insist on a written agreement. Control over the sale environment is very important.



The market is not out there, it is in here!!

- Experiment!
- Try as many different things in as many different ways as you can think of.
- And preferably don't copy your neighbour.

7.3 Potential financial benefits from

homestead agriculture

How much can typical families earn from production at home? Situations differ greatly, as we have already seen from some of the case studies above.

The following tables provide some results from different areas over the past couple of years, to give you a sense of what people have achieved.

Table 1: Summary of incomes produced through vegetable production, 2009

NAME and area	Size of plot	Crops grown	Marketing	Average monthly income
Phuthaditjaba,	Free State			
Mrs and Mr Gumbi	~1,800 m²	Variety: carrots, beetroot, spinach, mustard, rape, onions, cabbage, tomatoes, potatoes, green beans, turnips, peas	Locals	R400.00
Mr and Mrs Ntai	~1,000 m²	Spinach, pumpkin, peas, lettuce, potatoes, mustard spinach, rape, turnips, carrots, beetroot, maize	Vendors and locals	R1,180.00
Mr Sibeko	~ 500 m²	Spinach, rape, mustard, green and flat beans, pumpkin, potatoes, onions	Locals and Pick n Pay	R418.50
Mr and Mrs Mohale	3,000 m²	Beetroot, cabbage, lettuce, green beans, maize, pumpkin, tomato, spinach, rape, mustard spinach	Sells in town, with own transport	~R2,200.00
Potshini, KZN				
Ms P Mavundla	36 m²	Cabbages, tomatoes, potatoes, beetroot, spinach	Locals	R125.00
Mr V Zondo	400 m²	Tomatoes, carrots, chillies, beetroot, cabbage, spinach, onions, sweet potatoes, turnips, peas	Locals	R400.00
Ms B Hlongwane	100 m²	Cabbage, spinach, onions, chillies	Locals	R150.00
Ms Z Mduba	180 m²	Chillies, tomatoes, cabbage, spinach, potatoes, Kenyan spinach	Locals	R250.00

It is possible to analyse the incomes from food gardening in terms of the contribution

to the livelihood of that family. The example below of Cata provides some insight into the significance of seemingly small incomes to the overall livelihood security of the participating homesteads. The following figures come from records kept by Water for Food households in Cata, (Eastern Cape) for eight months from mid-2005. Border Rural Committee (BRC) summarised the results as follows (De Lange, 2007):

Table 2: Cata Water for Food households: value of production, 2005

	Cata Water for Food households Value of production over 8 months from mid-2005										
Title First name Surname Sales of produce Tota produce consumed produce or donated											
Ms	Sisiwe	Kiba	R 705.00	R 363.00	R 1,068.00						
Ms	Nothemba	Languva	R 2,492.50	R 623.50	R 3,116.00						
Mr	Zolani	Luti	R 963.00	R 120.00	R 1,083.00						
Mr	Pumzile	Mboso	R 1,435.00	R 775.00	R 2,210.00						
Ms	Nobuntu	Ntshutsha	R 484.00	R 987.00	R 1,471.00						
Mr	Mzwamadoda	Pama	R 965.50	R 302.25	R 1,267.75						
Ms	Nomzi	Sampempe	R 1,091.50	R 343.00	R 1,434.50						
Ms	Boniswa	Tontsi	R 746.00	R 441.00	R 1,187.00						
Mr	Mawethu	Tontsi	R 1,329.00	R 217.00	R 1,546.00						

Source: BRC internal report: Summary of records kept by Water for Food households, Cata.

The equivalent value of this household production would be an average of R2325.11 per year, R193.76 per month or R6.46 per day.

R 885.00

R 11,096.50

R 232.50

R 4,404.25

R 1,117.50

R 15,500.75

Some remarks can be made about these figures:

Vakata

Noluthando

Ms

- Firstly, R6.46 per day seems very little, but only until we compare it with the statement that "...half of SA survives on R20 a day" (Business Day Article).
- Secondly, it is sobering to consider that these households would not have had
 access even to the portion shown as 'produce consumed' without this
 intervention, simply because they would not have had cash to purchase
 these vegetables instead. It is internationally accepted that mothers'
 continuous access to own produce is one of the most direct strategies to
 achieve adequate child nutrition.
- Thirdly, this produce came from the first seasons of production, with only a portion of the home food garden established. Mrs Khumbane's records show that her production per trench improved year-on-year as the trenches matured, and she advocates a 'five-year food security plan' to households, meaning that the number of trenches are gradually increased over a five-year period. If we assume that the Cata households will expand their gardens on a yearly basis the value of their production on average would increase dramatically. Look at the table below, which provides an indication of what is possible.

Table 3: Cata Water for Food households: five year extrapolation of production value

	Value of household production, if garden is expanded annually by the same number of trenches as developed in the first year	Value of household production, if garden is expanded annually by half the number of trenches as developed in the first year
Year 1	R 2,325.11	R 2,325.11
Year 2	R 4,650.23	R 3,487.67
Year 3	R 6,975.34	R 4,650.23
Year 4	R 9,300.45	R 5,812.78
Year 5	R 11,625.56	R 6,975.34
Total value: (first five years)	R 34,876.69	R 23,251.13
Average per year: (first five years)	R 6,975.34	R 4,650.23

Results from a 2002 study by the International Water Management Institute confirm this gradual increase in yield and overall output. Mma Tshepo Khumbane's winter production alone (i.e. not counting summer production when fruit adds significantly to the overall output), yielded a metric tonne of vegetables in her backyard food trenches totalling 222 m² (i.e. a miniscule 2% of a hectare). Because of the intensive production, some of her crops yielded three times the average yield typically achieved by top commercial farmers. Significantly, the year 2002 was Mma Tshepo's fifth year of production since settling at this home. Her production figures are shown in the table below.

Table 4: Mma Tshepo Khumbane, Cullinan: Food grown in winter 2002 (De Lange, M. 2003)

MaTshepo Khumbane, Cullinan Food grown in Winter 2002							
food grown land food daily portion (sq. m) (kg) months of daily portion for 6 people							
Beetroot	30	126	7				
Broccolli	23	57	2				
Cabbage	12	96	8				
Carrots	12	50	4				
Cauliflower	10	69	4				
Lettuce	20	64	2				
Onion	50	350	65 (5.4 years)				
Peas	43	65	5				
Spinash	14	42	2				
Other	8	34					
2	22 sq.m	953 I	kg				
(=2% of a hectare) (=approx 1 tonne of v							

Source: International Water Management Institute

The number of months that a family of six people would be able to each eat a portion of the crops produced in the winter season in this example (provided these could be stored safely), is shown in the last column.

Agricultural Water Use for Homestead Gardening Systems – Resource Material

A large component of the production which is not contained in Table 4 is the greens which were fed to the pigs and the chickens (an approximate further 500 kg) and the large variety of herbs used for medicinal purposes for the family and animals.

Part of this winter production was R2 000 worth of onions from a 50 m² portion of the garden – enough to purchase half a year's maize meal for a family of six. Through simple extrapolation, a mature 100 m² Raw Water Harvesting garden, used both in winter and summer, could thus comfortably produce R8 000 per year worth of vegetables. This figure compares well with the projections based on the Cata figures above.

A summary of actual income for 15 homestead gardeners in the Ngumeya area around Cata for Jan-March 2009 averages out at **R445.73/month**. This amounts to a yearly average income of **R5 348.79**. This amount compares very favourably with the average amounts given in the table above. It provides us with a real sense of what is possible (Border Rural Committee, 2009).

7.4 Marketing ideas and appropriateness

Appropriateness for cash-scarce households

Cash strapped households are those that rely on their gardening to augment food, and income which is mostly from social grants. They have access to small parcels of land for vegetable production (100-3000 square meters). They do not own expensive equipment such as tractors.

Within this category there are those that have expanded their vegetable production to become their main source of income. These families generally work together (and employ labour in some cases), focus on gardening as their main activity, and use larger parcels of land (either their own or rented).

From the case studies above (1-3) the following points can be highlighted:

- Market locally first;
- Next, strive to set up arrangements with hawkers and shops;
- Preferably do something where you do not need to transport your goods, unless you can make an appropriate arrangement;
- Grow a range of vegetables that you can sell throughout the year; and
- Make arrangements with neighbours so that you do not compete with each other, but support each other in growing and selling.

How to identify how risky a venture is?

Cash strapped households naturally prefer not to take much risk. Therefore they want to avoid high-risk initiatives. How can the facilitator help them to assess how risky an opportunity might be? By asking themselves the following questions, the household can go into an undertaking with open eyes, or may decide to look for something more suited to their circumstances:

- Where can I market this crop or product? Who decides the price? Is there a lot of competition for this market from other growers?
- Is it a very volatile market (price and demand goes up and down a lot)? Can our household survive such volatility?
- Is it a single-channel market (only one place/organisation I can sell it to)? What is their track record, how long have they existed, how well do they treat their growers? What happens if they disappear?
- What start-up costs would be required? Can our household afford it? Would we need to incur debt to do this? What if we fail to repay our debt?
- Would we need to buy expensive inputs every season? Would we be able to afford it?
- Would we need to transport these products? How often? How much would it cost?
- How difficult are these crops to grow? Are they very vulnerable to climate factors, drought, pest and diseases that are found in our area? Is anyone else growing them successfully nearby? Can we speak to current growers to learn from their experience?
- Can our household store this product for a long time and sell it later, or is it a fresh product that must be sold immediately to avoid losses?
- Can we start small and expand later if we are successful?

You can add questions from your own and households' experiences to these. Remember that the idea is not to create fear and discourage people from trying anything, but to help households to assess all angles and make informed decisions that suite their circumstance.

In the next section, we will share a list of ideas for income generation from home which has been collated over many years. You can add to this from your own experience, and adapt ideas to local circumstances.

Income generation ideas for home food gardeners

The list below contains items that are suited for a range of circumstances – from rural village settings to commercial farming areas. The <u>underlined items</u> are more achievable for rural households, using the following criteria:

- Products with longer shelf-life;
- Activities not requiring constant <u>readiness for direct contact</u> with tourists/clients;
- Lower input costs and equipment demands; and
- <u>Flexibility</u> in household time demands (can they do it whenever they may have time, and leave it for a while when they don't have time/resources?).

[Note that some rural households may well find possibilities among the unmarked items too.]

Note: Many of the items were adapted from a document originally developed by Merida Roets of ScientificRoets.



Activity 1: Assessing marketing ideas for appropriateness

Aim:

To assess the appropriateness of the ideas provided in the table below for your situation

Instructions

For each income idea, **rate its appropriateness for a rural household**, by colouring in each of the right hand columns to show for all criteria whether you think it is:

good possible not good enough very bad

Table 5: List of income generation ideas

	Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
1.	Almonds: Long term investment.						
2.	Aloe Vera : Extracting the sap for cosmetic or medicinal use for sale to manufacturers, or making your own product range.						
3.	Alpacas : Are now being imported into the country. Hobby, fibre, pack animal and tourist potential.						
4.	Angora goats: Do it with a twist. Why not rather a petting zoo, tourist shearing, and hair for the home spinning and crafting?						
5.	Animal farm : Have a range of farm animals for visitors to see, feed, milk, shear and touch. Include a tea garden or picnic facilities.						

	Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
6.	Baby vegetables: correctly packaged these often have niche markets.						
7.	Baked bread, cakes, and cookies : The fresher the better.						
8.	Balloon rides: For the more adventurous.						
9.	Baskets : Woven from local grasses, grape vines or twigs are sought after utility and décor items. Use them to package other produce, like dried flowers or dried fruit.						
10.	Batik and painted fabrics : Made into wall hangings, tablecloths, curtaining or pillows, these fabrics are sought after.						
11.	Bead work : Items such as Christmas decorations, broaches, and handbags in traditional colours are becoming very popular.						
12.	Beans : mung, black grain: Why not dry them and package them with a soup recipe on the package?						
13.	Bed-and-breakfast : There is a growing market for restful, pleasant and interesting places for travellers to stay without the sterility of a hotel room. Indigenous fare and entertainment add to the appeal. Don't forget the businessman who is looking for a home away from home and a good night's rest.						
14.	Berries : A variety packaged together makes an interesting product.						
15.	Bicycle tours : Possibly a scenic, culinary or guided tour to a variety of places or farm operations in your area is an activity for the restless tourist.						

	Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
16.	Bird seed : Can be sold to pet shops, aviaries, or bird parks. Why not start a bird park on your property, and sell the seed to tourists who visit the park?						
17.	Blueberries: Sell fresh or as jam or pie.						
18.	Buchu : An indigenous fynbos herb.						
19.	Bush furniture : Need to get rid of some of that bush encroachment?						
20.	Cactus farm: A wide range of cactus plants can serve as a tourist attraction. A nursery near the Augrabies Waterfalls has done just that, and there is a beautiful cactus garden in a private garden in Victoria West. Did you know?						
21.	Calf rearing : As dairy replacements or for the feedlot industry. flavour.						
22.	Candles : Embed indigenous objects such as pods or seeds within the wax for a local						
23.	Cereal foliage : Supply florists with dried or unripened cereal plants. Durham wheat is very popular in flower arrangements.						
24.	Cheeses : Can be made from cow, goat or sheep milk.						
25.	Cherries : Sold fresh, as jams, preserves or as pie. Why not let people pick their own?						
26.	Child-care in a country setting : Offer a childcare service to city dwellers if you live close enough.						
27.	Christmas trees : Not really known in the South Africa market. Marketing may help. Sell them in pots for all round use.						

	Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
28.	Compost : Organic compost is gaining in market appeal.						
29.	Contract services : Offer building, fencing, or other maintenance services to neighbouring farms.						
30.	Crafts : Indigenous arts and crafts are a growing industry. These include colourful paintings, traditional objects, dancing dolls, ceramics, beads, pipes, bows and arrows, and shields are some examples.						
31.	Culinary tours : Visits to different farms in your area where various traditional or local dishes can be sampled. Provide South African poetry or story reading as entertainment.						
32.	Decorated eggs : Goose, duck, ostrich and quail eggs which are painted or decorated or made into things such as light fittings, candle holders, jewellery cases etc. are quite popular.						
33.	Do-it-yourself farm : For the uninitiated learning how to milk a cow or goat, to collect free range eggs, to bale out the horse stables, to pick cabbages, or to make cheese is as exciting, and sometimes preferable to bungee jumping off a bridge.						
34.	Essential oils : Distilled from various trees and herbs are popular in the cosmetics and perfume industries.						
35.	Evening primrose : The oil is in demand for therapeutic purposes.						
36.	Farm museum : Collection of old types of farm machinery.						

	Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
37.	Farm secretarial services: A definite need, especially financial record-keeping.						
38.	Farm tours: If your farm has large and interesting machinery or operations, farm tours from school children or overseas visitors may be an interesting business.						
39.	Farmhouse restaurant: Can be done in conjunction with other activities such as a petting zoo or roadside curio store. Location is important.						
40.	Fern nursery : Propagating and producing fern varieties.						
41.	Ferrets: Are popular as pets.						
42.	Firewood : Especially if you can incorporate a "Working for Water" project. (Contact the Department of Forestry and Water Affairs).						
43.	Fish : Raised in ponds, fresh or for fishing. Trout fishing is popular, along with picnic, camping or accommodation facilities.						
44.	Free range eggs and poultry : Gaining in niche market appeal. Sell exclusively to selected traders.						
45.	Fruit juices : Use the firm fruit for fresh sales, but turn the rest in juices or preserves.						
46.	Game birds : Sold quality packaged or for hunting.						
47.	Game farm : Hunting, bow hunting or photography or game viewing is always popular.						
48.	Game or bush lodge : A growing industry, if you have a pretty environment and a variety of game or bird species.						

	Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
49.	Garlic: May be difficult to grow commercially. Creative marketing can achieve sales in the kitchen décor industry.						
50.	Gift hampers: Offer a variety of produce and crafts from your region. Here your enterprise can add value to other products from your area.						
51.	Gooseberries : Fresh or as jams and preserves.						
52.	Herbs : Sold as small windowsill plants in pretty pots, fresh with vegetables or dried.						
53.	Herbal vinegars : A wide variety of possibilities.						
54.	Heritage routes : These can incorporate rock paintings, cultural villages, indigenous food and arts and crafts.						
55.	Holiday farms: Quite popular for the urban dwellers. Provide a range of relaxing activities for young and old.						
56.	Hydroponic plants : Big potential for vegetables and ornamental plants out of season.						
57.	Indigenous flowers: Export market exists for certain varieties of seeds, seedlings, pot plants, and bulbs.						
58.	Indigenous fruits, seeds or animals: Correctly packaged with recipes for the local and overseas markets.						
59.	Insectariums : Schools could be major clients if packaged to suit educational programmes.						
60.	Jam and preserve making: Women can be roped into to process crops on the farm.						

	Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
61.	Kiwi fruit: Fruits for a niche market.						
62.	Lavender oil or plants: Sold in pretty recycled pots or tins, oil distilled for the scent or perfume industries, or in dried flower arrangements or wreaths.						
63.	Loquats : Although you are not allowed to plant them anymore, you may have a tree from which you can obtain fresh fruit or make preserves.						
64.	Macadamia nuts: Long term investment.						
65.	Macaw parrots or other exotic birds: Need specialist care, are expensive, but have a worldwide demand.						
66.	Melons : Grow a variety; make preserves or a friendly tea garden in a melon patch.						
67.	Milking goats: Not only wonderful for a petting zoo, but can also be good for educational school tours. High demand for goat's milk out of season (can be frozen) and for making exclusive cheeses for niche delicatessen markets.						
68.	Milking sheep: As for goats.						
69.	Mobile animal nursery : Taking animals to children's schools or shopping centres.						
70.	Mulberries: Same as loquats.						
71.	Mushrooms : Technical requirements are high.						
72.	Nasturtium flowers : Sell small plants for gardens, larger plants or flowers packaged in salad mixes.						
73.	Nature trail hikes and guided tours: A pristine environment with basic amenities would cater to the local nature lover.						

	Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
74.	Olives : Long term investment. Can be planted as a windbreak. Sold fresh, pickled or for oil.						
75.	Orchids : Potential in niche markets for keen producers.						
76.	Organic cereal, meats or other crops: A niche market is developing locally, and already exists overseas.						
77.	Ornamental fish : Breeding and supplying unusual species of fish.						
78.	Peacocks : For pets or for feather arrangements (pretty eggs and feathers are popular as coffee table arrangements overseas).						
79.	Peppers: Various speciality types.						
80.	Pet motels : Upgraded versions of kennels or catteries.						
81.	Pick-it-yourself : If you are close enough to well-frequented routes and cannot handle all the picking in the harvesting season, make it a treat for the city folk.						
82.	Pottery : A clay and pottery tradition is part of South African culture. Use these pots to package honey, tea, sugar, jams, preserves, mustard, fried flowers or fruits.						
83.	Proteas : For the export market.						
84.	Quail : Sold fresh or frozen, but neatly packaged for the delicatessen industry. Quail eggs are popular pickled.						
85.	Rabbits : Can be used for hair, pelts or meat.						
86.	Reading and writing : older illiterate people in the rural areas need these skills.						

	Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
87.	Sheepskin or goat leather : Make your own leather and leather products.						
88.	Snails: Gourmet snails are popular.						
89.	Squabs or table pigeons : Delicatessen industry.						
90.	Story telling : Arrange story-telling evenings with the local tourism office. Rehearse and offer a picturesque setting and a light meal.						
91.	Sundowner night drives : Drive tourists to a scenic spot with a picnic hamper.						
92.	Sweet potatoes : For the restaurant and hotel trade.						
93.	Tree farm : A "library" of indigenous trees, plus seeds, information and seedlings to go with it.						
94.	Tree tomatoes : Can be eaten fresh or processed.						
95.	Trout farms : Popular throughout the country for the local market.						
96.	T-shirts : Painted with indigenous mythological figures, indigenous plants or landscapes.						
97.	Turkeys: Small niche markets locally – also processed meat potential as salamis and lean meat.						
98.	Weaving : Indigenous silk, wool, cashmere, mohair, and sisal – all products that can be woven into an array of products. Small handbags are very fashionable right now.						
99.	Wool packaged for home spinners: High quality or ultra-fine wool packaged in smaller lots for the home processing industry.						

Agricultural Water Use for Homestead Gardening Systems – Resource Material

Income idea	Market risk	Start up cost	Ongoing input costs	Management requirements	[Add your own criteria]	OVERALL
100. Woollen quilts and pillows : Increasing demand for natural products.						

7.5 References

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Index (Chapter 7)

D

Diversification 7-7, 7-11

Incentives 7-1, 7-13 Income 7-1, 7-13, 7-19, 7-24 M

Marketing 7-1, 7-23 Mobilisation 7-2

Ν

Niche marketing 7-11