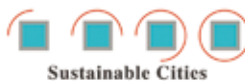




# Imagine Durban Demonstration Project



Canadian International  
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**This booklet is written as a product of The Mila Food Security Project by Bev Ainslie - Education, Training and Development.**

# Permaculture food gardening guide for schools



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# 1

## Introduction

This booklet was developed for teachers, learners and community members who would like to learn more about food gardening. It forms part of an Imagine Durban Demonstration Project called The Mila Project, which worked closely with the learners and staff from Cato Crest Primary School and Glenridge Pre-Primary School.

**This booklet documents the gardening process so that other schools can learn from it and be inspired to start their own food garden based on permaculture principles.**

Here are some of the feelings, experiences and ideas shared by the children from the Soul Buddies Group at Cato Crest Primary School.

"Permaculture gardening has inspired me in learning to do things on my own. I've learnt the importance of taking care for the nature and appreciating it. And I make sure not to harm it in anyway".

"We doing Garden because we like to help people who have no food. I am doing Garden because I love health food. We are doing Garden because we want to help schools."



"To me the vegetable garden means a lot because I am able to do my own and teach my community as I've started."

"Gardening is not fun but when you get use to it you actually enjoy it. When I first start gardening I was exhausted, sun was hot but I like gardening."

To learn more about The Mila Project of 2010 at Cato Crest Primary School and Glenridge Pre-Primary School see **Annexure A: Background to The Mila Project.**

# 2

## Permaculture

Permaculture comes from a combination of two words: permanent and agriculture.

**Permaculture is a way of living and growing food by copying nature AND working with nature.**



If you create a food garden based on ways found in nature, by listening and watching carefully how nature works, you will be playing an important role in repairing the earth.

# Ethics

The three ethics underpinning permaculture are:



# Principles

[Adapted from 2006 SEED (Schools Environmental Education and Development) **Growing the Living Laboratory - Permaculture for Environmental Education in the NCS - Intermediate Phase Grades 4-6.**]

**Permaculture has a number of basic rules or principles. These are rules for good design.**

<b>Principles</b>	<b>Example</b>
1. Work with, rather than against, nature.	Encourage earthworms in the soil as they loosen it and add plant food through their faeces.
2. The problem is the solution.	'Weeds' can become chicken food or compost for feeding the soil.
3. Everything works in at least two ways.	Chickens can eat plant pests, produce eggs, meat and feathers, dig and add manure to the soil. A structure to shade seedlings can also be used to grow vines like granadillas or grapes.
4. Bring food production back into cities.	Herbs and vegetable plants can be grown successfully in containers and on rooftops in confined city spaces.

**Permaculture has a number of basic rules or principles.  
These are rules for good design.**

Principles	Example
5. Use natural materials whenever possible.	To keep the soil fertile, use compost, mulch and earthworms rather than fertiliser. Use chickens to dig and weed rather than tractors and hoes.
6. Recycle resources on site.	Recycle plant waste such as vegetable peels, pulled weeds and grass mowings by using it as mulch to make compost or by feeding it to chickens.
7. Save energy.	Plant directly into the soil instead of first digging or ploughing the soil. Place the food garden close to the home, so energy is not wasted walking and carrying to and from the garden.
8. Encourage diversity of living organisms.	Grow many different kinds of plants that will encourage many different wild animals such as birds, frogs, bees and butterflies.
9. Help your community to become more self-reliant.	Grow food plants, save water, save energy, produce food or other products to sell.
10. Start small.	Small gardens are easier to look after and they save energy and resources.
11. Use patterns.	Patterns improve the systems by creating more surface area on which to grow
12. Use intensity.	Intensify to make the best use of time and space. For example grow plants vertically to improve the use of space and grow fast-growing plants under slow-growing bushes to improve the use of time and space

# 3

## What do you need to start a food garden?

Here is what you will need to start a food garden at your school:



### REMEMBER:

Keep the 12 permaculture principles in mind when planning your food garden!



## Land

Design your garden on paper and consider the following points:

- Start small. You can always expand later.
- Choose an area that is protected from the wind and fairly flat. If you only have steep slopes, you can build swales to catch rainwater and minimize topsoil from eroding away. See **Annexure B: Making swales** for more information on swales.
- Place your garden as near to the kitchen and water source as possible.



**Gardens can be made without “land.” With permaculture, food gardens can be grown in containers, on rooftops, paved surfaces or even vertically.**

- Identify a safe place to store your gardening materials, equipment and tools near the garden.

# Water

Water is essential for a food garden.

## Rainwater harvesting

To use rainwater, you need to catch enough to water your vegetables on days it doesn't rain, especially in Durban's dry, winter months.

- Ideally you should have three 5000 litre tanks attached to the gutters to catch all rainwater that runs off the roof of the school building.
- Rainwater can be stored in tanks for months; but remember, it is untreated water, and is unsafe to drink.
- To install a rainwater harvesting irrigation scheme (which includes tanks, piping, fittings and taps, and labour) is costly. Some schools look for sponsorships or donor-funding for this.

**Use RAINWATER and/or RECYCLED WATER for your food garden. It is FREE while tap water is expensive.**



## Recycled or grey water

RECYCLED or GREY WATER is water that you have already used once before, for example bath and dish water.

- Grey water must be used within 24 hours, to prevent build up of bacteria.
- An advantage of using grey water it that is it a constant supply of water (even during the dry winter months) – so you need fewer storage tanks compared to what is needed to harvest rainwater.

Whether harvesting rainwater OR grey water, the storage tanks should ideally be placed higher than the garden. This allows you to use gravity to help move the water to your garden. Otherwise pumps are needed, which are costly to install, run and maintain.



## Sunlight

Vegetables need sunlight to grow. You need to choose an area for your garden that has at least six hours of sunlight every day.

- Seedlings, however, will battle to grow in full sunlight. Make a shaded area near your garden that you could use as a nursery for sowing seeds.
- Shadecloth can also be used to cover your garden beds and stop monkeys from eating your vegetables.

**Remember  
ALWAYS wear a  
hat when working  
in your garden to  
protect your skin  
from the strong  
rays of the sun.**



## Soil

Each school will find that they have different types of soil – loam, clay or sandy soil.



- Generally the BEST soil to have for a food garden is loamy soil - a blend of organic matter, sand and clay. This type of soil is dark, loose and readily supplies nutrients to your vegetables.
- Clay soil is made of tiny particles with little room for air, tending to drain poorly and stay too wet.
- Sandy soil does not hold water well and has very little organic matter, which plants need to grow well.
- You can do a test to see what soil you have:



If picking these soils up when moist.....

....clay soil clings together in a ball.

....sandy soil feels gritty (i.e. coarse, grainy, rough).

....loam soil breaks apart into loose chunks.

If your soil is either too sandy or too clay-like, adding compost is a great way to improve it.

See **Annexure D: Other ways of improving your soil** for further information.



## People

You need at least ten enthusiastic learners, two committed teachers and two parents and/or community members for a strong school gardening team. It is a good idea to enlist the support of your school principal early on.

- The gardening group should hold a site visit and meeting to talk about what is needed to start a garden: land, water, sunlight, soil, people, seeds and tools.
- Give your gardening group and garden a fun name.
- Your gardening group might begin meeting once a week, but once you start planting, the garden will need attention every day.
- Once your garden is established, your gardening group should continue meeting at least once a month to discuss various gardening issues that may arise.
- It is a good idea to have a gardening committee and some guidelines for the gardening group to follow.

**Visit your garden daily for weeding, watering and mulching.**



## Seeds

- Collect seeds from family, friends, the kitchen staff or community members – either from their existing vegetable gardens or from the vegetables bought for cooking. Examples of seeds to collect include pepper, butternut and tomatoes seeds. You can also plant the skin of a potato (when the eyes are starting to shoot) and a potato plant will grow!



- You can also take stem cuttings from vegetable plants to grow more of the same vegetable.
- If you need to buy new seeds, buy open pollinated seeds.

**Remember what other people throw away, you could use to start your school vegetable garden!**

**Vegetable peels can be used for your compost heap; while seeds can be used to start your garden!**

# Tools

Your gardening group will need a few basic tools:

- Spades (x 3)
- Digging forks (x 3)
- Hand forks (x 5)
- Trowels (x 5)
- Watering cans (x 5)



- These tools can be shared amongst the group at different times.
- Before buying this equipment, see if any family, friends or community members have tools that they no longer use and would be happy to donate to the school.
- You could also introduce an exciting recycling project, where learners from your school are challenged with the task of making gardening equipment from waste!

Examples of this include:

- Make your own shadecloth by cutting open plastic mesh bags (the type that vegetables are sold in) and sewing them together.
- Watering cans can be made out of an old 2-litre milk container (you could even punch small holes at the bottom so that it makes a fine spray).
- A wheel-less barrow, made from a drum cut in half lengthwise and nailed to two pieces of wood.
- Old kitchen forks and spoons can be used for transplanting seedlings.
- Hard plastic bottles used for spray bottles, or cut to make scoops for compost.
- Your spade, which is about 1 metre long, used as a measuring stick.

Source: <http://biophile.co.za/gardening/your-own-food-garden>

# 4

## Start your food garden

Here are some simple steps to follow when starting your food garden:

**Remember you can also garden using containers, rooftops or on paved surfaces!**

### Design your garden

- Take a while to look at the land and the buildings and draw up a design for your garden considering things like water, sunlight, wind, and ground slope, as well as proximity to your school building, tool shed and water source.
- Start your design with a small manageable garden that you can enlarge as time goes on.
- Design beds of various shapes and sizes - like a horseshoe, a circle or a figure of eight.

Note:

- Your beds should be narrow enough so that your smallest gardener is able to reach the centre of the bed from either side – no wider than 120 cm.
- To avoid walking on and compacting the soil in your garden beds, you should create paths at least half a metre wide.



# Prepare your bed and improve the soil by sheet mulching

You can prepare your bed and improve the soil at the same time by sheet mulching:

## Sheet Mulching....



Step 1:  
Cut down all the weeds and grass. Leave them on the soil as they will later decompose into humus.



Step 2:  
Mark out the shape of your garden. Lay down thick layers of wet newspaper and cardboard. Overlap the sheets well. The sheet of mulch excludes sunlight from the weeds and grass. They die after 3 – 6 months after which they are no longer a problem in the garden (SEED, 2006.)



Step 3:  
Layer the cardboard with a dry brown leaves. If you are not going to plant your seedlings immediately, you could also add a layer of green garden waste and organic kitchen waste. Over a couple of months this will break down into humus.



Step 4:  
Add a layer of soil.



Step 5:  
Add a layer of compost.



Step 6:  
Then a layer of manure.



Step 7:

Put a 15 cm layer of seed-free dried grass or straw on top. Go right to the edges. Water well. This will break down into humus. Must be seed-free, otherwise the seeds can begin to grow and create weed problems (SEED, 2006.)



Step 8:

Make a hole through the upper layer of straw and plant your seedlings in the soil.

Step 9:

Plant your seedlings 20 – 50 cm apart.



Step 10:

Water your seedlings daily.

## Plant your seedlings

Plant your seedlings at least 15 cm apart from each other in triangular shape, to maximise your space. For vegetables that grow quite large, like cabbages, place them about 30 to 50 cm apart.



**To measure about 15 to 20 cm on an adult-sized hand....  
...extend your thumb and small finger only. You can use this to measure the space between your seeds.**

Once you have planted all your seedlings, water daily with a fine sprinkle or spray, preferably in the early morning so that the hot mid-day sun doesn't simply evaporate the water.



# Additional natural ways of improving your soil

## Compost heap

Make your compost heap near to your garden in a spot that has some shade and some sunlight. There are basic steps in making compost:



Layer 1:  
Sticks and branches. Place these in different directions on top of each other to build some height. This will ensure your compost heap has air.



Layer 2:  
Dry, brown leaves.



Layer 3:  
Fresh, green leaves, like comfrey that give nutrients to the soil.



Layer 4:  
Dry leaves again (these could include dead weeds).



Layer 5:  
Chicken manure and/or organic kitchen waste, like vegetable peels.



Layer 6:  
Fresh, green leaves, like comfrey again.



Layer 7:  
Topsoil.



Layer 8:  
Water.



Layer 9:  
Dry cut grass.

**Note: Kitchen waste should be covered immediately to minimise pests and odours.**

- As soon as you decide to start a food garden, ask the kitchen staff at your school if you can start collecting organic kitchen waste for your compost heap.
- Also ask the school caretaker for all the garden waste collected around the school for you to use for your compost heap.

## Mulching

As seen in the description of sheet mulching, mulching is when you place grass cuttings, leaves, tree bark or stones to cover the soil in between the plants:

- This stops the weeds from growing
- Retains water
- Decreases erosion
- In the case of organic mulches, as they decompose over time, they add nutrients to the soil.



## Chickens and a mobile chicken tractor

Chickens, in a mobile chicken tractor, can help you prepare your garden beds by eating weeds and pests; fertilising the soil with their manure and digging the soil surface over, thereby mixing it up with their manure.

- You can build a chicken tractor with poles and wire mesh – for example in a dome or in a triangle shape.
- Make sure that you build a level above the ground, attached to the roof, for the chickens to use to lay their eggs.
- Move the tractor around every two weeks.



- Each new piece of land you put it on, you will have weeded and fertilised by your chickens. You can also eat the eggs that they produce!



There are lots of other ways of improving your soil. See **Annexure D: Other Ways of Improving Your Soil** – worm farming, green manures and liquid manures.

## **Sowing seeds**

If you have an outside semi-shaded area you can sow your seeds in containers until ready for transplanting into your garden beds.

**Remember root vegetables (like carrots, beetroot, madumbie and potatoes) should be planted directly in beds, as they don't transplant well.**

- Seedlings need to be watered gently everyday. They grow best if not exposed to harsh weather conditions like heavy rain, full sunlight and strong winds.
- Practice succession planting when sowing seeds: Plant every three weeks to stagger your harvest so you can harvest vegetables all year round.

Once your seedlings have their second set of leaves, they will be ready to plant in your prepared bed.

See **Annexure E: Sowing seeds** for further details.

## **When to plant and when to harvest your crop**

You need to know the best times of the year to plant specific vegetables and how long they will take to mature. See **Annexure F: When to Plant and When to Harvest** for this information about common garden vegetables.



## **Have learners keep a gardening journal**

- Learners can keep a garden journal by recording the date and location of each crop planted.
- You will then know when it is time to harvest, (especially important with root crops, as the actual vegetables are under the ground!)
- You can also use the journal to help you plan your crop rotation with next year's garden.



**Creating a production schedule is a great way to tie the garden to the curriculum.**

## Crop rotation

Crop rotation is when you grow different types of crops in the same area from year to year.

- Different crops use different nutrients or plant food stored in the soil.
- By using a method of crop rotation, you do not overuse some of the plant foods, while not using others.
- This helps to keep the soil fertile year after year.

See **Annexure G: Crop rotation** for further advantages of rotating your crop.



## Companion planting

Companion planting means planting certain plants together so that they:

- Help each other grow;
- Improve the plant's flavour; or
- Attract pollinators or deter pests.

See **Annexure H: Companion Planting** for more examples.



## Control pests and diseases naturally

Pests, like certain insects and snails, could damage your plants. Fortunately, there are ways of controlling pests WITHOUT using chemical poisons that are harmful to people and the environment. Always use natural ways of controlling pests and diseases!

See **Annexure I: Integrated pest management** for further detailed examples.

**Keep bugs away by planting marigolds and herbs in between your vegetables, planting lavender near lettuce; and basil near tomatoes.**

# 5

## Food garden network

Durban Botanic Gardens (DBG), together with The Mila Project team and Imagine Durban are encouraging food garden networks in the City:

Gardens and gardeners do not exist alone. Our vision is a network of accessible food garden centres across the City. Imagine being able to walk to your neighbourhood food garden, meet the grower, harvest your own vegetables and share ideas about growing. This is the garden-city future that the DBG are passionate about turning into a reality.

There is a host of local city permaculture food garden projects already emerging. To be a successful gardener one needs the support of others to share ideas and resources. The challenge now is to develop the network and connect gardens and gardeners. The DBG Permaculture Centre provides the opportunity to help develop neighbourhood communities that support food gardening. DBG invites you to contact them to find out how you can become part of this exciting venture by starting a food gardening network in your area.

Source: Durban Botanic Gardens Permaculture Centre

# 6

## Conclusion

Enjoy the healthy vegetables that you harvest from your garden!



The information provided in this booklet, together with your enthusiasm, commitment and learning experiences, as well as networking with other gardens, will enable you to successfully start and maintain a food garden based on permaculture principles.



# 7

## Glossary

Term	Description/Examples
Accumulation	Build up.
Aerate	Has air, ventilation, can breath.
Agricultural lime	A soil additive made from pulverized limestone or chalk. The primary active component is calcium carbonate.
Casting (worm)	Undigested materials, soil, and bacteria excreted by a worm. Basically worm manure.
Compact	Dense, solid, packed in or packed together, compressed, squashed.
Compost	Fertilizer, nourishment, manure.
Confined	Restricted, small, cramped.
Contour	Curve, line, shape and form of land.
Decompose	To break down into component parts or basic elements; or to rot. Decomposition is an organic process necessary for the continuation of life since it creates essential nutrients that plants and animals need and use.
Dilute	Thin, water down, weaken.
Erosion	Wearing away, wearing down.

Ethics	Beliefs, morals.
Faeces	Waste product of animals and humans, also referred to as stools.
Harvest	Collect, gather.
Humus	Organic material consisting of decayed vegetable matter. It provides nutrients for plants and allows soil to better hold water.
Irrigation system	Water system, e.g. rainwater harvesting or grey water system.
Legume	An erect or climbing bean or pea plant of the family Leguminosae.
Manure	Organic matter, especially farmyard or stable dung, with discarded animal bedding, such as straw - which can be used to fertilise the soil.
Mulching	To cover the soil between plants with a layer of material, like grass cuttings, leaves or tree bark.
Open pollinated plants or seeds	Open pollinated plants are varieties that grow true from seed. This means they are capable of producing seeds from this season's plants, which will produce seedlings that will be just like the parent plant.
Organic	Untreated, unprocessed, pure, raw.
Permaculture	An approach to living which takes its inspiration from Nature.
Principles	Beliefs, values, ideas.
Repellent	Off-putting.

School Nutrition Programme	A government programme that supports schools so that they are able to supply a healthy meal to school children living in disadvantaged communities.
Seedling	Young plant.
Slashing	Cut, hack or gash.
Subsoil	The layer of soil under the topsoil, which includes substances such as clay and/or sand that has only been partially broken down by air, sunlight, water, wind etc., to produce true soil.
Swales	Low area of land (usually on a contour) to catch the rainwater and decrease erosion.
Topsoil	The upper, outermost layer of soil, usually the top 5 – 20 cm. It has the highest concentration of organic matter and micro-organisms and is where most of the Earth’s biological soil activity occurs.
Water (grey)	Water that has been used before or recycled, but not treated for drinking or cooking.
Water (potable)	Treated tap water or potable water which can be potted and used for human consumption.

# 8

## Annexures

### Annexure A: Background to The Mila Project

In January 2010, Cato Crest Primary School and Glenridge Pre-Primary School became part of the Imagine Durban Demonstration Project, funded by the Canadian International Development Agency (CIDA).

**Mila means  
“grow” in  
isiZulu**



An existing group of grade 5, 6 and 7 Cato Crest Primary School learners, called the Soul Buddies, together with teacher and community representatives and the children and staff from Glenridge Pre-Primary School formed a school gardening project called The Mila Project. The Mila Project was managed by Bev Ainslie and Brenda Mhlungu. Khanyisa Projects installed the rainwater harvesting tanks and Durban Botanic Gardens provided the practical training on food gardens based on permaculture principles.



Representatives from the Soul Buddies group become facilitators and transferred their food gardening and permaculture knowledge and skills on to children from Glenridge Pre-Primary School.



## Annexure B: Making swales

SEED, describe swales and how they can be made:

Swales are ditches dug along contour lines, especially to harvest water. Contour lines are imaginary lines that run along points on the land that are at the same height. Swales spread and sink rainwater that would otherwise run off the site. Swales can be small ditches in a garden or a large trench in a field.

Step 1: Use an A-frame to mark the contours  
**(see Annexure C: How to make an A-frame).**

Step 2: Dig the ditches along a contour line. Place the topsoil that you remove on the downhill side to form a bank.

Step 3: Use stones to close both ends of the swales, otherwise water will flow out of the swale and erode the soil down the slope.

Step 4: Plant trees and other useful plants on the banks so that they can use the water in the swale and hold the soil on the banks.

Source: **Growing the Living Laboratory**  
- **Permaculture for Environmental**  
**Education in the NCS - Intermediate**  
**Phase Grades 4-6**, Published by **SEED**  
(Schools Environmental Education and  
Development), 2006.



## **Annexure C: How to make an A-frame**

SEED, describe how to make an A-Frame:

### **A contour tool – the A-frame**

#### **Making the A-frame**

1. Use the poles and frame in the shape of an A.
2. Tie one end of the string to the top of the A.
3. Tie the stone to the other end of the string so that it hangs down just below the horizontal crossbar of the A.

#### **Calibrating the A-frame**

4. Stand the A-frame upright in level ground. Mark the ground where the legs stand.
5. Hold the A-frame still, and use a pencil to mark where the string crosses on the cross bar.
6. Turn the A-frame around, so that each leg stands exactly where the other had stood.
7. Make a second light mark on the cross-bar where the string crosses.
8. The two marks on the cross-bar should be fairly close to each other. Mark the point halfway between the two marks as this will show where the string would cross on perfectly level ground. Make this mark with a koki or cut it with a knife.



## Marking the contour

9. Choose a place on the slope to begin. Stand the A-frame up and mark where the first leg stands with a peg or a stone.
10. Keeping the A-frame upright, and without moving the leg, swing the second leg up or down the slope until the string crosses exactly at the heavy koki mark.



11. Mark where the second leg stands.
12. Keeping the second leg in the same position, lift the first leg up and pivot it around. Move it up or down the slope so that the string crosses the cross-bar on the koki mark.

13. Mark where the first leg is now with another peg or stone.

14. Continue in this manner till the end of the field.

15. The line of pegs/stones will mark a contour line: they will be at the same height on the slope. The pegs are usually not in a straight line. If necessary make a smooth curve by moving them up and down a little.

16. To mark another contour line, move up or down the slope a certain distance (usually about 20m on a gentle slope, or 15m on steeper slopes). Repeat the process from step 9 onwards.



17. You can then dig ditches, construct terraces or plant trees along the contour lines using the pegs/stones as a guide.

Source: Growing the Living Laboratory - Permaculture for Environmental Education in the NCS - Intermediate Phase Grades 4-6, Published by **SEED** (Schools Environmental Education and Development), 2006.

## Annexure D: Other ways of improving your soil

### Worm farming

A worm farm is a container in which you keep earthworms. Every week you add organic matter, especially fruit and vegetable scraps, to the container for the earthworms to eat. They then excrete a substance called castings which is a rich fertiliser containing five times more nitrogen than topsoil as well as high amounts of potassium and phosphate.

Feeding garden and kitchen waste to earthworms is a cheap and simple way of getting rid of waste and of fertilising food gardens.

Worm farms use earthworms that thrive in the dark, warm, food-rich, moist environment of the worm farm. The best earthworm to use is called the red wiggler. The population in a well maintained worm farm doubles every two to three months.

#### You will need

- A container for the worm farm. There are many types of suitable containers for keeping worms, including simple polystyrene or wooden boxes from the shops, an old metal drum, and old bath tub or old tyres. There must be holes in the base of the container to let water drain out.
- Two or more bricks to raise the container off the ground so that water can drain out easily.
- At least 2000 compost worms. These worms will breed and multiply to about 8000 worms in 6 months.
- Organic starter material, which can include partly decomposed compost, straw, grass clippings, shredded paper, fruit and vegetable waste or leaf mould. There should be enough to half-fill the container.
- A loose cover, such as Hessian sacking. If you do not have Hessian, you could use a sheet of cardboard or even a whole newspaper.
- Grit – a mixture of soil and sand, needed by earthworms for digestion.

## **Establishing the worm farm**

1. Choose a shady spot outdoors for your worm farm, preferably where there is good drainage.
2. Place the container on bricks.
3. Half fill the container with the starter material mix.
4. Sprinkle on a layer of grit.
5. Water until moist but not wet.
6. Add the compost worms.
7. Cover the container.

## **Maintaining your worm farm**

Add fruit and vegetable scraps each week. The paragraph below describes what to feed the worms. Add less food in the first week and gradually increase the amount over 6 months. It is best to feed your worms weekly. If uneaten food remains, then you know you have overfed the worms. Chop up the food before adding and try to feed the worms a mix of materials. After feeding the worms each week, cover the food scraps with some compost or soil to avoid attracting fruit flies.

Add water every few days or when necessary to prevent the worm farm from drying out. You may need to add more water during hot, windy weather. It is important to keep the worm farm moist, as the worms may die if it dries out. However, the worm farm should not be soggy either. Remember, there is moisture in the food scraps.

### **After 6 months, start another worm farm by:**

- Starting the whole process in another container by collecting the worms from the top feeding level of the previous container.

- Place a second container with holes in the bottom on top of the first and put food scraps only in the top box. The worms will migrate through the holes to the top box to feed.
- Use the remaining worm castings in the garden in the same way as you use compost.

## What to feed the worms

Worms will eat almost any type of vegetable and food scraps, coffee grindings, paper, leaves, and even damp cardboard. Add egg shells as the worms need the calcium in the shells. Do not add onions or garlic or too much acidic food like citrus or pineapples. Avoid materials contaminated with toxic chemicals, for example, sawdust from treated wood.

Source: Growing the Living Laboratory - Permaculture for Environmental Education in the NCS - Intermediate Phase Grades 4-6, Published by **SEED** (Schools Environmental Education and Development), 2006.



## Green manures

Green manures are plants grown specifically to improve the soil's fertility and to prevent soil erosion. Most green manure plants are fast growing.

- Green manure can also be cut and dug into the soil during and after growing season.
- Examples of a green manure plants grown for ground covers (also known as living mulches) are cowpeas, vetch, red clover and lupins.
- Another example of a green manure is a plant called Comfrey.

## The advantages of growing comfrey are:

- It fixes potassium in the soil and absorbs nutrients in the soil.
- It prevents weeds from growing because of the shade its leaves make; and because of the manure produced into the soil through its roots.
- The roots can help the soil hold water.
- It improves the stability of soil particles and creates useful drainage channels.

## Liquid manures

Liquid manures can increase the growth of your crop by providing nutrients and can also help to fight disease.

- Liquid manures are also referred to as teas and are usually made with one part of the plant or manure to four parts of water (1:4), in a drum or bucket that has a lid.
- Comfrey tea can be made by soaking the leaves in water for two days. It must be diluted to a ratio of 1:2 (one part comfrey liquid to two parts water) when using it on your crop. If you use it on young seedlings, dilute it 1:4.
- Manure teas can be made from chicken or cow manure and used after three weeks and then diluted 1:5.



## **Annexure E: Sowing seeds**

### **For sowing seeds in seed trays you will need....**

#### **Seeds trays**

- You can use any container for seed trays - like old milk containers cut in half, or large yoghurt containers.
- Just remember to make at least 3 or 4 holes in the bottom of the containers for water to drain out.

#### **Soil**

- Mix together some compost (or topsoil, sieved, if you don't have compost) with river sand. Alternatively you can buy a seedling mix.

#### **Seeds**

- Don't make holes for each seed, simply take two or three seeds at a time and sprinkle them on the top of the soil.
- Then sprinkle a thin layer of soil on top of this.
- Compact the soil gently with the palm of your hand or a flat piece of wood.

#### **Water**

- Sprinkle water over the soil gently by using a watering can with a fine spray, so that you don't lose your seeds when watering!
- Keep your seedlings in semi-shade and water daily (preferably early evening to avoid daytime sun evaporating all the water!).

#### **Label your seed containers**

- It is important to know what and when you planted your seeds, so that you know when you can transfer them to your garden bed.
- Make a label out of a plastic container cut into triangles or rectangles and write the name and the date that you planted the seeds, using a permanent marker pen.

## Annexure F: When to plant and when to harvest

Vegetable	Possible sowing time	Growth time
Brinjal (eggplant)	Jan – Sept	2 - 3 months
Tomatoes	Jan - July	3 months (Can be harvested for 2 to 3 months)
Onions	Jan – April	6 – 8 months (180–230 days)
Cabbage	Feb – Aug	3 - just over 4 months (90 –130 days)
Potatoes	Feb - Sept	3 ½ - 5 months (105–150 days)
Green bean (bush type)	Feb - Sept	1 ½ - 2 months to first pick (50 to 60 days) Pick over 10 to 15 days
Carrots	Feb – Sept	3 - 4 months (90 – 120 days)
Swiss chard	Feb – Oct	2 months. (Can be harvested (often called spinach) for 2 to 3 months)
Lettuce	March - July	2 – 3 months (55 – 90 days from transplant)
Beetroot	April – Sept	2 - 3 months
Green pea	May - June	3 – 4 months (100 to 120 days)
Chilli (hot peppers)	July – March	2 – 3 months
Gems	July – March	± 3 months (85 to 95 days)
Butternuts	July – March	3 - just over 3 months (90 to 100 days)
Pumpkins	July – March	4– just over 4 months 120 to 130 days
Sweet pepper	July - March	2 – 3 months (70 to 80 days) Picked over 2 – 4 months
Madumbie	July – Oct	7 – 9 months (200 – 270 days)
Sweet potato	Aug - March	4 – 5 months

Source: <http://www.nda.agric.za/docs/VegProductionInAnutshell.pdf>

# Annexure G: Crop rotation

## Veggie Crop Rotation

Improve your soil structure and nutrients, and reduce pest and disease risk by simple crop rotation...you will have bigger crops of healthier veggies all year.

### What is Rotation

A Crop Rotation system works on a three year cycle, with different types of crop being sown/planted in the ground each year to avoid any build-up of disease.



## How to start - Plan

**Make a list of all the plants you want to grow** in your veggie garden this year. Divide your list into summer and winter plants. **Divide your plants into veggie type:**

**1 - Root & Bulb**

**2 - Fruit & Seed**

**3 - Leaf & Stem**

**Draw a diagram of your veggie garden and divide into 3 areas,** 1 area for each veggie type per year. **Keep a record of what you grow and where,** as a reminder for the next season.

## The Rules Of Rotation

For each area select a different veggie type in year 1, then change to the next veggie type in year 2 and the next in year 3, then back to the year 1 selection in year 4, and on it goes....

**Veggie Type 1:** Root & Bulb - Carrots, parsnip, potatoes, beetroot, kohlrabi, radishes, onions, leek, garlic.

**Veggie Type 2:** Fruit & Seed - Peas, beans, tomatoes, capsicum, sweet corn, eggplant, pepper, cucumber, endive, courgette.

**Veggie Type 3:** Leaf & Stem - Cabbage, cauliflower, broccoli, celery, lettuce, silver beet, spinach, brussels sprouts.

Long-term crops such as asparagus and rhubarb are grown outside the rotation.

# 3 Year Crop Rotation

## Root & Bulb



## Fruit & Seed



## leaf & Stem



Adapted from <http://www.kings.co.nz/Growing+Guides/Vegetable+Crop+Rotation.html>

## Annexure H: Companion Planting

(Antagonists are plants that don't grow well with one another.)

Vegetable	Companion	Antagonist (don't plant next to this vegetable)
Beans	Potatoes, carrots, cucumbers, cauliflower, cabbage	Onions, garlic, gladiolus
Beets	Onions, kohlrabi	Pole beans
Cabbage family (cabbage, cauliflower, kale, kohlrabi, broccoli)	Aromatic plants, potatoes, celery, dill, camomile, sage, peppermint, rose	Strawberries, tomatoes, pole beans
Carrots	Peas, leaf lettuce, chives, onions, leeks, rosemary, sage, tomatoes	Dill
Corn	Potatoes, peas, beans, cucumbers, pumpkin, squash	
Eggplant	Beans	
Lettuce	Carrots, radishes, strawberries, cucumbers	
Onions and garlic	Beets, strawberries, tomatoes, lettuce, camomile	Peas, beans
Potatoes	Beans, corn, cabbage, marigold, eggplant	Pumpkins, squash, cucumbers, sunflowers, tomatoes, raspberries

Pumpkins	Corn	Potatoes
Spinach	Strawberries	
Sunflowers	Cucumbers	Potatoes
Tomatoes	Chives, onions, parsley, asparagus, marigolds, nasturtiums, carrots	Kohlrabi, potatoes, fennel, cabbage

Source: **Growing the Living Laboratory - Permaculture for Environmental Education in the NCS - Intermediate Phase Grades 4-6**, Published by SEED (Schools Environmental Education and Development), 2006.

# **Annexure I: Integrated pest management**

SEED refer to pest control in their book *Growing the Living Laboratory*. Parts from the section called Integrated pest management are reflected in the tables below:

## **Integrated pest management**

These methods help to prevent pest problems as well as getting rid of pests that are already there.

### **Keep your plants healthy**

Healthy plants are attacked by fewer pests and diseases than plants that have a shortage of minerals and water. Give your plants plenty of organic matter and mulch to keep the soil wet.

### **Check plants for pests**

Regularly check for pests on your plants. Control any pests as soon as you notice them.

### **Pick large pests off the plants**

Pick large pests such as grasshoppers, snails and beetles off plants. If there are small numbers, stand on them. If there are large numbers of the pests, carry a bucket of water to throw them into. Feed the pests to chickens or other birds.

### **Wash small pests off the plants**

Small pests such as aphids and mealybugs can be washed off leaves with a strong spray from a hose-pipe. These insects are seldom a problem if you use sprinkler irrigation because the spray washes the pests off the leaves.

## **Use crop rotation**

Crop rotation means changing the plants you grow on each piece of land. If you grow the same plant in the same place over many seasons, the pests and diseases that attack that plant will increase. If you grow different plants every season then the pests and diseases of the previous season's plants will have nothing to live on and so will die out.

## **Bury fallen fruit**

Fruit in which eggs have been laid or in which larvae are feeding often fall off the plant. Bury this fruit or allow pigs and chickens to feed under fruit trees to stop the life-cycle of the pests.

## **Use home-made pesticides**

You can make sprays to control certain pests. These sprays do not cause the problems that chemical pesticides cause. These sprays are still poisons and so you must use them with care. Do not make the spray too strong or put too much on the plants as you could damage or kill the plants. There are many different types of home-made pesticides. Some of these are given below.

**Garlic spray:** Chop 85g of garlic bulbs and add 2 tablespoons of paraffin to the garlic. Soak together for 48 hrs, and then add 800 ml of water, and grate 7g of hard Sunlight soap into this mixture. Strain the mixture through gauze and store in a glass or plastic container. When you want to use it, you must dilute it 100 times. If you need 5 litres of spray: mix 50 ml of the original with 5 litres of water. This is a spray that kills aphids, cabbage white butterfly, caterpillars, mosquitoes, snails and wireworms. It can also kill other beneficial insects, so use carefully! It also helps to halt downy mildew and leaf spot in cucumbers and bean rust and blight.

**General spray:** Chop 1 onion, 1 chilli and 1 garlic bulb. Steep overnight in enough water to cover it. Dilute 5 times before you use it. This spray repels most pests and also kills funguses. Spray for heavy infestations.

**Soapy water:** Mix 30g of grated Sunlight soap in 1 litre of water. Stir until soap is dissolved. Strain and use against aphids, maggots, leafcutters, mealybugs, red spider mites and whitefly. If you have a serious pest infestation, add 1 tablespoon of paraffin to the mix. You can also add soap to other sprays to make sure they stick to leaves.

**PLEASE NOTE THAT SOME ORGANIC INSECTICIDES ARE POISONOUS. USE THEM WITH CARE.**

## **Inter-crop**

Inter-cropping means planting two or more different kinds of plants together. If there is a big area of one kind of plant, the pests of that plant have plenty to feed on and quickly increase in number. Pests can spread easily from one plant to another. If you separate plants of one kind from one another by plants of other kinds, the pests have to look for other plants to feed on. Pests do not spread so easily to healthy plants.

## **Encourage the natural enemies of pests**

There are many creatures that eat the pests which eat crop plants. These pest-eating animals, which we call predators or natural enemies, help to keep pest numbers down. Spraying with chemical pesticides kills the natural enemies as well as the pest insects. Examples of natural enemies of plant pests are lizards, chameleons, insect-eating birds including chickens and ducks, ladybird beetles and larvae, preying mantises, spiders, wasps and some fly larvae. Some wasps lay their eggs into the larvae of pest insects.

We can encourage natural enemies by leaving wild areas and by creating wildlife habitats. Natural enemies come to garden areas from wild areas and thereby help to control garden pests. By creating habitats for the natural enemies, and encouraging biodiversity, we can further improve our pest control.

Lizards mainly feed on insects, many of which are plant pests. By building a lizard habitat, we increase the number of lizards in our garden and therefore get better pest control.

## Building habitats for lizards

You will need:

- stones, rocks, digging tools, plants, logs and mulch. Lizards like stones and rocks on which to lie in the sun. They also like logs to hide under and underground chambers that stay dry in winter where they can shelter from predators. The lizard garden needs to be close to the food garden, so that our predators can be on hand to eat plant pests.



Source: **Growing the Living Laboratory - Permaculture for Environmental Education in the NCS - Intermediate Phase Grades 4-6**, Published by SEED (Schools Environmental Education and Development), 2006

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