

Atoll Food Futures

Climate Resilient Home Gardening



Exploring Climate Resilient Home Gardening
Technologies for Pacific Nations

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Atoll Food Futures



Introduction

The *Climate Resilient Home Gardening Guide* has been developed to complement face-to-face training on the use of climate resilient home gardening technologies. It was written for community members familiar with gardening, who will also be receiving instruction by a trainer who can provide additional information and demonstrations.

The climate-smart agricultural practices outlined in this guide are water efficient and can be used when land for gardening is limited. These technologies are different to regular gardens because you can plant vegetables closer together and grow a lot more with a small amount of space.

Using the technologies in this guide will help you produce as much fresh healthy food as possible, helping to improve your household food security and increase your resilience to climate change. By using the information in this guide, watching carefully, and sharing your experience with other families who are also growing produce, you will build the knowledge and experience to grow an abundance of fresh, delicious and nutritious vegetables.

Consult your local agriculture extension worker or Live & Learn staff for more information on home gardening.

PART 1

This chapter discusses different types of garden beds that you can use in your home or community, including:



foodcubes



wicking gardens



raised garden beds
(including keyhole gardens)

Most of the technologies featured in this chapter can be made using simple materials that you already have access to.

Climate resilient gardens can help you grow crops in any conditions, so that you can eat fresh and nutritious food all year long.



Technology benefits

Foodcubes

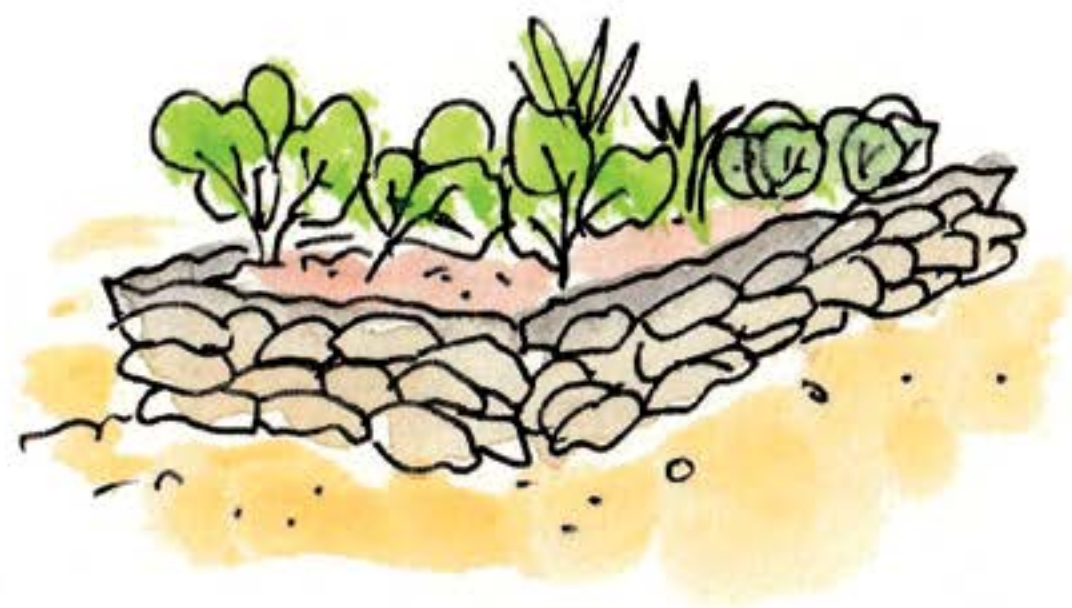
Foodcubes are an advanced wicking-bed design made from 80% recycled food-grade plastic by Biofilta International. This makes them light-weight to transport and movable once in use. They are water efficient by enabling plants to draw water from an adjustable reservoir under the soil via the soil cones.

Foodcubes are ideal for growing a variety of vegetables, especially leafy vegetables or vegetables that don't require a lot of space to grow. If utilised well, Foodcubes can grow up to 30kg of produce per year. Foodcubes can also be connected to one another to maximise on space in a community garden and can be raised for disability access.



Wicking gardens

A wicking garden bed is a self-water garden bed made from a large container (or watertight tarpaulin) with no holes. This means that the water is retained within the garden bed unit. They are great for conserving water because water is stored underneath a layer of soil. This water is known as 'well water' and when the well water is full it is drawn up from the bottom to the roots of the plants. Wicking beds work well in combination with Foodcubes because they provide more space for crops, including root vegetables, that need a lot of nutrients and more space than a Foodcube can provide.



Raised garden beds (including keyhole)

Raised garden beds can be made using a variety of materials. There are several options for raised garden bed design, including creating a keyhole garden. Raised garden beds have twice the production rate of regular dig-in gardens, which improves food production. This is especially true in the wet season because water can drain through them and away, preventing overwatering. A raised garden bed, especially a keyhole bed, is also an ideal choice for anyone with mobility issues since they aren't low to the ground.





Materials, construction and use

Think about location before building your garden. While many of these designs don't need much space, they should be placed in a sheltered area to reduce direct sunlight, excessive heat (especially between 9am and 3pm), strong winds and heavy rain.

You can provide shade from the afternoon sun by placing your garden by the side of a building and/or under trees. If the materials are available, you can construct a canopy over your garden using shade cloth.

Foodcube

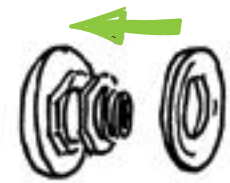
Materials

All pieces for basic Foodcube construction are provided. Remove all pieces from the inside of the tub, making sure everything is there.

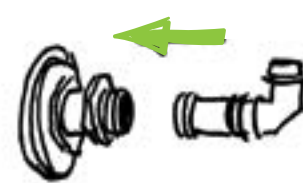
Foodcube

Construction

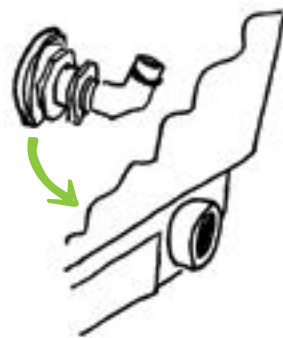
LEVEL SETTER ASSEMBLY:



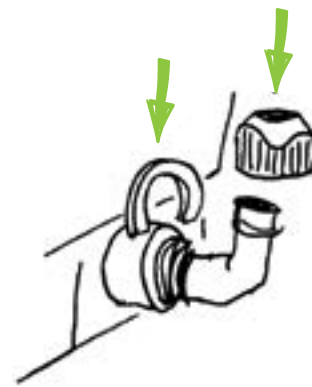
- 1 Place level setter seal over level setter outlet and push against the end flange.



- 2 Push level setter into outlet with a twist, until the second O ring is no longer visible. Lubricate O rings if needed.



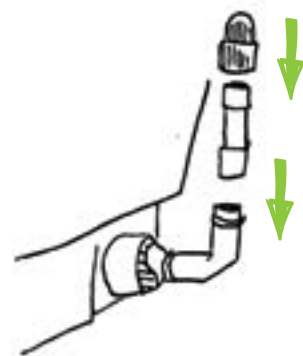
- 3 Insert level setter, outlet and seal from the inside of the tub until the thread is fully visible. Straight edges must align.



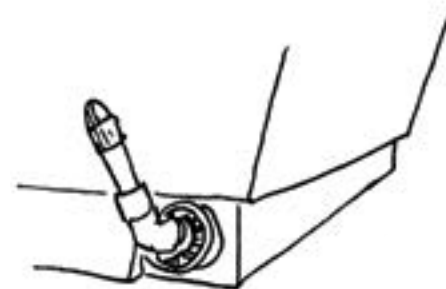
- 4 Slide circlip down groove at end of thread to stop outlet from sliding back into the tub.

- 5 Slide backnut over level setter and tighten until it reaches the tub. This needs to be very tight.

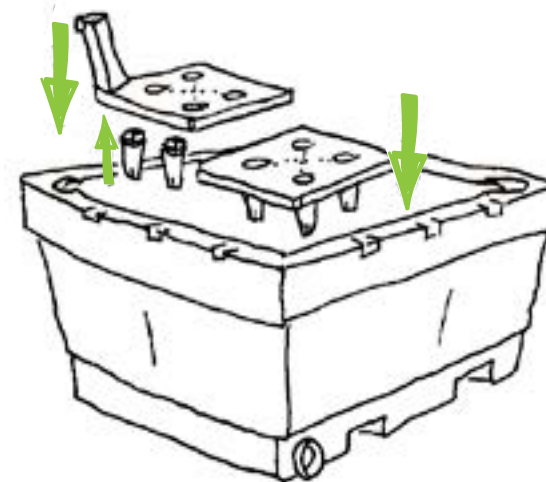
If you are not joining multiple Foodcubes, repeat steps 1 to 5 on the other side of the Foodcube.



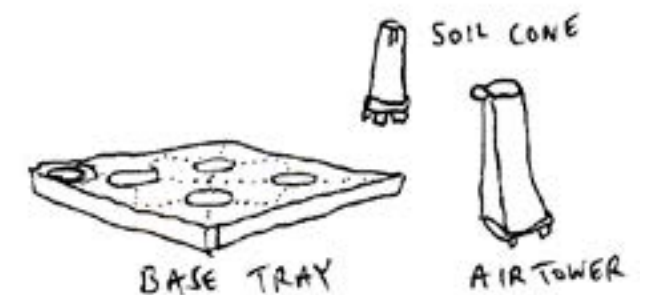
- 6 Screw the level setter extensions and mosquito cap into level setter to provide level height as shown.



TRAY SET-UP:



- 7 Attach each air tower to the two base trays with tower connections.



- 8 Attach soil cones to bottom of the four trays. Place trays in bottom of tub.

- 9 Hook tops of air towers into slots at corners of tub.

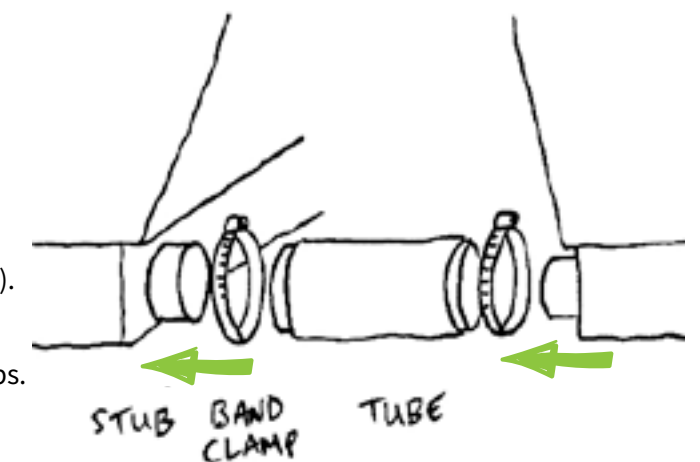
MULTIPLE TUB CONNECTION (OPTIONAL):

- 10 Place tubs close together with outlet stubs facing each other. (Level setter must remain on end tub.)

- 11 Place band clamps in grooves of connecting tube (but do not tighten yet).

- 12 Slide connecting tube onto stubs on tubs.

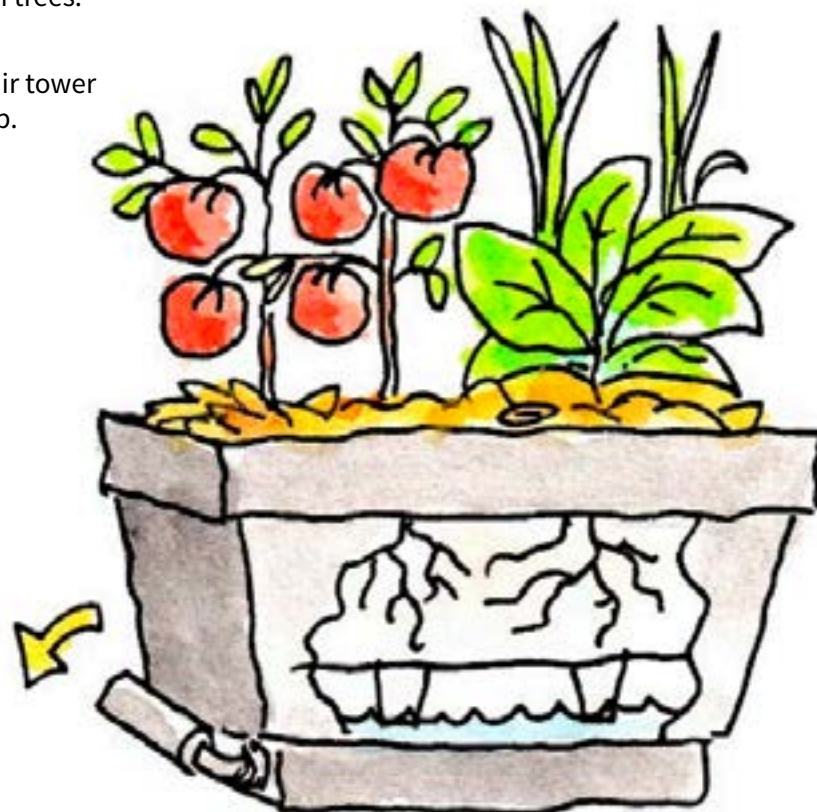
- 13 Tighten band clamps.



Foodcube

How to use

- 1 Ensure the cubes are on a firm, level surface.
- 2 Test seals by filling to maximum water level before adding the soil mix.
- 3 When beginning to fill the tub, push the soil mix into soil cones to ensure contact with water.
- 4 Cover the soil surface with newspaper (if available) and thick mulch (3-5cm) to minimise water loss. This could be any leaves (e.g., taro, banana), coconut husk or broken branches from trees.
- 5 Add water using the air tower vents at corners of tub.



Maintenance

- Remove the soil every 12 months and replace with new soil mix. Remove trays and check for root build-up in cones.
- Top-up with compost as needed.

Watering

Foodcubes can be watered through the spout at the base known as the 'level setter.' This is a handy way to adjust the amount of water needed in the Foodcube.

Level setter

- Use the level setter to control the water height.
- Use maximum setting to saturate the soil for seedlings.
- Use normal setting to create air gap between water and soil and to avoid root rot for mature plants.
- Check water level by checking level setter. Water should be visible inside the handle when set at the appropriate level.
- Tilt level setter downwards below horizontal to drain tub.

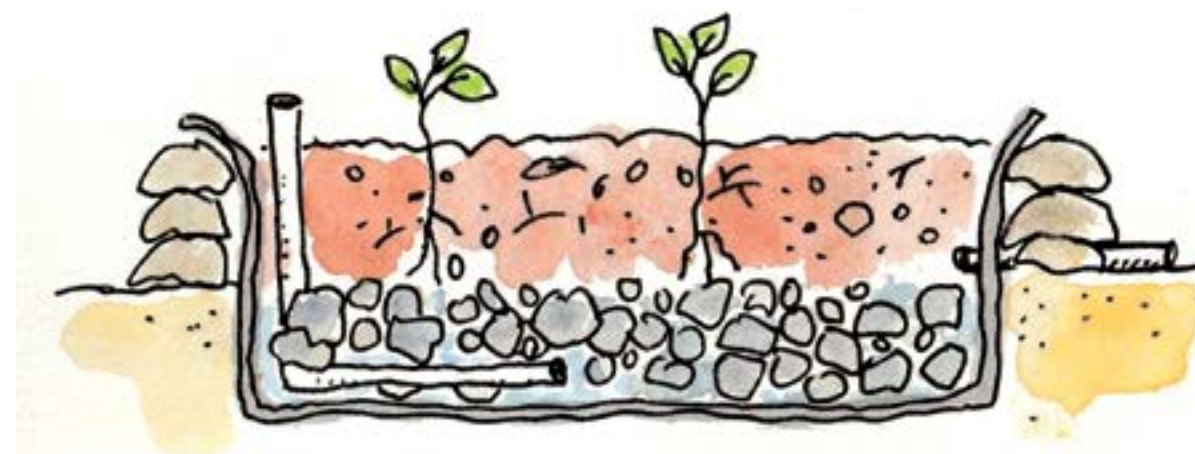
Wicking garden

Materials

- A large watertight tarpaulin to line the garden bed. A container could be used if this is not available e.g. a plastic tub.
- Something for the bottom of the container that will make space for water and hold the fill up on top of it, e.g. small rocks or old plastic bottles
- Nursery mesh to separate the soil and the reservoir created by the rocks (needs to be close weave mesh to avoid soil coming into the reservoir)
- Plastic pipes or tubes: one the same height as the container and the other 20 to 30cm long.
- Materials for the walls of wicking system – coconut husk or similar
- Soil (See Part 2: Soil).
- Mulch: You'll need enough mulch on top of the soil that reaches the depth of a hand (from the tip of your fingers to your wrist).

Construction

- 1 Dig a hole for your wicking bed; dimensions should be 15cm deep and no wider than 1m (to allow access to the middle of the bed). Length should be around 2m for the wicking process to work best.
- 2 The first layer in your watertight container/tarpaulin will be the item you choose to make space for water and support the soil on top of it (e.g. small rocks or old plastic bottles). This layer should be 15cm deep. It will become the water reservoir.
- 3 Take your first plastic tube and place it vertically so that it is almost touching the bottom and sticking out at least 40cm above the top.
- 4 Cover with a layer of nursery mesh (you will need to make a hole for the plastic tube).
- 5 Lay your second pipe horizontally on top of the mesh, with part inside the bed and part sticking out.
- 6 Build up the sides of your wicking bed with coconut logs, rocks or similar.
- 7 Add your soil mix and cover with a final layer of mulch. Do not cover over the top of the plastic tube.



Watering and use

The vertical pipe sticking out the top of the container is the watering pipe. Pour water into this pipe so that it fills the well in the bottom. You will know when it is full because water will come out of the overflow pipe. Thanks to this pipe your wicking bed can never be overwatered, even when it rains.

When you have planted your vegetables in the wicking garden bed, give them a quick water on top to help them get started. After planting, only water your garden using the top pipe. The moisture will be evenly divided at the base for the roots to access water as they need it.

After two years of use, remove all the contents and start again. This way you can replace any parts that have broken or rotten, as well as improve the soil quality. For continued use of your wicking garden bed replace or top up the soil after harvesting.



Alternative wicking garden designs are available. To learn more consult Live & Learn staff or your local agriculture extension officer.

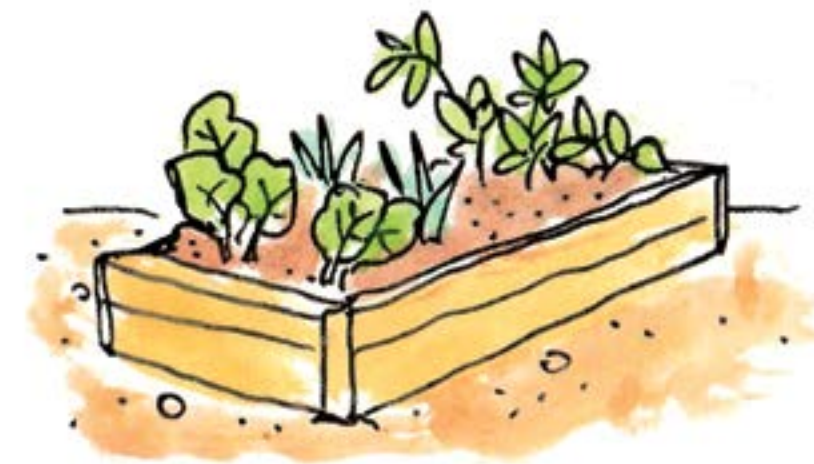
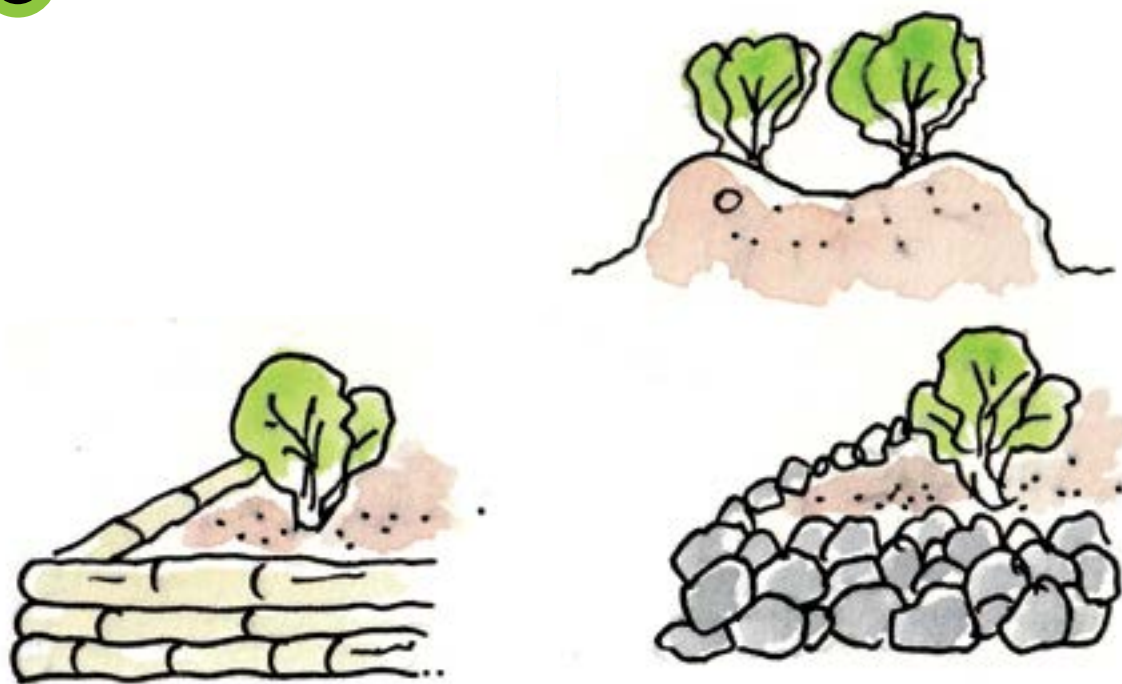
Raised garden bed

Materials

- Edge materials: The boarder/edge of your raised garden bed can be made of whatever material you have available, e.g. rocks, wood, earth bricks. (A raised garden bed can be made without edging materials, but after a while the soil will be washed out of the bed.)
- Soil mix (See *Part 2: Soil*).

Construction

- 1 Using the edge materials, create your raised garden bed boundary. Your raised garden beds will need to be small enough so that you can reach all your cops without stepping on them, but wide enough to be able to retain water. A good size to follow is 2m by 1m, and 40 to 50cm high.
- 2 Add soil mix.



Watering and use

To tell if your raised garden bed needs water there is one simple test you can do. Simply stick your finger into the soil (roughly three centimetres deep). If the soil is damp and sticks to your finger after you remove it, there is no need to water. If the soil is not moist or doesn't stick to your finger, it's time to water.



Keyhole garden

A keyhole garden is another type of raised garden bed that is especially good for access, as the design includes a pathway into the middle of the bed.

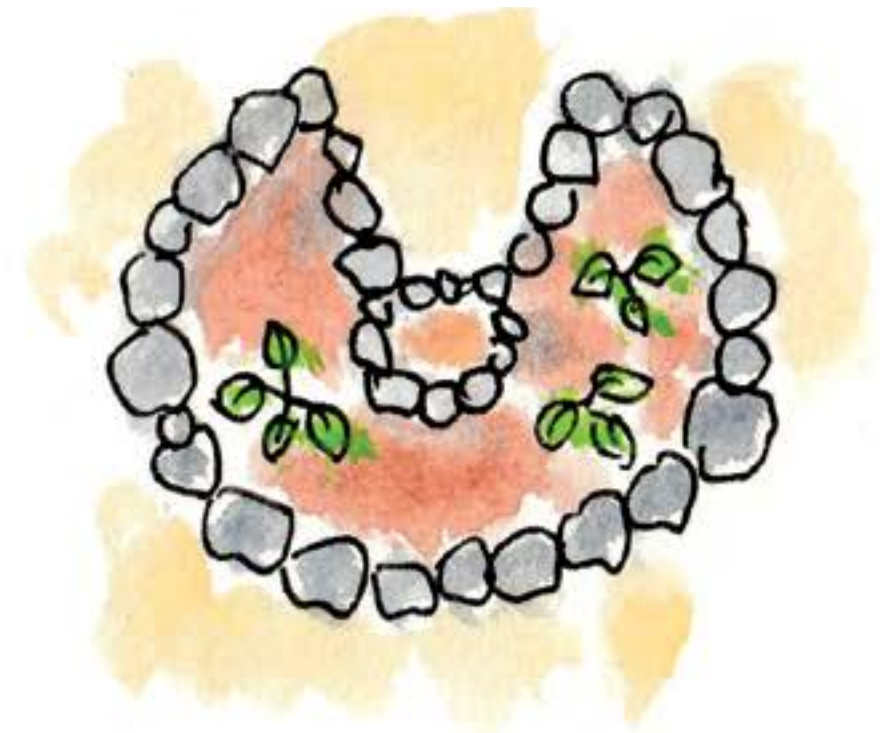
Materials

- Edge materials: rocks, cement, old bricks, wood etc.
- Compost wall materials: sticks, palm leaf stalks, thin wood poles, thin branches, grass or thin vine
- To fill your keyhole garden: soil, manure, compost, rock dust, green leaves, dry leaves, seaweed, charcoal, ash (half a bucket)

Construction

- 1 Make a circle on the ground 3 meters in diameter where you want your keyhole garden to be. Make a circle in the middle for the compost area, 90cm in diameter. Allow for a path to the compost circle in the middle. This should be wide enough for a person.
- 2 Start with the compost circle in the middle first. Dig the sticks/thin wood poles/branches into the ground to make the circular compost wall. Make sure some of the sticks used are at least 150 cm high and stick out above the others. The rest of the sticks should be lower (roughly 100 to 120 cm high) so that you can easily add the compost. Secure the sticks using grass, twine or string.
- 3 Fill the compost circle compost (See Part 2: Soil).
- 4 Start building the outside wall of your keyhole garden with whatever sturdy materials you have. This could be rocks, cement or bricks. Make sure the outside wall is complete before you start filling in your garden bed.
- 5 Fill the garden bed with a mix of soil and manure. Make sure that the top layer is a mix of soil/compost that is 10 cm thick. This will allow you to plant straight away. As you build your garden add water to the soil and finish with a layer of mulch.

OPTIONAL: Use shade cloth or build a grass roof over your compost to protect it from the sun and rain. Or you can plant taller crops, like climbing beans, next to your compost for protection.



Watering

Plant your vegetables into the garden bed and water well. After a couple of weeks, when the plants are growing well, you can water your keyhole garden via the compost circle in the middle. The plants will grow their roots towards the compost. Add more ingredients to the compost to keep it full.

PART 2

Soil

The soil in your garden is very important because healthy soil helps us to grow healthy plants with good yield. Every garden will need a mix of soil and compost to give plants all the nutrients they need. This chapter will discuss soil health and making quality soil for your garden.

When adding soil, you need to think about the quality of it. In atolls, a lot of the soil is too sandy or made from too much broken down coral to give the right nutrients needed for plants to grow well. Likewise, soil where waves and salt water have regularly covered it is not great for growing most types of crops, due to high salinity which stunts and sometimes prevents crop growth altogether.



HOW CAN YOU TELL SOIL IS HEALTHY?

There are a few signs of healthy soil. There should be many bugs, like earthworms, living in your soil. It should be darker in colour, meaning lots of old plant and animal material. Good soil absorbs moisture well and is moist but also lets water drain through when there is heavy rain. Dry or sandy soil will not hold water well.

Do not use only soil from the ground to fill your wicking garden bed; instead create a soil mix with plenty of compost for your plants to grow in. In some cases, people will have a collection of coconut trees, and branches of breadfruit or papaya that have had some time to decompose. These can be mixed with existing soil. This kind of soil is really good for Foodcubes, wicking beds and raised garden beds.

Foodcube

Each individual Foodcube container needs to be filled with 330 litres (33 buckets) of soil mix.

This soil mix needs to be high in compost. A mix you can make is below:

- 70% compost.
- 30% dried coconut husk (also called coir or cocopeat) for further water retention.

If you don't have enough compost, you can add up to 20% sandy soil, but do not add more than this because sandy soil lacks nutrients for plants and does not hold water well.

Coir is rich in carbon, and is a useful addition to compost, helping to balance nitrogen-rich materials like grass clippings and kitchen waste. Coir is the combination of coconut husk fibres and finely mulched coconut husk, which has a consistency like coffee powder.

If you don't have this large an amount of compost, contact your local suppliers. Live & Learn or your local government staff can help identify who these are for you.

Wicking gardens

Do not use only soil from the ground to fill your wicking garden bed. Instead create a mix that is:

- 50% soil.
- 25% compost.
- 25% dry coconut husks.

The amount of soil required will be based on how big you choose to make your wicking garden bed.

Raised garden beds

The mix of soil and compost should be:

- 60% soil.
- 40% compost or manure.

You can also add dried shredded coconut husk (coir or cocopeat), with a rough ratio of 40% soil, 30% compost and 30% coir.

Recipes

A high percentage of compost is needed for your garden. If your soil is rich in compost this will create a healthy environment for your plants to thrive in.

IN-SITU FERMENTATION

This method breaks down waste materials but is slightly different to composting because the contents don't need turning for airflow. The layers are slower to break down but the soil can be used to fill a raised garden bed or wicking garden. It can also be used in an in-situ, or in-ground, bed, as long as there is no danger of saltwater getting in from below.

METHOD

- 1 Fill the first 10cm with any of the following materials to make your base: chipped wood, cardboard or paper products, coconut husks, coconut trunks etc.
- 2 Add 10cm of green materials e.g. food scraps, grass, rotten fruits or vegies.
- 3 Add 15cm of brown materials e.g. seaweed and shredded logs (a mix of these would be ideal).
- 4 Add 12cm of compost mixed with black sand/ soil. A ratio of 50/50 is ideal.



HOT COMPOST RECIPE

RECIPE

INGREDIENTS

3 parts brown – 3 parts green – 1 part manure

Brown: Fallen leaves of trees (such as Breadfruit with Premna and Guettarda), rotten coconut logs

Green: Beach Cabbage or any kind of green leaves e.g. banana leaves or veggie scraps (no lemon or orange because they are too acidic)

Manure: Pig manure, human urine, old compost



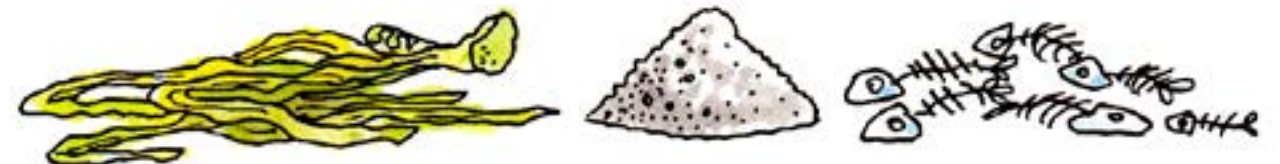
COMPOST SEASONING FOR ADDED NUTRITION

(like the salt in a good meal):

Seaweed: Adds potassium, iron, manganese, copper, phosphorus, zinc and sulphur. Must be left to rinse in rainwater (to get the salt off)

Coconut ash: Adds potassium, iron, manganese, copper, phosphorus, zinc and boron. Sprinkle 1 cup of cooled burned coconut husks and shells in cooking fires on top of each layer of brown, or 2 shovels (4–5 kg) mixed in a cubic metre compost heap

Fish waste or human urine: Adds nitrogen



EQUIPMENT

The only tools needed are a pitchfork, rake and a waterproof cover.

HOT COMPOST

METHOD

- 1 Make a base 20cm high with sticks or coconut husks for air circulation.



- 2 Add a 25cm layer of brown materials (dead plant material).



- 3 Sprinkle two shovels of ash over brown layer.



- 4 Add a 15cm layer of green material (green leaves and food scraps), fish waste and urine.



- 5 Add some manure and/or old compost.



- 6 Sprinkle some water over the layers so they are not dusty. You need to be able to squeeze a drop of water out of a big handful after 4 days.



- 7 Repeat brown and green layers, water lightly after each layer until heap is 1 metre high.



- 8 Cover heap with a tarpaulin, banana leaves or palm fronds to make it hot.



- 9 Wait for 2-3 days then check temperature by pushing a knife into the centre of the pile. The knife blade should be hot when you pull it out.*

**If it is not hot enough your heap might need to be made bigger (over 1.5m high) or check to see if it might be too wet or too dry.*

- 10 Leave the pile to heat up for a week then turn compost every two days.



- 11 By day 18 the finished compost pile should be the same size as in the beginning, but everything has changed to a dark colour, with a fine texture and a slightly warm temperature.

Always wash your hands with soap and water after working with compost!

LIQUID MANURE FERTILISER

← RECIPE

Liquid manure fertiliser can be applied to your garden if your plants aren't growing as well as you think they should be. This recipe is especially important to use if your soil mix is over three months old because it will put much needed nutrients back into your soil. You also need to add some liquid manure fertiliser if the leaves of your vegetables are yellowing.

MATERIALS

- Fresh poultry or pig manure
- Water
- 2 containers



METHOD

- 1 Fill a quarter of the container with the manure and fill with water to the top of the container and cover.
- 2 Stir the mixture three times a day for two days, until the mixture turns a pale-yellow colour.
- 3 Pour the liquid into another container until it is a quarter full, then top it up with fresh water. The liquid is now diluted and ready to be applied to the soil and mulch around the plant.

Always dilute liquid fertiliser before applying it to. You can apply it to the soil under the top layer of plants. About 1/2 litre per square metre of garden.

Note:

You can use pig manure, but chicken manure has a higher amount of nitrogen (N), phosphorous (P) and potassium (K).

Chicken Manure: N – 1.8%, P – 2.7%, K – 1.5%

Pig Manure: N – 0.3%, P – 0.4%, K – 0.2%



SEAWEED TEA FERTILISER

← RECIPE

This solution has a dual function: it controls pests and keeps the soil healthy. It is full of many useful nutrients. This recipe works just as well by replacing the seaweed with banana skins. You don't have to dilute the liquid after soaking the banana skins.

MATERIALS

- 20-litre bucket with lid
- Seaweed (not sea grass)
- Fresh water
- Stick, for stirring



METHOD

- 1 Put seaweed into a bucket.
- 2 Add 5 litres of water and firmly close the bucket with the lid.
- 3 Leave in bucket for 2 weeks, stirring every few days.
- 4 Strain out the liquid.
- 5 The seaweed left in the bucket can be used in mulching the Foodcubes or included in making more compost.
- 6 Take half a cup of seaweed solution and mix it with three quarters of a cup of fresh water to make your pest control and fertiliser solution.
- 7 Water your garden conventionally using the solution.

PART 3

Plant Lists

Foodcubes

Planting the right combination of vegetable seeds is essential to making the most out of your climate resilient food technology. Different combinations of plants have different benefits and by growing produce at the right time and in the right combination you can harvest all year long. This chapter will help guide you through different options for planting in each technology.

It is important to think about your household's food needs when choosing your vegetables. Planting a variety of vegetables from different food groups in your garden can give you the nutrients you need, for example: a bean, a dark green leafy vegetable and an orange vegetable like a carrot. Try unfamiliar varieties and see which grows best. If you are planning on selling your crops, you might also want to consider the market value of each item you are planting.

Although the cubes are small and they aren't very deep, you can grow a lot in them with the right combinations of plants. Here are a few things to consider when planting vegetables in your Foodcube:

- Different heights will allow better access to sunlight. Climbing plants like beans and cucumber can be trained to climb frames that you add to your Foodcube, making more space for other vegetables.
- Some plants spread out a lot under the soil (e.g. Taro Futuna), which means they have to be spaced out more and it don't make efficient use of the limited space. Other plants don't take up as much space (e.g. carrot).
- Some plants prefer less sun – they can be shaded by others within the Foodcube.
- Some plants use more nutrients than others. We call these 'heavy feeders'. Some help make nutrients available for others. We call these 'heavy givers'. Others are somewhere in between (let's call them tweeners). We need to have a good mix of types of plants in the cube. We are trying to avoid too many heavy feeders (they also normally need more space!).
- Consider planting seedlings of the same vegetable 2 weeks apart – this will give you more produce for longer.

People often plant cabbage or root crops or fruit trees in Foodcubes, but these crops are more resilient and can be grown outside Foodcubes. They also take up a lot of space in the Foodcube that could be used for other vegetables. We want the Foodcubes to be as productive as possible.

The following is a guide to plant types, with harvest timeframes based on raising from seed.
If you are planting seedlings, reduce each time given by 2-3 weeks.

PLANT	TYPE/ FAMILY	BELOW GROUND	HEIGHT	SPACING	TIME	SUN	WATER
Spring onion	Tweener/ Amaryllodaceae (Lily or Onion)	Shallow	40cm	10 X 10cm	8 weeks	Full	Moderate
Carrot	Tweener/ Apiaceae	30cm	30cm	5 X 10cm	10 weeks	Half	Moderate
Broccoli	Heavy feeder/ Brassica (cabbage)	15cm	40cm	40 X 30cm	8 weeks (remove head and it'll regrow)	Full	Moderate
Chinese cabbage / bok choi / wong bok	Tweener/ Brassica (cabbage)	Shallow	30cm	15 X 20cm	8 weeks	Full	Moderate
Kale	Heavy feeder/ Brassica or (cabbage)	Moderate	40cm	40 X 30	8 weeks (remove some leaves and it will keep growing)	Full	Moderate
Kumala (Sweet Potato)	Tweener/ root crop	30cm	70cm	40 X 50cm	16 weeks	Full	Moderate
Okra	Tweener/ root crop	Shallow	1m (sprawling)	20cm X 30cm	12 weeks	Full	Moderate
Beets (beetroot)	Tweener/ Chenopodiaceae (beet)	15cm	40cm	20X 20cm	8-10 weeks	Full	Moderate
Cucumber	Heavy feeder/ Cucurbitaceae (squash)	Shallow	70cm	30 X 30cm	8 weeks	Full	Moderate
Bean / long bean, / snap bean	Heavy giver/ legume family	Shallow	1.0-2.0m	10 X 10cm	12 weeks	Half	Moderate

PLANT	TYPE/ FAMILY	BELOW GROUND	HEIGHT	SPACING	TIME	SUN	WATER
Wing bean	Heavy giver/ legume family	shallow	1.0-1.2m	10 X 10cm	9 weeks	Half	Add additional water by hand
Capsicum	Heavy feeder/ Solanaceae (tomato)	15cm	60cm	20 X 30cm	10 weeks	Full	Add additional water by hand
Eggplant	Heavy feeder/ Solanaceae (tomato)	20cm	40cm	30 X 30cm	10 weeks	Full	Moderate
Tomato	Heavy feeder/ Solanaceae (tomato)	15cm	1.0m	40 X 40cm	10 weeks	Full	Moderate
Ginger	Light feeder/ Zingiberaceae	30-40cm	1.5+m	30X30cm	30 weeks	Shade	Avoid too much water
Herbs (coriander, amaranth, mustard)	Light feeder/ various	shallow	30+cm	10cm X 10cm	4-6 weeks	Full	Add additional water by hand



Wicking gardens

The following is a guide to plant species that are best suited for wicking garden beds, when used in combination with Foodcubes. These timeframes are based on raising from seed. If you are planting seedlings, reduce each time given by 2 to 3 weeks.

PLANT	TYPE/ FAMILY	BELOW GROUND	HEIGHT	SPACING	TIME	SUN	WATER
Giant Taro (Alocasia)	Heavy feeder/ Araceae (arum family)	Plant 30cm deep, needs 50cm+	1m+	1m X 1m	9-12 months	Partial	Moderate
Taro Futuna (Xanthosoma)	Heavy feeder/ Araceae (arum family)	Plant 30cm deep, needs 50cm+	1m+	1m X 1m	8-10 months	Partial	Moderate
Taro Tonga (Colocasia)	Heavy feeder/ Araceae (arum family)	Plant 30cm deep, needs 50cm+	1m+	60 X 60cm	8 months	Partial	Moderate
Kumala	Tweener/ root crop	30cm	70cm	40 X 50cm	16 weeks	Full	Moderate
Cabbage	Heavy feeder/ Brassica (cabbage)	Plant shallow, needs 30cm	Low	40 X 40cm	4 months	Partial	Moderate
Melon	Heavy feeder/ Cucurbits (squash)	Plant shallow, Needs 50cm+	Low	60 X 60cm	3-4 months	Full	High
Pumpkin/ squash/ gourd	Heavy feeder/ Cucurbits (squash)	Plant shallow, Needs 30cm+	Low	60 X 60cm	3-4 months	Full/ Partial	Moderate
Bean	Heavy giver/ legume	Shallow	1.0m+	10 X 10cm	12 weeks	Half	Moderate
Pele	Tweener/ Malvaceae (mallow family)	Plant 10cm, needs 1m	1m+	90 X 90cm	3-4 months	Full	Moderate
Banana	Heavy feeder/ Musaceae	Plant 50cm, needs 80cm,	1m+	1m X 1m	10-12 months	Full/ Partial	Moderate

PLANT	TYPE/ FAMILY	BELOW GROUND	HEIGHT	SPACING	TIME	SUN	WATER
Plantain	Heavy feeder/ Musaceae	Plant 30cm, needs 80cm	1m+	1m X 1m	14-20 months	Full/ Partial	Moderate
Maize / corn	Heavy feeder/ Poaceae (grass family)	Plant 10cm, needs 30cm	1m+	20 X 30cm	4-5 months	Full	Add additional water by hand
Cassava	Super heavy feeder/ spurge family	Plant 10cm, needs 50cm+	1m+	60 X 60cm	8 months	Full	Low
Fruit trees*	Tweener/ various	varies	1m+	varies	2-3 years (Banana grows well after taro)		High

*Some fruit trees can grow too big for the beds in this guide. Use dwarf varieties or make sure your bed is big enough. Keep topping up with compost and fertiliser if you have plants that last more than two or three years in the bed.



Raised garden beds (including keyhole)

Raised garden beds are slightly different to other forms of climate resilience technology because they can rely on a mix of heavy and light feeders. The recommended ratio is:

- 30% heavy feeder.
- 30% tweener.
- 30% heavy giver.
- 10% either tweener or heavy giver.

Plants from either of the lists above can be used in your raised garden bed.



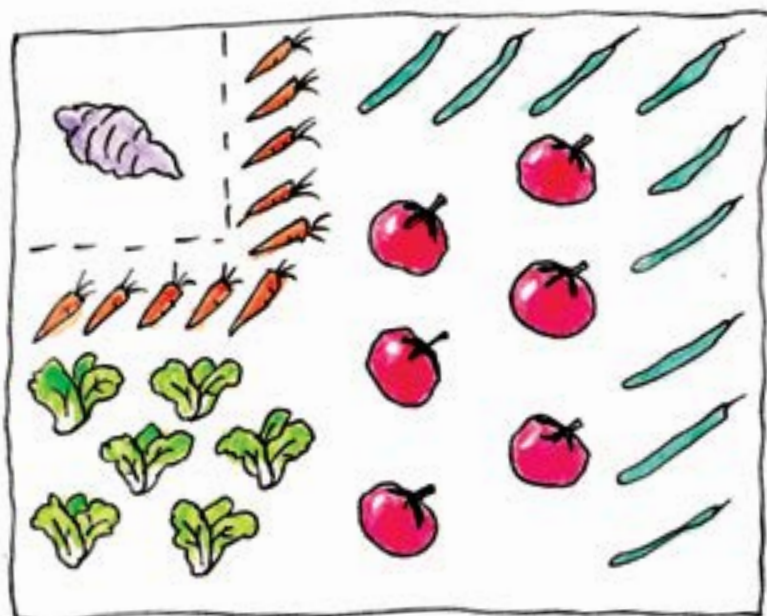
Arranging the plants

The following arrangements were designed for Foodcubes but can be applied to other climate resilience technologies. Use them as inspiration for your own gardening style!

It is recommended to have a good mix of plant families in your garden so that you can grow and eat a diverse range of vegetables. These can be arranged in a few ways, according to the space each vegetable needs, to maximise the amount of vegetables a cube can produce. A few options have been developed for people new to Foodcubes or other raised garden bed planting technologies.

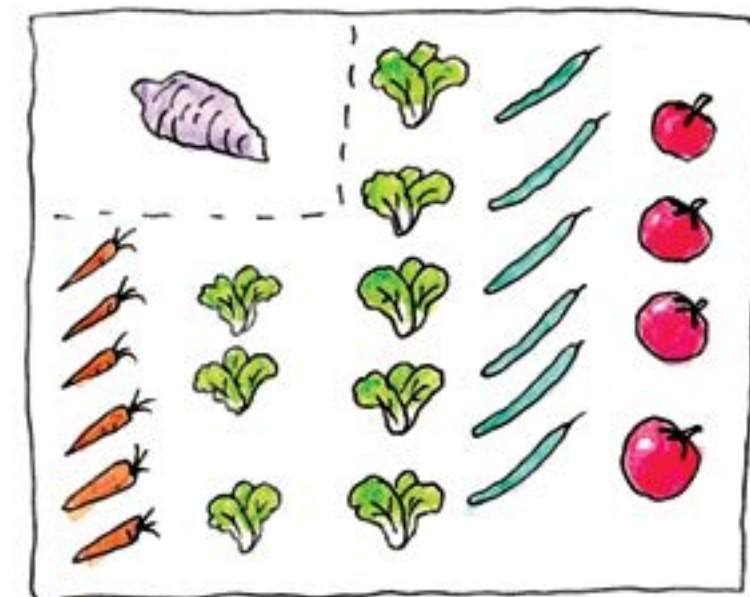
OPTION 1: VEGGIE BOWL

- 1 kumala
- 9 beans (heavy givers)
- 6 heavy feeder (tomato, capsicum, eggplant or cucumber)
- 6 leafy tweeker (e.g. Chinese cabbage)
- 10 root tweeker (carrots, but these could be switched with spring onion)



OPTION 2: LEAFY GREENS

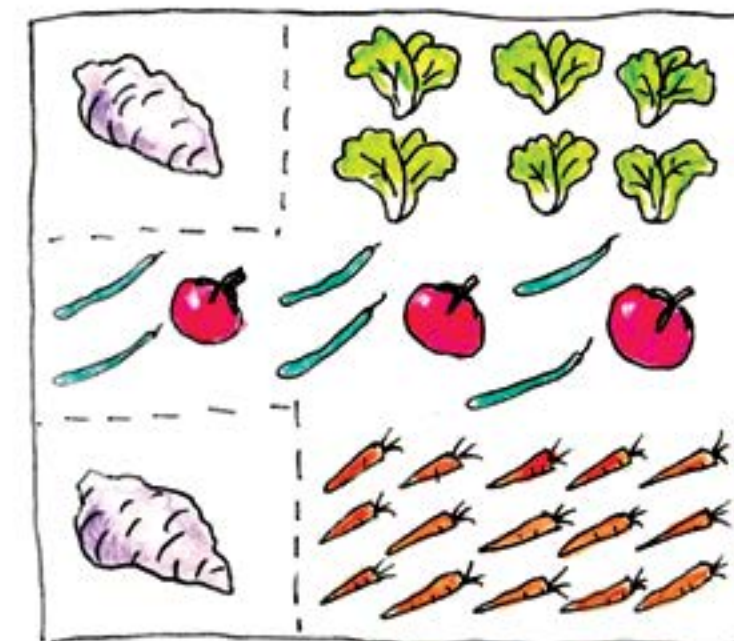
- 1 kumala
- 6 beans (heavy givers)
- 4 heavy feeders (tomato, capsicum, eggplant or cucumber)
- 8 leafy tweekers (e.g. Chinese cabbage)
- 6 root tweekers (e.g. carrot)



OPTION 3: ROOT RICH

This option has lots of root vegetables and 2 rows of taller vegetables that will need a climb frame.

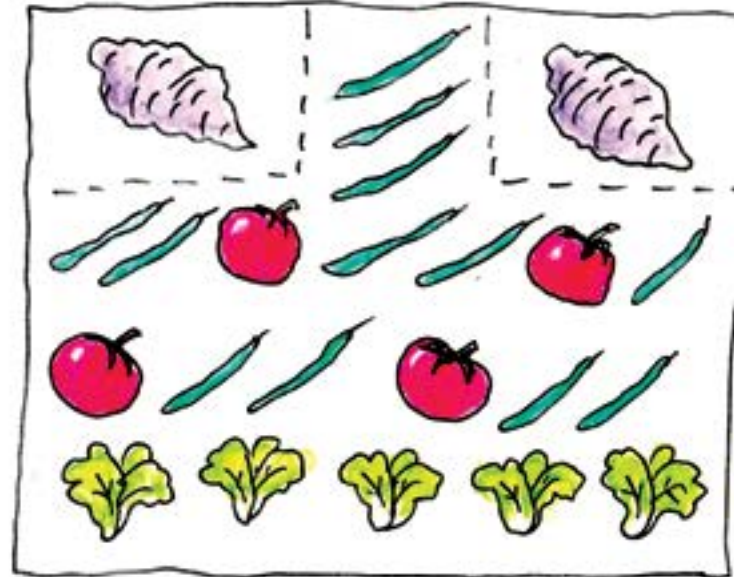
- 2 kumala
- 6 beans (heavy givers)
- 3 heavy feeders (tomato, capsicum, eggplant or cucumber)
- 6 leafy tweekers (e.g. Chinese cabbage)
- 15 root tweekers (e.g. carrot)



OPTION 4: ROOTS AND GREENS

This option has root veggies and 3 rows of taller veggies that will need a climb frame. It is similar to option 3, except the carrots have been replaced with more leafy greens. One of the rows of beans and heavy feeders could be replaced by an additional 5 leafy tweekers if more greens are desirable.

- 2 kumala
- 12 beans (heavy givers)
- 4 heavy feeders (tomato, capsicum, eggplant or cucumber)
- 5 leafy tweekers (e.g. Chinese cabbage)



Pest Control

Natural pesticides are one way to manage pest problems. Natural pesticides should be a part of regular pest management but should only be used when necessary. Do not use natural pesticides if there are no pests and crops are not damaged.

Some natural pesticides are very strong and will kill all insects, both good and bad. Be careful, because most insects are not harmful to your crops and killing them can cause more problems in the future.

Hands are an excellent natural pesticide!
Many pest problems can be controlled by regular observation and hand removal of pests.

Encouraging natural pest predators

Healthy soil produces strong plants that resist disease and pests. Natural predators are very effective at controlling pests in the garden, and include birds, lizards, frogs, bats, dragonflies, wasps, spiders, praying mantis, ladybugs and some types of flies.

Natural pest predators can be encouraged in your garden if you provide:

- small ponds or water containers for birds, frogs, dragonflies and fish.
- trees for birds, bats, wasps, bees and spiders.
- rocks and rotting wood for lizards and spiders.
- flowers, small trees and vine plants for wasps, bees, spiders, praying mantis and ladybugs.



Natural Pesticide Recipes

RECIPE

INSECT SPRAY

- Collect a handful of insects that are eating your plants.
- Crush them and mix them into a small bucket of water.
- Leave for 2 days.
- Strain the liquid and spray onto affected crops with a mist spray (a well rinsed and dried container for household cleaners can be used).



Use only a small amount of the solution on the leaves. If you don't have a mist spray, you can add the solution to a cloth or paint brush and wipe plant leaves. The same type of pests as the ones in the spray will be repelled by the liquid. The remaining insect bodies can be put in containers and placed around crops. The smell of this will continue to repel pests. This spray works well for caterpillars, slugs, snails and various small pests. It is less effective for grasshoppers.

RECIPE

GARLIC AND ONION SPRAY

- Combine 3 bulbs of peeled garlic with a large onion and add to a pot of water.
- Add about a tablespoon of grated soap or liquid detergent.
- Stir and leave for one day.
- Strain the liquid and use a mist spray to apply to affected plants (if you don't have one, you can wipe on the leaves with cloth or paint brush).



Garlic is an insecticide, fungicide and pest repellent. Onion is also an insecticide and insect repellent. The soap will help the spray stick to plants and pests. Use this liquid for aphids, caterpillars and moths. Garlic and onion plants will naturally repel many insects and can be planted in between crop rows to act as a natural deterrent. Some people add other ingredients like chilli to the spray.

RECIPE

TARO LEAF SPRAY

- Crush 10 taro leaves.
- Place into 3 litres of water and stir well.
- Spread onto plants using a palm broom.
- Make sure every plant is covered well with this liquid.

Taro leaves contain lisolic acid. When insects eat this it feels like eating broken glass! Most pests hate this spray, so it's good for general use.



Atoll Food Futures

