TOP Green ideas

This document outlines the environmentally friendly measures we are giving very strong consideration with a view to reducing our running costs and giving us greater chance of long-term financial sustainability. We are at various stages of research and aim to have enough information about each technique so that we know **exactly** what we are doing when we get to Botswana and can start to implement these techniques at the outset.

Water

Solar Energy to heat water
Water storage tanks
Water recycling
Cleaning water using coke bottles and sunlight
Black Plastic piping on roofs

Power

Solar Power
Charcoal fridge
Methane gas tanks
Diesel
Solar Oven
Firewood Saving Stoves

Land

Aquaculture
Worm farm for compost
Fences
Vetiver Grass
Jatropha trees
Moringa trees
Vegetables
Crop rotation
Pests
Orange Trees
Waste Management
Old car tyres
Recycling paper
Keeping decorative plants in pots to save water
Walls of tyres
Growing Soya

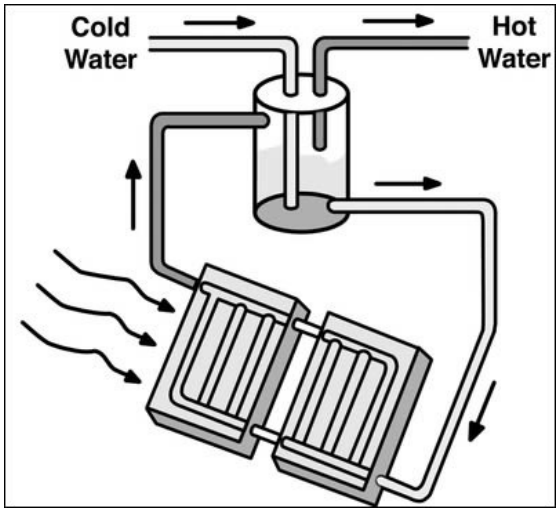
Water

Using Solar Energy to heat water.

- Using solar energy to heat water produces no harmful greenhouse gas emissions. A solar water heater can provide between 50 percent and 90 percent of your total hot water requirements, depending on the climate and the model of heater.
- The upfront cost of a solar water heater (including installation) is higher than electric or gas water heaters but energy bill savings will compensate for this over time.
- Most solar hot water systems use solar collectors or panels to absorb energy from the sun. Water is heated by the sun as it passes through the collectors. It then flows into an insulated storage tank for later use.
- In passive systems, water flows unassisted between the collectors and the tank. In active systems, water is pumped between the collectors and the tank.
- The storage tank is usually fitted with an electric, gas or solid fuel booster that heats the water when sunlight is insufficient. Some solar water heaters also have frost protection to prevent damage in frost prone areas.
- Solar collectors trap and use heat from the sun to raise the temperature of water. Flat-plate solar collectors are the most common type. They are comprised of:
    - An airtight box with a transparent cover.
    - A dark coloured, metallic absorbing plate containing water pipes.
    - Insulation to reduce heat loss from the back and sides of the absorber plate.
- Properly maintained solar thermal collectors should outlast the life of the storage tank. When the tank needs replacing, the existing collectors can be connected to the new tank.
- Frost protection for solar collectors is essential in frost prone areas. During a frost, water can freeze in the solar collector and damage it unless preventative measures are taken. Common types of frost protection include:
- Knock valves (mechanical drain down valves). These valves can be problematic as they often jam open and drain the tank, or fail to operate, causing severe damage.
- Electric heating elements, which are vulnerable in the event of power failure.
- Closed circuit systems, which separate the heating fluid from the water (see below). Closed circuit systems are usually the best option in frost prone areas as they ensure that water does not flow through the solar collectors.
- In an open circuit system, water flows directly through the solar collectors, into the storage tank and then through pipes into your home.
- Active systems are usually more expensive to purchase and require more maintenance than passive systems.

Passive systems

In Passive systems (or thermosiphon systems) the tank is placed above the solar collectors so that cold water sinks into the collectors, where it is warmed by the sun, and rises into the tank. A continuous flow of water through the collectors is created without the need for pumps.



Water storage tanks

It is possible to extend guttering or simply dig tanks into the ground and collect the rain water when it finally falls!

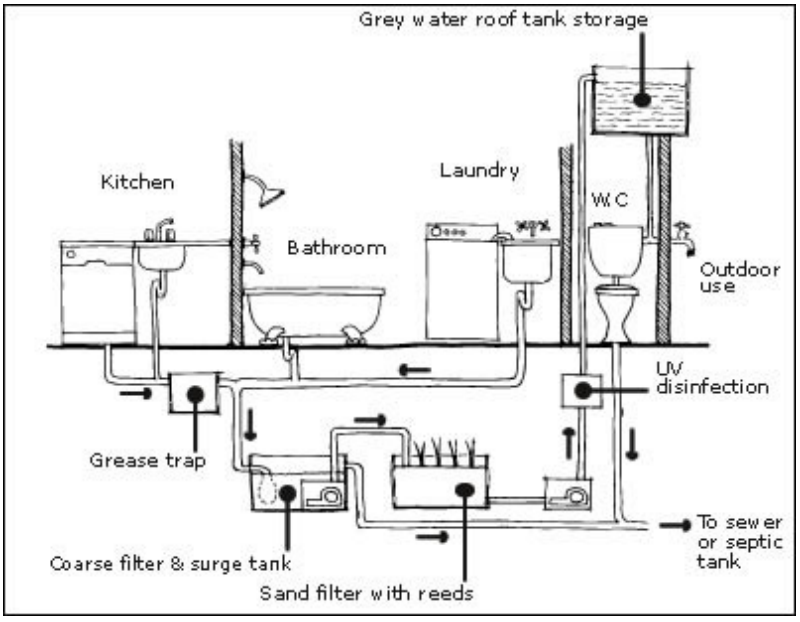
http://www.gaia-movement.org/files/Booklet%2010e%20Roof%20Water%20Tank.PDF

Water recycling

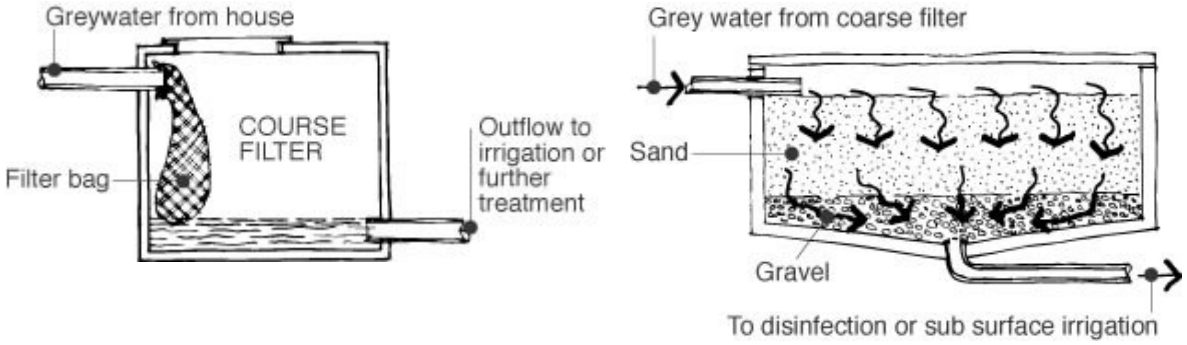
BLACKWATER	LITRES/PERSON/DAY
Toilet	22
GREYWATER	**LITRES/PERSON/DAY**
Shower	56
Hand Basin	6
Kitchen tap	12
Dishwasher	5
Laundry tap	7
Washing Machine	27
Total - Greywater	**113**
Total - Overall	**135**

Greywater can be re-used indoors for toilet flushing and clothes washing. Toilets and clothes washers are two of the biggest users of water in an average household.

An inefficient showerhead can use 20 to 30 litres of water every minute while an efficient one will give a high quality shower using only nine litres of water every minute.

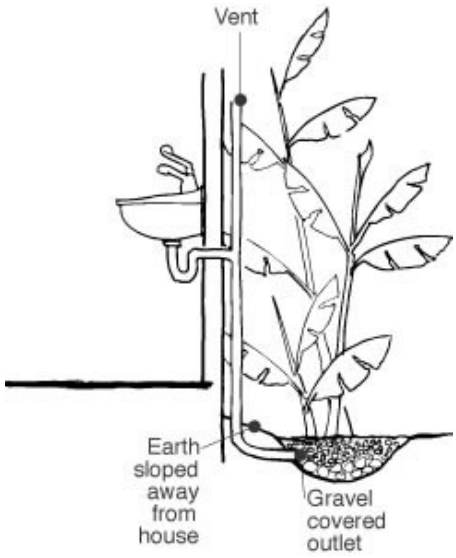


Greywater needs to be filtered before being treated in order to remove large waste particles. A coarse filter for greywater can be quite simple. See the diagram above for an example for owner operators. It comprises a waterproof box and a filter bag or stocking attached with rubber bands. The stocking or bag must be checked regularly and replaced when full.



Once coarse filtered, greywater can be treated using a sand filter. The basic structure is a waterproof box filled with coarse sand laid over a gravel bed. Greywater flows in at the top and out the bottom. A number of commercial sand filters are available.

Reed beds and sand filters treat the wastewater through filtration and some biological nutrient uptake. Wastewater needs to be pre-treated to allow removal of large particles, otherwise clogging will occur, and the lifetime of the system will be reduced.



A very simple way to recycle water is to let it flow directly out from the basin into the garden.

Avoid watering fruits and vegetables with re-use water if they will be eaten raw. There is a chance that pathogenic organisms may be present in wastewater even after treatment.

Cleaning water using coke bottles and sunlight

Cleaning water

If you drink water that is not clean, you are continually receiving bacteria, parasites and worms. It is not healthy to have these in your body.

If you are HIV positive they keep your immune system constantly active where HIV, If present, will multiply up to ten times more than normal. By drinking clean water you will keep the production of HIV virus cells in your body at a low level and you will live longer.

How to clean water with sunlight

- Find empty bottles of CLEAR and TRANSPARENT plastic – eg Plastic coke bottles. Avoid using bottles that are too scratched as this will restrict light entering.
- Fill bottles ¾ of water
- Close and shake well to get air into the water. (The oxygen from the air helps to kill the bacteria)
- Fill the bottle with more water and close well (with no air inside)
- Use the cleanest water that is available to get the best results
- Place the bottle lying down in a sunny place with the blackened side on the bottom
- After 6 hours of sunlight, the water is clean. If the water is very cloudy, leave it in the sunlight for 2 days
- Place the bottle in a cool place, or in water to cool off
- Keep the water in the same bottle and use it. Do not fill it into other containers that have not been disinfected.

For more instructions, please refer to the TCM booklet titled “How to live a long and good life with HIV cheaply”.

Water heating with black plastic piping on roofs

Work in progress

Power

Solar Power

The science of converting energy produced from the sun into electricity. Edmond Becquerel discovered the concept known as photovoltaic effect in 1839

- Solar modules, constructed by laminating electrically interconnected solar cells under glass, carry out the conversion.
- Solar cell and module technologies vary in cost and performance; the amount of energy that each produces being a function of the particular technology and the amount of light (insolation) available.
- A percentage of light energy falling onto a solar module is converted into direct current (DC)electricity for use at the place of generation or an inverter can convert the DC electricity into alternating current(AC)and feed it back to the electricity grid.

PHOTOVOLTAIC PANELS

Photovoltaic (PV) modules convert sunlight into electricity. They have no moving parts and are therefore reliable and require little maintenance. PV panels can be expected to last 20 years or more. PVs are suitable for use in urban areas as they take up little space and make no noise.

A typical module will provide a peak power output voltage of 17V and output current of 4.7A under optimum conditions, giving a rating of 80 Watts peak (Wp). Modules can be connected in series or parallel to form an array to provide higher voltage and current outputs as required.

Solar modules come in two distinct categories

1. Crystalline silicon and
2. Amorphous silicon thin film.

1. Mono and poly crystalline modules

Crystalline modules need to be cooled by wind/breeze/shade and cannot get hotter than 25 degrees.

2. Amorphous silicon

One of a number of thin film technologies. This type of solar cell can be applied as a film to low cost substrates such as glass or plastic in a variety of module sizes.

Advantages

- Include easier deposition and assembly, low cost of substrates or building materials, ease of production and suitability to large applications.

- Efficiency of thin film modules is lower than that of crystalline modules but all the types of modules are price competitive. Those currently on the market degrade in output by up to 10 percent when first exposed to sunlight but quickly stabilise to their rated output.
- Thin film modules have various (often flexible) coating and mounting systems. Some are less susceptible to damage from hail and other impacts than those covered in glass
- Output power of an array is directly proportional to power received from the sun. This will vary throughout the day.
- System designers calculate the output energy from the peak sun hours, which is a measure of the available solar energy. It is numerically equal to the daily solar radiation in kWh/m2 (Note: it is not the same as the number of hours of sunlight). Peak sun hours varies throughout the year. Peak sun hours are usually averaged and presented as a monthly figure.

The following table shows the monthly and annual peak sun hours for various locations in Australia.

	MELBOURNE	**SYDNEY**	**BRISBANE**
January	6.9	6.7	6.5
February	6.4	5.8	6.2
March	5.2	5.7	5.7
April	3.8	4.4	4.8
May	2.8	3.6	4.2
June	2.4	3.4	4.1
July	2.7	3.3	4.2
August	3.3	4.4	5.2
September	4.3	5.2	6.0
October	5.3	5.8	5.9
November	6.1	6.3	6.0
December	6.6	6.9	6.3
Annual	**4.6**	**5.1**	**5.4**

The peak power output of modules is rated in kilowatt peak (kWp), and is measured under standard test conditions. The table below indicates the annual load in kilowatt hours (kWh) that can be met by a 1 kWp grid connected system and a stand alone system for different annual average peak sun hours. Output over the year will vary in line with the monthly sunhours as shown in the table above. The figures for the systems differ due to the different efficiencies of associated equipment such as inverters and batteries.

Annual Peak Sunhours	4	4.5	5	5.5	6
kWh/year grid connect	1120	1260	1400	1540	1680
kWh/year stand alone	810	910	1015	1115	1215

A typical Sydney household has an electricity usage of about 5,000 kWh per year. A house with energy efficient appliances and using non-electric cooking, heating and hot water could use as little as 1,000 kWh pa.

Standard solar modules are supplied with junction boxes on the back to facilitate electrical interconnection. Some modules used in grid connected systems now have leads and plugs/sockets for easier installation.

Shading one of the cells in a module is similar to opening a switch in a circuit and stopping the current flowing. This results in a loss of power from many cells, not just the one that is shaded. Partial shading can cause "hot spots" that can damage the module. This occurs in mono and poly crystalline modules but not in amorphous modules. Arrays should not be located near trees that will grow and shade the modules.

Positioning. Solar modules produce most power when they are pointed directly at the sun. It is important to install them so that they receive maximum sunlight. Ideally they should be in full sun from 9am to 3pm in mid winter

All PV modules need to be cleaned periodically to maintain their efficiency.

Elevation and Location

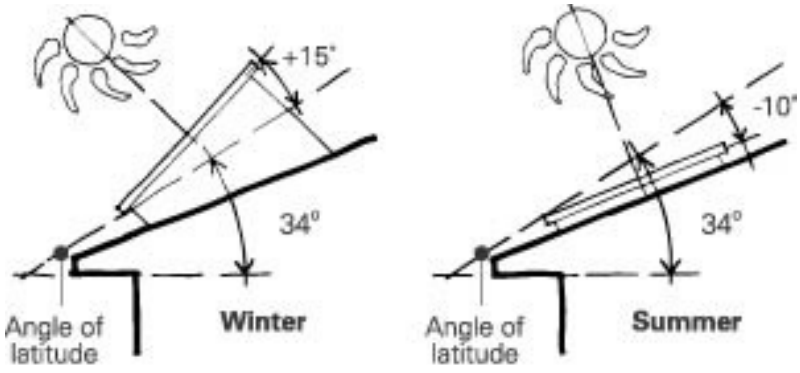
Elevation

For stand alone PV systems (SAPS), where winter operation is crucial, the angle should be the latitude plus 15 degrees

Location

At night solar cells act as a resistance and current will flow from the battery bank into the module. Blocking diodes should be installed in junction boxes to prevent this.
In SAPS the PV array needs to be installed as close as possible to the batteries to minimise the power loss between the modules and the batteries.
If modules are mounted some distance from batteries, they can be wired in series to allow higher voltage and lower current. An electronic component called a maximiser is used to convert output to the correct battery voltage.

Fixed frames are set at the optimum tilt angle for the system. Optimum tilt angle is dependent on the type of load and available solar power.

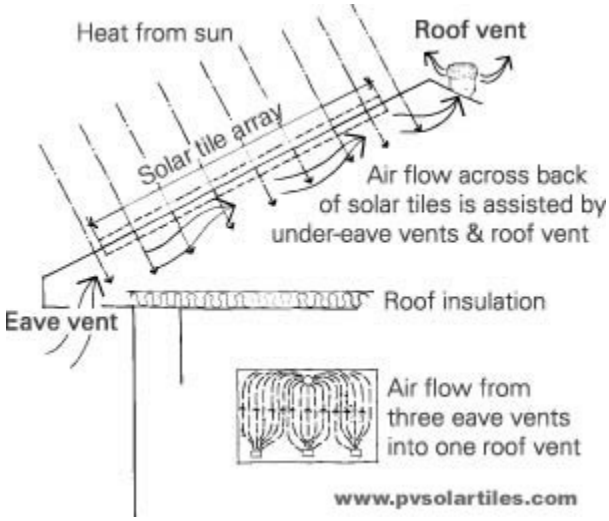


Solar panel must face due north. Sydney angle of latitude is 34°

Avoid corrosion.

If the array frame and module frame are made of different metals they must be separated by an isolating material to prevent electrochemical corrosion. This also applies if mounting a module on a metal roof.

For PV systems of more than 1kWp, it is worth considering the installation of a maximum power-point tracker. This is a control device that ensures that there is always the maximum energy transfer between the modules and the load.



- Fluorescent tubes and compact fluorescent bulbs are truly efficient

Charcoal fridge

These are made from wood and charcoal.

Pour water in a bucket, deep wicks (like those of a lantern) partially in the bucket so that the other end tips over the edge. Place the bucket on top of the fridge. The wicks suck water and drip it on the charcoal, cooling it. Temperatures in the storage chambers drop to 50 C.

A charcoal fridge can preserve food for three days but the technology has not been tried in very hot areas.

Rwabunda used $80usd to start the project.

The basic size of the fridge is 3x3ft. However, specifications vary depending on the order.

Methane gas tanks

Seems quite simple to construct using plastic sheets connected together to form a tube and put in the ground where you can load it with animal waste.

Ideally suited to livestock farms. GAIA website has a full run down on how to make one.

http://www.gaia-movement.org/files/Manual%203e%20%20Biodigester%20.PDF

Diesel

Creating usable diesel from OLD vegetable oil is a fairly lengthy and chemical procedure.

http://www.green-trust.org/making_biodiesel.htm

However new vegetable oil is usable.

Solar Oven

Benefits:

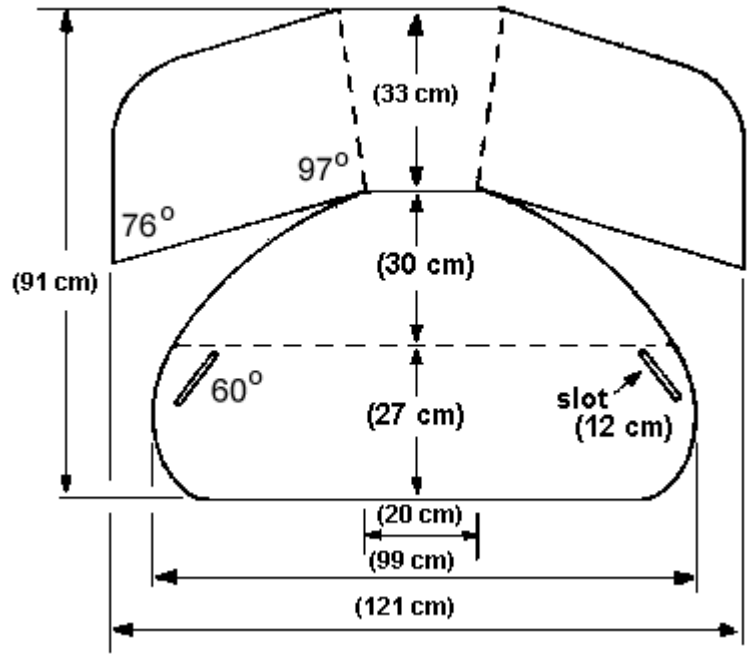
- Saving on electricity or fire wood using solar power
- Easy to make

Materials:

- Strong Cardboard 100cm x 133cm
- Cooking Pot
- Aluminium foil
- Glue
- Scissors/Knife

Construction:

- Start with a big piece of cardboard about 1m x 1.33m (3'x 4'). Cut and fold as shown below.
- The angles and folds shown are best, but small variations are OK.
- Make the slots a little too small and narrow so that they fit snugly to hold up the front panel.
- Glue aluminium foil on the side that will form the inside surfaces when the oven is set up for cooking.
- To set up, lay panel flat with shiny side up. Fold up front and back parts and fit back corners into the slots in front.



- Put the food into a dark-coloured pot then place the pot inside a plastic bag (an oven cooking bag will withstand the heat best).
- Close the open end of the bag and place pot and bag into the centre of the cooker. Raising the pot on a wire frame improved cooking!

More information on solar ovens made using different materials can be found on:

http://www.gaia-movement.org/files/Manual%204e%20%20Cardboard%20Solar%20Cooker.PDF

or for the model shown here:

http://solarcooking.org/cookit.htm

Firewood saving stoves

Different types of clay firewood saving stoves

- There are many different types of stove.
- Some have two pot-holes and a chimney. The chimney ensures that there is no smoke in the kitchen, but it is less firewood saving and more difficult to make.
- I have chosen the model which utilises house bricks as a base because it is sturdier than the portable version, will save wood and two or three could be constructed next to each other for a Kitchen designed to cook for many people.

Important considerations:

- **Size**: If the distance from the firewood to the pot is too long it will not utilize the heat efficiently. If the stove is too small, you will have to chop the firewood too much and you might not use the stove.
- **Pot rests:** Don't make the pot rests too thin or too thick: If they are too thin they will not effectively let the smoke escape from the stove. If they are too thick they will allow too much heat to escape and the stove will be less effective!
- **Clay:** Using the correct amount of water in the mixture will make the stove stronger and there will be less cracks while drying.

Materials needed:

- Seven house bricks
- Clay – You can use the soil from small anthills or you will just have to dig deep to find the clay.
- Sand
- Water

How to construct:

- The clay needs to be cleared of all sticks and stones then crushed into dust and soaked in water over night.
- Mix sand and clay to the ratio of 1 sand and 2 clay.
- Add water until the clay is easy to work with.
- You can check the quality by forming a ball. Drop the ball on the floor and if it splashes out the mixture is too wet. If it breaks apart, too wet.

Full instructions with photographs on how to make both kinds (portable and fixed) of stoves are available on:

STURDY STOVE

http://www.gaia-movement.org/files/Stove%20manual%20TWP%20Gwembe.pdf

Step 1 – Foundation

- Decide upon where to place the stove. It can be placed anywhere in the kitchen but it must face the door in order to get enough air for the fire to burn well.
- Lay four big clay bricks (15 cm x 20 cm) as a square
- Fill up the hole between the bricks half way with clay and plaster the bricks out side and on top.

Step 2 - Heat Insulation

- Fill approximately 5 cm of ash between the bricks and cover with clay.
- The ash acts as a heat insulator so the heat from the fire does not go down into the ground.

Step 3 - Build up the Stove

- Use a 5 l oil paint tin - or a similar tin as a mould. The tin should be 17 - 20 cm in diameter.
- Place the tin on the middle of the foundation - on top of the ash insulation layer.
- Put the clay and sand mortar around the tin until it is 4 cm from the top of the tin to make the firebox 19 - 20 cm high.

Step 4 - Make the Firewood Rest.

- Lay three bricks as in the picture for foundation.
- Plaster the bricks with clay mortar.

Leave the stove to rest over night

Step 5 - Shape the Stove

- Move the tin.
- Shape the outside of the stove using a knife or building trowel.
- Shine the stove using water.

Step 6 - Carve Out the Mouth for Firewood.

- Carve out the side opening (mouth) for firewood using a building trowel or a knife.
- The size should be the same as the hole inside the stove. Don’t make it small because then you will need to chop the firewood too much.
- Take care that the stove wall on top of the mouth is not less than 5 cm or it can easily break.

Step 7 - Carve the Edge.

- Carve the edge to 45 degrees using a knife. This will make it possible to place the pot rests and to use pot of different diameter.

Step 8 - **The Pot Rest**

- Use a piece of clay to make the pot rest. About 3 fingers wide and 1 finger thick (5cmx 1cm).
- Make small cuts in the pot rest & on the stove where it is to be placed (to make firm Contact). Also add a little water on the two surfaces.
- Press the pot rest well into the stove and shape it nicely.

Step 9 - Place the Pot Rests

- Place three pot rests. (It is important to make three and not any other number)
- The pot rests allow the smoke to come out and the use of pots of different diameter

Note: If the pot rests later fall off, you must replace them. Without these the stove will not function well.

Step 10 - Let the Stove Dry.

- Let the stove dry completely before use. It will take 2 to 3 weeks depending on the weather.
- Cracks might appear while the stove dries. Repair these with some leftover clay mortar. It is best if you keep a bit of the original mixture for this purpose.
- Cracks might come later. These can also be repaired using the same type of mortar.

PORTABLE STOVE

http://www.gaia-movement.org/files/Manual%20portable%20clay%20stove.doc

1: pound the clay until it is soft	2: remove all stones and plant residues
	
3: make a flat base according the size of your pot	4: start building up the body of the stove
	
5: the height should be 20 cm when moulding	6: join the ‘sausages’ and don’t leave gaps
	

7: smooth the walls outside and inside	8: flatten the edge with an inclination inside
	
9: fit three pot rests in equal distance	10: pot rest height should be 1.5 cm (1finger)
	
11: Draw the door 12 cm high between 2 pot rests and mark the position for the handles	12: Make holes in the wall to fit the handles right through the wall, so they don't break off
	

13: Finished handle	14: Cut the door after one day and fit a knob
	
15: the stove is finished and needs to dry slowly for 2 – 3 weeks covered in a cloth or bag	16: the stove can be used like it is or get fired after it is dried. Firing increases longevity.
	

More than 15.000 stoves are in use in the Mulanje area. The stove design was advised by expertise from Tanzania and Kenya (e.g. ITDG Kisumu, Kenya). The training of producers and awareness campaigns were carried out mostly by the home economics of the Ministry of Agriculture.

Christa Roth and Christoph Messinger
c/o Integrated Food Security Programme Mulanje
P.O. Box 438
Mulanje
Malawi

Phone: + 265 - 1- 466 279
Phone/Fax: 466 435,
cell: +265- 8-860 936
email: messinger.roth@africa-online.net

Land

AquaCulture

http://www.gaia-movement.org/files/Manual%202e%20%20Fish%20Farming.PDF

Requirements

- Measuring tape
- Shovels to dig the pond
- Plastic liner if soil is not good enough at retaining water
- Protective fleece as padding for plastic liner
- Coconut fibre mats as shoreline protection
- Tilapia fish
- Fertilizer
- Fish food

Location

- Choose a piece of land that has a gentle slope.
- Choose a sunny, sheltered location
- Don't locate under or too near to trees or big shrubs
- Choose a place close to your home so people will not steel the fish.

Practicalities

- Each side should be about 14 meters long, 10 meters for the pond and 2 meters for each bank of the pond (The greater the size the less maintenance required).
- The bottom of the pond should be even and sloped toward the deep end.
- In the shallow end, the water in the pond will have to be about knee-deep and the deep end should be waist- deep.
- As you dig the soil out, put it on the 2- metre strips to be the banks of the pond.
- Do not make the sides too steep, but slope them to make them stronger.

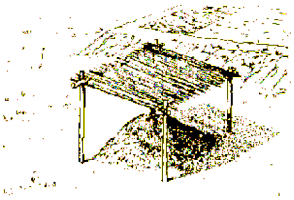
If the soil is not good at holding water use a liner and a protective fleece as padding to prevent damage to the liner. Use shore mats made from coconut fibres to give plants a strong hold on the shoreline.

The general formula for calculating how much liner you might need is;

Length + double depth x width + double depth = required liner amount in sq metres

Making Fertilizer

- To make more food in the water, fertilize the water by adding compost or manure.
- Make a compost pile near the pond. Put it in a shady place protected from rain.



- Make your pile in layers. The first layer is of grass or leaves mixed with a spade full of topsoil, and dampened with water to make it rot faster.
- Make a second layer of animal manure mixed with a spade full of topsoil and some water. Use animal manure from sheep, goats, cattle, pigs, chickens or ducks. In place of animal manure you can also use cotton seeds, spoiled fruit, household garbage, ashes from the fireplace or night soil
- Then make another layer of grass or leaves & another of manure until you have a large pile.
- Keep your compost pile damp by watering it every few days.
- Let the compost pile rot for about a month.
- Take compost from the bottom of the pile, or the old part of the pile, where it is most rotten, to put in your pond.
- Add new layers to your pile every week so that you will always have compost.

Adding the fertilizer to the pond

If you are going to fertilize the pond with animal manure, you will need to put in 2 to 3 kilograms of poultry droppings for each 100 square meters of pond each week

- Build a crib with bamboo or other wooden poles, in the shallow part of the pond, and fill it with compost.

- You will need to put in 10 kilograms of compost for each 100 square meters of pond each week
- About a week later the water will become green, showing there is more natural food in the pond and the fish will grow faster.
- To keep the water green, put a bucket of compost in the crib every week.
- Test the water has enough green in it each week by putting your arm in the water up to the elbow and if you are just able to see the ends of your fingers, the water is

green enough. If you are able to see the ends of your fingers well, you will know that the water is not green enough.

- If the water is not green enough, add more fertilizer each week and test the water from time to time until you see it is green enough.

Feeding the fish

You must still feed your fish the other kinds of food that they need to grow strong and healthy.

- Feed the fish every day with some of the following: Termites, Grain mill sweepings, Rice bran, Beer wastes, Vetiver leaves, Slaughterhouse wastes, Spoiled fruit, Kitchen waste, Cassava leaves and cassava wastes
- Feed the fish in the shallow part of the pond so that you can see them eat and feed them only what they will eat each day.
- If the fish are healthy they will eat quickly.
- If they do not eat all their food give them a little less the next day.
- If they eat everything quickly give them a little more the next day.

Adding the fish

- Before you put the baby fish in the pond, be sure that the water where they are is not hotter or colder than the water in the pond.
- With Tilapia you will need two baby fish for each square meter. If each side of the pond is 10 meters long (100 sq meters) you will need 200 fish (about 2 kilograms or 5 pounds).
- **Do not take any fish out of your pond during the first five months.** After five months you may catch four or five big fish each week to eat.

Maintenance

- Add a bucket of compost every week to the compost crib in the pond. Or add manure directly to the pond.
- Be sure the pond is full of water.
- Do not let weeds cover more than one quarter of the surface
- Plant Vetiver grass around the banks to ensure they remain sturdy

- Keep weeds and grass on the banks of the pond short to reduce mosquitoes
- **Get rid of birds, frogs, turtles, rats and snakes. They can hurt the fish.**

Worm farm for compost

Materials needed:

- Worms
- A shady place where the piles or boxes can be made
- Organic waste - Vegetable and food leftovers, plant material, cow dung etc. If the pieces are big it is good to cut them to smaller pieces. To make sure air comes into the heap it is good to mix the waste with fibrous materials - grass, twigs etc.

The worm box

- The height should be 2 feet (60 cm). For a normal household 2 x 2 feet will be enough.
- Any material can be used. It is good to make small holes at the bottom to let air into the box and for water to drain out.
- **It is also possible to make the system in many smaller containers like flower pots.**
- Place 3-4 inches (10 cm) of fibrous material in the bottom - straw, twigs, husk etc
- The easiest way to start is to get some compost and worms from someone already making it. Spread it out on the fibrous material and cover with cow dung which has aged for at least one month. If there is no cow dung you can use normal garden compost.
- It is good to add crushed egg shells as the worms need this to make cocoons.
- It is also possible to start your own production without vermicompost. You must then find the worms in the soil - best in an old garden with rich soil.
- **Keep the temperature and moisture right and after short time you will have enough worms to eat all the kitchen waste.**

What kind of worms can be used?

- The surface worms which feed mostly on leaves and other plant material. They are normally red in colour. They are the ones used for vermicomposting.
- The other kind of earthworms is deep, burrowing worms which mostly eat soil. They are important for mixing the soils and making channels so air can come into the soil. They are normally grey and are not good for household vermicomposting.

When is it finished:

- After about 1 month the compost is ready. It will be black in colour, not very heavy and smell of humus (soil).
- To separate the worms from the compost, stop watering two to three days. As it gets dry most of the worms will go to the bottom of the box and it is possible to take the good compost.

Rats

If there are rats in the area it is good to make sure that they do not get into the worm box. The boxes should then be covered and the sides solid.

Moisture

It is important that the material is kept moist but not too wet. If it is too dry the worms will dig deeper down and the waste will not be eaten. If it is too wet other micro organisms will take over and the heap start to smell of rot.

Normally the vermiculture will need to be watered every day - but not too much.

Fences

Trees for hedges are planted very close together. For example, a typical planting is with trees in double rows 0.5 meters apart, with trees also 0.5 meters apart within the rows. Hedges require frequent trimming to the desired form (height, width, and shape) to encourage secondary branching, and thus an impenetrable hedge

NFT genera of particular importance for hedges include *Acacia, Pithecellobium* and *Prosopis.* The species of importance in these genera are typically thorny, a particularly good characteristic for keeping out large animals. *Casuarina* also can be formed into a thick hedge

Vetiver Grass (Vetiveria Zizanioides)

http://www.vetiver.org/TVN_greenEng.pdf

In dry areas without irrigation vetiver hedges are a way of harvesting rainwater and being able to grow vegetables/crops in to the dry season.

This is done by planting vetiver in contour (same height) every 10 metres.

The rainwater is stopped by the hedges and kept in the soil, which means that it is possible to grow for longer time, or grow crops that need more water.

If you are in a very dry area the vetiver could be planted across the drainage areas and the dry river beds - to catch and stop the little water that comes. Areas behind the hedges could then be used for planting crops.

A 2-year-old Vetiver root system from China

How to cultivate and plant:

- A gully can be used as a nursery where the grass is sown heavily together.
- Plant the slips at the beginning of the wet season so they get most rain.
- To remove a slip for planting from the nursery dig up the plant - roots and all - and tear off a small clump of grass and roots – This is what should be planted.
- Before planting cut the tops off 20cm above the base and the roots to 10cm below the base
- Fertilise the slips with Diammonium Phosphate (DAP) by Dibbling DAP into the holes before planting the slips
- The slips should be put into a deep hole with the roots all facing down. Push the soil around them and plant them 10-15 cm apart along the same line (to form a hedge when grown) Hedge rows should be 30-40cm apart if grown in parallel
- A furrow should be cut in immediately behind the hedge after a month of planting to increase run off and encourage growth.

Other Information

- Vetiver hedges take around 3 years to be fully effective under low rainfall.
- Annual trimming is needed to 30-50 cm above ground.
- In 75 days the roots can grow 3 meters in 25-30 degree climate and will do well in between 45 – 10 degrees heat.
- Grass can stay water logged for up to 45 days
- Vetiver can be planted along new tree saplings or along Natural fences to ensure soil moisture retention and protect the saplings from wind with the firm leaves.
- Vetiver will also repel rodents and snakes due to the thick leaves and will not be eaten by other animals.

Other uses

- Basketry, picture frames, lampshades, folders and book covers
- Accessories such as lady's bags, hats, belts and broaches.
- Fans, clothes hangers or when mixed with other dried flowers; pot-pourri.

Materials needed:

- Vetiver grass shoots / seeds
- Fertiliser (possibly not massively important)
- Knife/Machete/Secateurs to cut saplings
- Watering can / Hose Pipe
- Shovel & fork to dig up nursery plants and for digging furrow after 1 month

Jatropha trees

Jatropha makes efficient live fences in one or two years under dry conditions. It can be pruned for firewood during its lifetime of up to 50 years.

The advantages of planting Jatropha are that they are not browsed by animals, are easily grown from cuttings and that it is possible to produce a useful oil from the many seeds. This oil can then be used for **lamps, soap production or as fuel for cooking**. Fruit production will start after the first or second year. The seeds are pressed in a manual ram press (as used for pressing oil from sunflower or sesame) to produce the oil. In Mali in West Africa it is even used as a diesel substitute directly in simple types of diesel engines, such as the ones used many places in India for irrigation or grinding mills. 1 km of hedge gives 200 litres of oil. The press cake left after pressing the oil is poisonous and cannot be used as feed but is a very good fertiliser - better than raw cattle manure.

Moringa trees

It is an extremely fast-growing tree, a good living fencepost, it seems to thrive in impossible places-even near the sea, in bad soil and dry areas and you can cook and eat the leaves.

The leaflets can be stripped from the feathery, fern-like leaves and used in any spinach recipe. Small trees can be pulled up after a few months and the taproot ground, mixed with vinegar and salt and used in place of horseradish. Very young plants can be used as a tender vegetable. After about 8 months the tree begins to flower and continues year round. The flowers can be eaten or used to make a tea. They are also good for beekeepers. The young pods can be cooked and have a taste reminiscent of asparagus. The wood is very, very soft, though **the tree is a good living fencepost**.

It is an extremely fast-growing tree. Roy Danforth in Zaire wrote, The tree in our organic garden grew to about 15 feet in 9 months, and had been cut back twice to make it branch out more. It is well to prune trees frequently when they are young or they will become lanky and difficult to harvest.
The leaves are outstanding as a source of vitamin A and, when raw, vitamin C.
They are a good source of B vitamins and among the best plant sources of minerals. The calcium content is very high for a plant.
The content of iron is very good (it is reportedly prescribed for anemia in the Philippines). They are an excellent source of protein and a very low source of fat and carbohydrates. **Thus the leaves are one of the best plant foods that can be found.**

It seems to thrive in impossible places--even near the sea, in bad soil and dry areas. Seeds sprout readily in one or two weeks. Alternatively one can plant a branch and within a week or two it will have established itself. It is often cut back year after year in fence rows and is not killed. Because of this, in order to keep an abundant supply of leaves, flowers and pods within easy reach, "topping out" is useful. At least once a year one can cut the tree off 3 or 4 feet above the ground. It will readily sprout again and all the valuable products will remain within safe, easy reach."

COOKING THE LEAVES. The growing tips and young leaves are best however you can sometimes pull the leaflets off and cook them without regard to age. Unlike other kinds of edible leaves, benzolive leaves do not become bitter as they grow older, only tougher. When you prepare the leaves, always remove them from the woody stems which do not soften.
The leaves can be used any way you would use spinach.
.
FEEDING LIVESTOCK. Moringa would seem to have great potential for feeding livestock. Several Zambian farmers who have tried leucaena for this purpose have been disappointed because it is extremely susceptible to termite damage. Moringa has the advantage that it is less susceptible and can be grown from cuttings. A 2-meter cutting means that from the day of planting the top of the tree should be out of reach of goats." Ronald says that though palatable to termites, moringa seems to be able to resist the challenge, particularly when grown from cuttings.

COOKING THE PEAS. Alicia Ray writes that the seeds, or "peas," can "be used from the time they begin to form until they begin to turn yellow and their shells begin to harden. Only experience can tell you at what stage to harvest the pods for their peas.

THE DRY SEEDS. The dry seeds are apparently not used for human food, perhaps because the bitter coating has hardened. They are used for their oil, which is about 28% by weight. The oil can be removed by an oil press. I have heard reports that the residual cake is not safe to feed to animals, "The Khassonkes in Mali have been growing moringa trees for their leaves as far back as anyone's knowledge seems to go. Besides leaves, we have found good profit in a high quality edible oil readily pressable from the seeds. Seeds from mature pods (which can be 2 feet long) can be browned in a skillet, mashed and placed in boiling water, which causes an excellent cooking or lubricating oil to float to the surface. The oil reportedly does not become rancid and was once sold as "ben oil."

THE FLOWERS. A visitor who had spent time in the Pacific area told me recently that the flowers are eaten there. Unfortunately, I do not recall details. Perhaps our readers can help. Alicia Ray says they are used in Haiti for a cold remedy. Water is boiled, then a cluster of flowers is placed to steep in it for about 5 minutes. Add a little sugar and drink as needed. It is very effective!

ECHO can provide trial-sized quantities of Moringa oleifera from the trees on our farm. For those seeking other potential sources we can recommend the following:

Christas Cactus, 529 W. Pima, Coolidge, AZ 85228, USA; phone 602/723-4185.

Greenleaf Seeds, P.O. Box 98, Conway, MA 01341, USA; phone 413/628-4750 (No telephone orders).

Of the Jungle, P.O. Box 1801, Sebastapol, CA 95473, USA.

Peace Seeds, 2385 S.E. Thompson Street, Corvallis, OR 97333, USA; phone 503/752-0421.

Peter B. Dow & Co., P.O. Box 696, Gisborne 3800, NEW ZEALAND; fax (079) 78 844.

Ellison Horticultural Ltd., P.O. Box 365, Nowra, N.S.W. 2541, AUSTRALIA; phone 6144-214255.

Kumar International, Ajitmal 206121, Etawah, Uttar Pradesh, INDIA.

Samuel Ratnam, Inland & Foreign Trading Co., Block 79A, Indus Road #04-418, SINGAPORE 169589; phone 2722711; fax 2716118.

“The Moringa is one of God's abundant resources for the struggle against world hunger.”

See GAIA website for information on how to purify water with Moringa seeds:

http://www.gaia-movement.org/files/Booklet%205e%20%20Water%20Purification.pdf

Vegetables

Before planting, analyze your space. Garden areas that receive full sun for a good part of the day are ideal for fruiting crops like tomatoes, peppers, cucumbers and snap peas. Shady locations are good for leafy and root crops--such as lettuces, radishes and onions--that can tolerate partial shade. In addition to garden bed space, you can take advantage of vertical space along a fence to support climbing plants like snap peas, cucumbers and pole beans. You can also grow tomatoes in hanging baskets.

- Onions are ready to harvest when the tops fall over and dry down. You can pull them up before that time to enjoy fresh in a salad, but they will store better if they dry down naturally.
- After harvesting onions, lay them out in single layers in a dry, shady spot to cure, which allows them to develop their protective, papery wrapper

Crop rotation

Important to avoid / control the following:

- Disease management
- Insect management
- Weed control and volunteer crop control
- Resistant weed management
- Herbicide carryover
- Residue management
- Soil moisture returns
- Seedbed preparation
- Harvest and planting schedule
- Frost risk
- Gross economic returns

A growing plan for a simple garden:

http://www.hdra.org.uk/factsheets/croprot.htm

Vegetable families fact sheet

http://www.hdra.org.uk/factsheets/vegfam.htm

Pests

Destroy Ant homes with boiling water early in the morning before they get up and go to work!

Pest	Plant Repellent
Ant	mint, pansy, pennyroyal
Aphids	mint, garlic, chives, coriander, anise
Bean Leaf Beetle	potato, onion, turnip
Codling Moth	common oleander
Colorado Potato Bug	green beans, coriander, nasturtium
Cucumber Beetle	radish, pansy
Flea Beetle	garlic, onion, mint
Imported Cabbage Worm	mint, sage, rosemary, hussop
Japanese Beetle	garlic, larkspur, tansy, rue, geranium
Leaf Hopper	geranium, petunia
Mexican Bean Beetle	potato, onion, garlic, radish, petunia, marigolds
Mice	onion
Root Knot Nematodes	French marigolds
Slugs	prostrate rosemary, wormwood
Spider Mites	onion, garlic, cloves, chives
Squash Bug	radish, marigolds, tansy, nasturtium
Stink Bug	radish
Thrips	marigolds
Tomato Hornworm	marigolds, sage, borage
Whitefly	marigolds, nasturtium

GAIA website has some interesting information on Bio-Pesticides like tobacco leaf juice to stop Aphids and wood ash to stop caterpillars.

http://www.gaia-movement.org/files/Booklet%2025e%20Biopesticides.pdf

Orange Trees

Work in progress

Waste Management

Work in progress

Old car tyres

There are many uses for car tyres and South Africa is highlighting the dangers of burning car tires for cement factories.

http://www.earthlife-ct.org.za/ct/article.php?story=2004081220391285

Uses include:

- Flooring
- Suspended on metal chains or ropes they make excellent swings.
- Watering systems, rubber hosing & low pressure irrigation drip hoses
- Agricultural pipes
- Flower pots, wall hangers, pot plants
- Animal bedding
- Protective fencing
- Sprayable linings for grain silos, storage tanks, etc
- Tyres for agricultural machinery

http://www.hero.ac.uk/uk/business/archives/2001/tapping_the_tyre_mountain1192.cfm

Recycling paper

By pressing it into bricks used for the cooking fire.

Work in progress

Recycling of plastic and glass

Work in progress

Keeping decorative plants in pots to save water

Work in progress

Walls of tyres

Work in progress

Growing Soya

Work in progress