

Ecological Sanitation

The toilet that makes humus

*An account of the Fossa alterna system and its
usefulness in rural and peri-urban communities*

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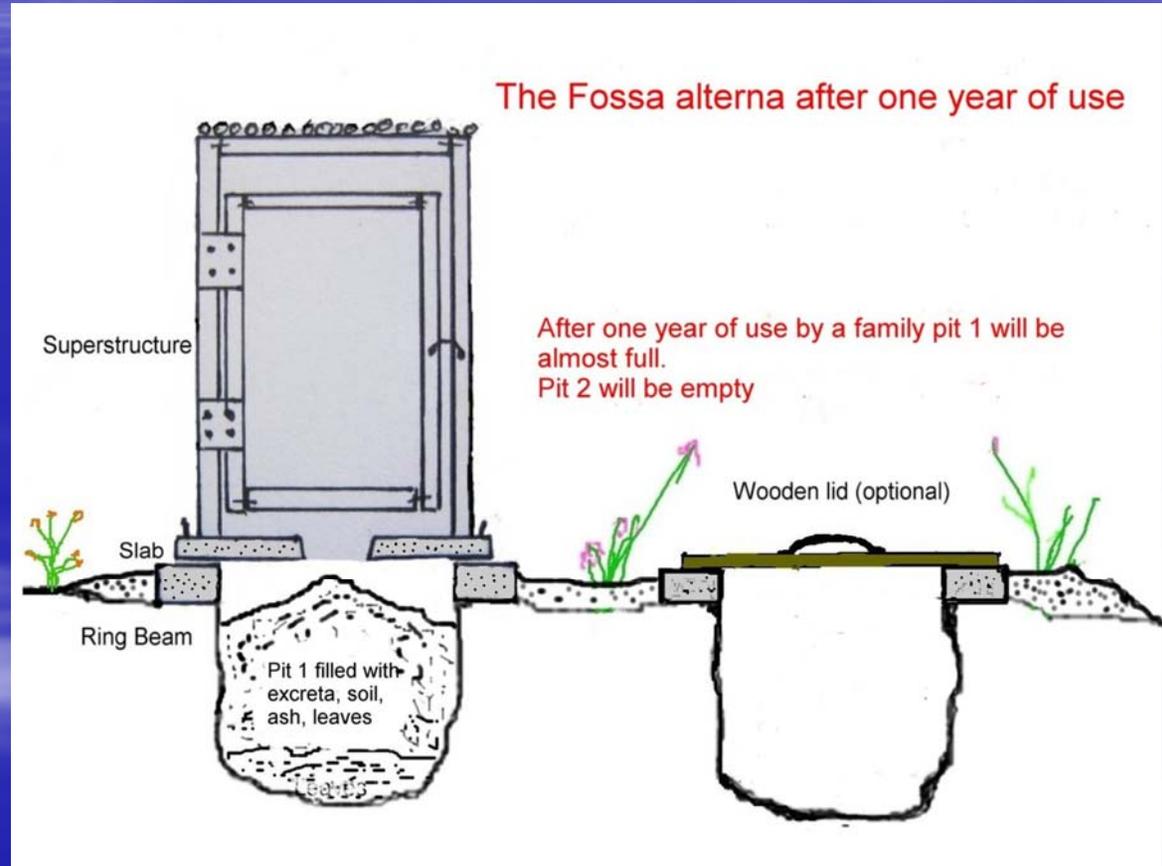
2004

Making humus in shallow pits with the *Fossa alterna*

- *The Fossa alterna is an alternating shallow pit system in which soil, ash, leaves and excreta (faeces and urine) are added regularly to the pit.*
- *The system uses two pits but only one pit is used at any one time, whilst the second composts the mix to make humus. The use of the pits alternates at yearly intervals.*
- *Because soil, leaves and ash are added regularly to each pit, the excreta can change into humus within 12 months - the filling time for a shallow pit (1.2 – 1.5 m deep) used by a family.*



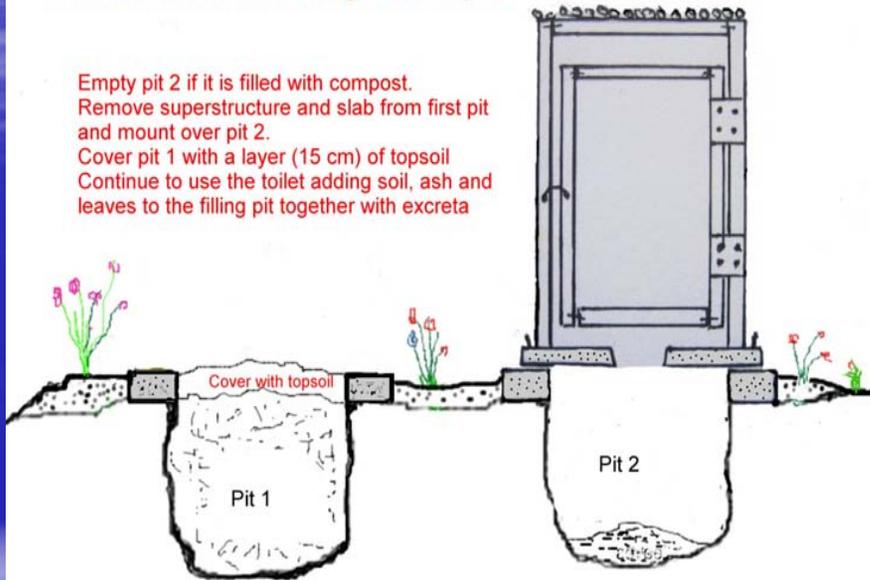
'How the Fossa alterna works



'How the Fossa alterna works

The Fossa alterna during second year

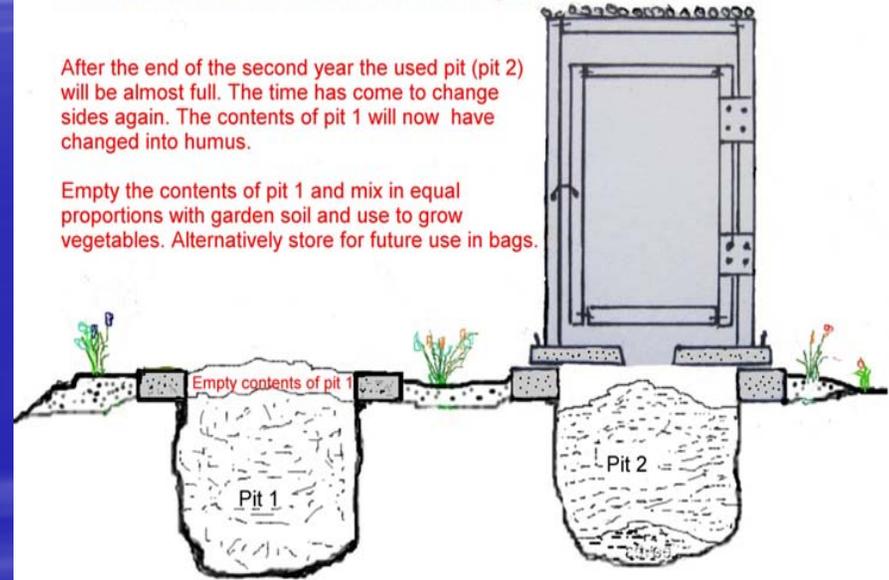
Empty pit 2 if it is filled with compost.
Remove superstructure and slab from first pit and mount over pit 2.
Cover pit 1 with a layer (15 cm) of topsoil
Continue to use the toilet adding soil, ash and leaves to the filling pit together with excreta



The Fossa alterna after the second year

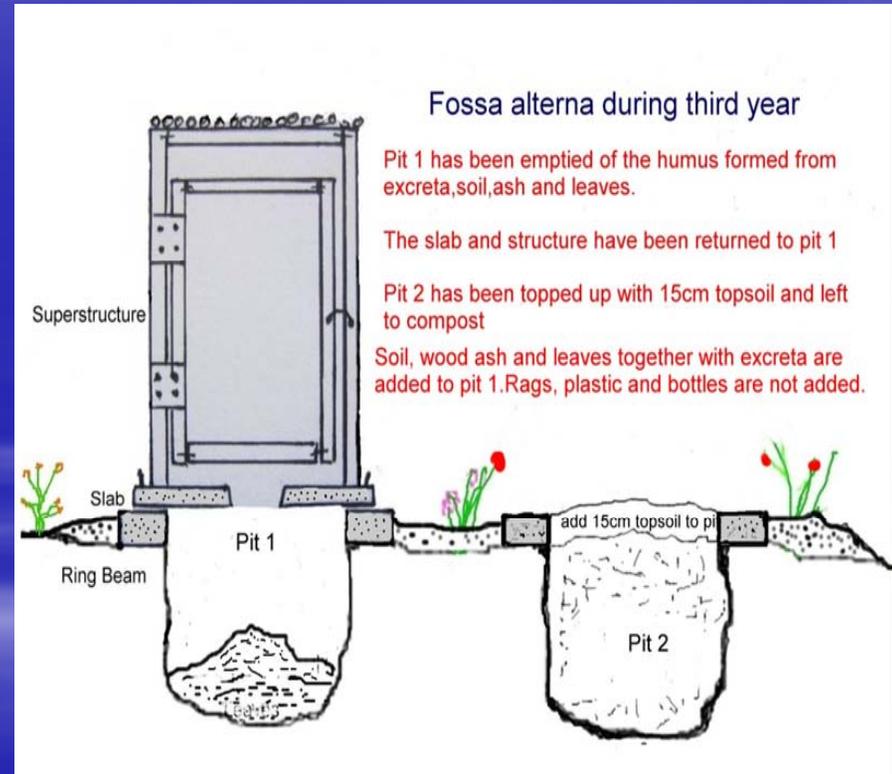
After the end of the second year the used pit (pit 2) will be almost full. The time has come to change sides again. The contents of pit 1 will now have changed into humus.

Empty the contents of pit 1 and mix in equal proportions with garden soil and use to grow vegetables. Alternatively store for future use in bags.



How the Fossa alterna works

After one year of composting a mix of excreta, soil, leaves and ash, the pit contents can be excavated. The pit shown below was excavated in 30 minutes.



The Fossa alterna in Zimbabwe

In Epworth (left) and Marlborough (right)



The Fossa alterna in Mozambique

The Fossa alterna is very popular in Mozambique. It is seen as a more permanent solution than the conventional pit latrine, and its shallow pits are easy to dig by the household. The nutrient rich humus is also favoured in areas where the soil is very poor. The regular addition of soil and ash also helps odour and fly control, in areas where vent pipes are too expensive to install.



The Fossa alterna in Mozambique

The Mozambique ecosan programme in Niassa Province is run by a partnership of WaterAid (UK) and a local NGO, ESTAMOS. The construction of demonstration latrines, a thorough educational programme using the PHAST technique, and the offer of a choice of technologies helps to promote the programme. Radio interviews with users are also used as a promotional tool. At least 500 Fossa alterna have been constructed in Niassa, and the demand is considerable.



The Fossa alterna in Malawi

The Malawi ecosan programme is funded by WaterAid in Salima, and also in Embangweni and Ekwendeni (under the CCAP). Canadian Cida, through COMWASH, supports projects in Thyolo and Phalombe. Most projects use the Arborloo to start and then move towards the Fossa alterna. As in Mozambique the two Fossa alterna pits are often enclosed in a single permanently sited superstructure, often made of bricks. Grass structures are also be used. Below a Fossa alterna in Lilongwe



The Fossa alterna in Malawi

The Fossa alterna can be made with simple locally available materials as the photos show. The main feature is that two shallow pits are dug and protected and are used alternately. For the concept to work, soil, ash and leaves should be added regularly.



The Fossa alterna - Stages of construction

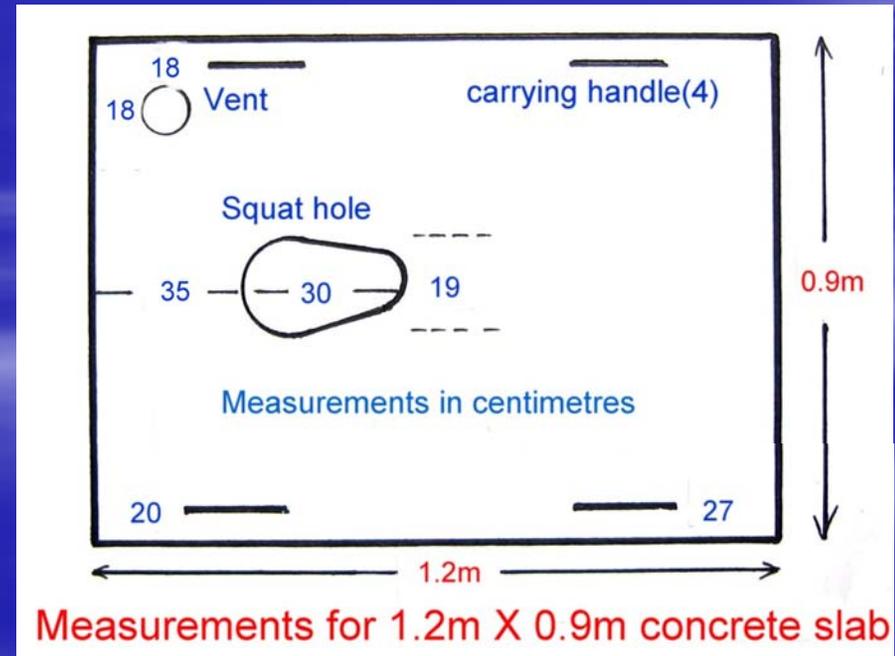
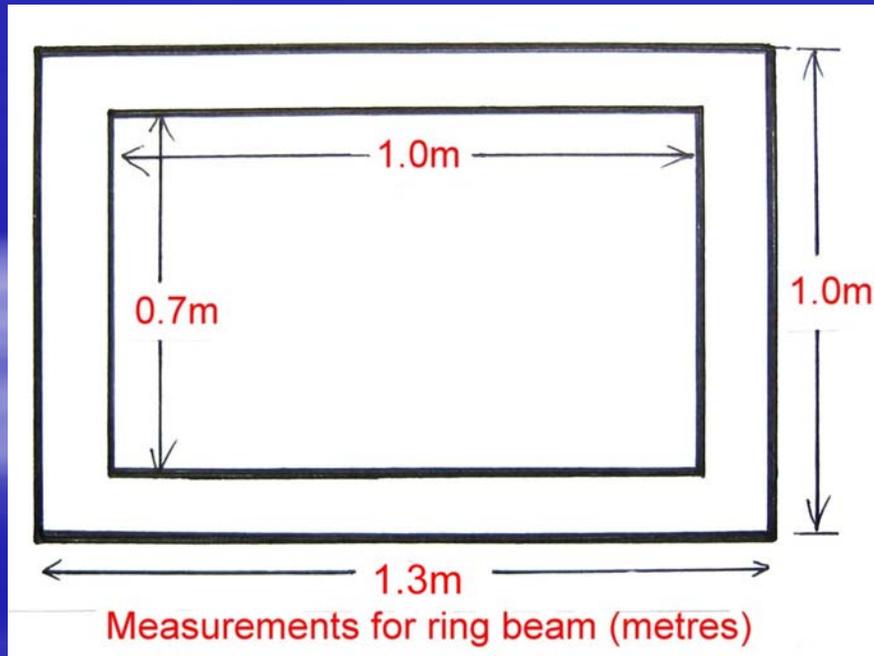
The Fossa alterna is made up of two shallow pits, a single concrete slab and a superstructure which provides privacy. In firm ground all that is required are two ring beams made of brick or concrete, laid or cast on the site about 0.5m to 1.0m apart. The single concrete slab is mounted over one of them. The superstructure can be made as a single non movable structure build around both pits or a light weight portable structure mounted over one of the pits. This is moved from one pit to the other once a year.



The Fossa alterna - Stages of construction

Sizes of the concrete ring beams and slab – square type.

The concrete ring beams (2) and single slab are each made by mixing 50 litres of river sand with 10 litres of cement and adding to a mould made from bricks and wood. A mould for the squat hole and a piece of pipe are inserted for the vent pipe. In each case 4 pieces of 3mm wire are laid in each direction (8 pieces) after half of the concrete mix has been added to the mould. After adding the wire, the second half of the mix is added. The top is smoothed down. The concrete is allowed to cure overnight and then watered the following morning and kept wet for 7 days before moving .



The Fossa alterna - Stages of construction

The concrete ring beams can be cast where the toilet is to be used. It is also possible to cast the ring beams in another place and then move them on to site. Once the ring beams have set hard, the pits are dug down within the ring beams and the soil removed is compacted around both ring beams. Both pits are dug down to 1.2m to 1.5m deep.



The Fossa alterna - Stages of construction

If the soil is loose, it is best to lined each pit with fired bricks and cement mortar. Where a heavy structure made of bricks is built above the two pits, the pits must themselves be lined with bricks. A rectangular pit should have internal dimensions of at least 0.7m X 1m and a round lined pit should be 1metre in diameter. The top surface of the brick lining should be covered with a strong cement mortar.



The Fossa alterna - Stages of construction

The efficient conversion of excreta into humus in the pit depends on liberal quantities of soil, wood ash and leaves being added to the pit in addition to excreta. It helps greatly to add two sacks full of leaves to the base of the pit first as this provides a good environment for composting.



The Fossa alterna - Stages of construction

The concrete slab is now added. It is best to lay some weak cement mortar over the ring beam first to form a good seal between slab and ring beam. This is particularly important if a vent pipe is to be fitted to control flies and odours.



The Fossa alterna - Stages of construction

The hole in the concrete slab is made either for squatting or to accept a pedestal. It is possible to make home made pedestals from plastic toilets seats and buckets. A hole is also made for a vent pipe which helps to keep the toilet free of odour, controls flies if fitted with a corrosion resistant fly screen like aluminium or stainless steel. The vent pipe also removes excess moisture from the pit, which assists composting.



The Fossa alterna - Stages of construction

Making a pedestal

Durable pedestals can be made using a 20 litre bucket and a plastic toilet seat. The base is cut out of the bucket. Holes are drilled in the ribs under the toilet seat and a wire threaded through. Strong cement mortar is laid under the seat around the wire. The bucket is mounted (upside down) on the cement and strong cement mortar (3:1) is built up around the bucket. This is allowed to set and wire is wound round and a new layer of mortar applied. Once cured the seat and cement work are turned the right way up and mounted within a small wooden mould which is used to form the concrete base of the pedestal. This is all allowed to cure.



The Fossa alterna - Stages of construction

Mounting a portable structure

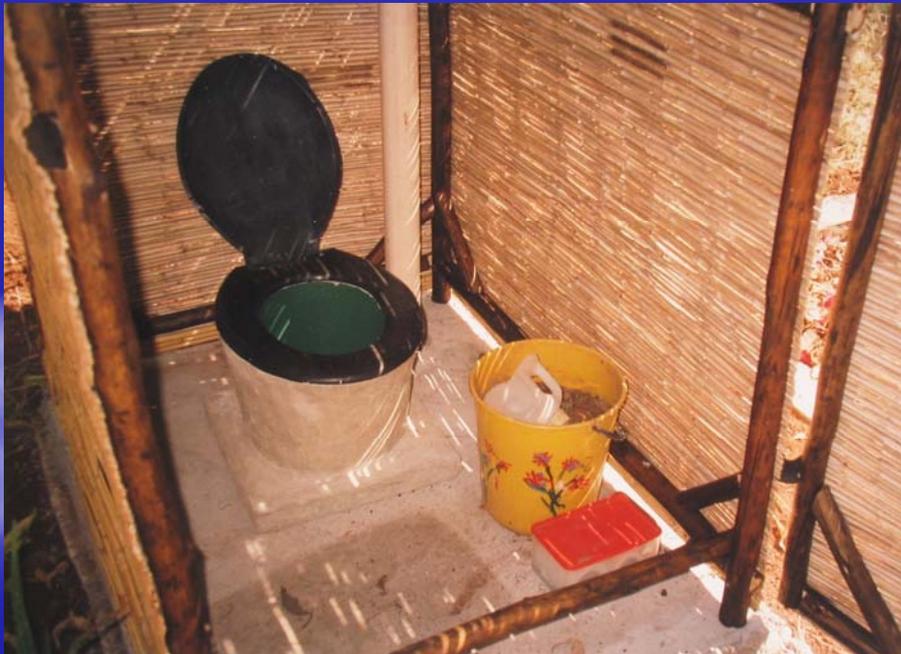
Many types of structure can be mounted over the slab. These photos show an effective portable unit made with a steel frame. The door is held up with durable hinges made from car tyres. The roof section is covered with chicken wire, a plastic sheet and then covered with grass. Walling material is optional: grass, wood, plastic etc.



The Fossa alterna - Stages of construction

Interiors

The inside can be very smart with a pedestal or squatting hole. Extra ingrediants like soil and ash musyt be added every day. Buckets of soil and ash should be placed within the toilet, so that daily additions can be made to the pit. Leaves should also be added from time to time.



The Fossa alterna - Stages of construction

Interiors

In these cases from Malawi the pits on the left has been lined with blocks. On the right the ground was hard and there was no need of any pit lining or protection. Both have been fitted with domed slabs. The single slab moves from one pit to the other and back at yearly intervals.



The Fossa alterna - Stages of construction

Superstructures

There is a huge variation possible in superstructure design. Many Fossa alternas in Mozambique and Malawi are made with non portable structures mounted around both pits. These can be made of grass or bricks etc. Portable structures can be made from poles and grass or steel frames and grass.



The Fossa alterna - Stages of construction

Superstructures

Below are shown a tin superstructure built on wooden frame in Kenya. In this case both pits were lined with coral limestone blocks as the soil was unstable. On the right and pole and reed superstructure mounted over two concrete ring beams. The soil was firm in this location and pit lining was unnecessary.



The Fossa alterna – Routine management

The Fossa alterna is able to work because the breakdown of excreta is accelerated by the addition of soil, wood ash and leaves compared to the slower breakdown of excreta alone in pits. The higher the proportion of these additional materials, the more effective the composting. The addition of two sacks of dry leaves in the base of the pits helps to start the process off. Once in use daily additions of soil and ash should be placed in the pit. In fact a small mug full of soil (mixed with ash) can be put down after every visit made to defecate. A bag of leaves can be placed down the pit from time to time. Some people put soil and leaves in.



The Fossa alterna – Routine management

When dry soil and ash are placed down the pit, a mound of soil and excreta may pile up directly below the squat hole. In order to get the maximum use of the pit, the user should place a stout stick down the hole from time to time and try to level off the contents.

No rubbish must be thrown down the pit. Plastic, bottles, rags, rubber items and all other garbage must be placed elsewhere. In the Fossa alterna, the pit contents will be dug out after a year of composting. If the pit also contains rags and other garbage, the pit will be more difficult to dig out.

If a ventilation pipe is used, the inside of the vent pipe should be washed down with a bucket of water from time to time, to wash away cobwebs which may block the pipe, or considerably reduce the air flow.

The Fossa alterna – Changing pits

After 12 months use an average family will have almost filled the pit . It is time to change sides. If a portable structure is used this must be taken off the slab and placed on one side. Next the slab should be removed and placed on one side.



The Fossa alterna – Changing pits

The contents of the exposed pit will need covering with a generous layer of leaves and soil. This will then compost for a year whilst the second pit is filling up.



The Fossa alterna – Changing pits

If the Fossa alterna is in its first year of operation the second pit will be empty. However from then on, the alternate pit must be emptied of its contents of composted excreta. If extra ingredients have been added regularly to the pit, and no garbage has been added, this should be a simple and inoffensive task, taking about 30 to 45 minutes. The whole operation of changing sides including slab and structure movement should take less than a year. If necessary the humus can be bagged for future use.



The Fossa alterna – Changing pits

Two sacks full of dry leaves are then thrown down the pit and the slab and structure are fitted back over the empty pit. A seal made of anthill mortar or weak cement is placed over the pit lining or ring beam to form a seal. The toilet is then reassembled (vent pipe and pedestal) and put back to use. The full pit now composts for the year and the empty pit now fills.



The Fossa alterna – Changing pits

For a normal family the change should take place during the same month every year preferably in the dry season. It is wise to place a small poster inside the Fossa alterna, reminding the users to place plenty of soil, ash and leaves down the pit and what month they should change pits.

With this system, the Fossa alterna may operate for many years. Each year humus is taken out of one pit, which then makes an empty pit available for use during the coming year. Every year humus is formed for use on the vegetable garden.



The Fossa alterna – potential problems

1: Conversion of excreta into compost will only take place if plenty of soil, ash and leaves are added. If the pit fills up with excreta only the change into humus will not take place within a year and the system cannot work.

2: The water table should not rise into the pit. Composting does not take place well in wet conditions. The pit should be well drained and not waterlogged. For this reason it is unwise to add too much water to the Fossa alterna.

3: If a large family uses a Fossa alterna pit it will fill in less than a year. Since the composting time must be 12 months, three shallow pits will be required and used on a rotational basis.



The Fossa alterna – hand washing devices

If the full benefits of improved sanitation are to be realised a hand washing device should be attached to the toilet . There are many ways of making simple hand washing devices for use on toilets.



Humus from the Fossa alterna

On the left a mix of faeces, urine and soil. On the right a mix of faeces, urine, soil and leaves.



Nutrient levels in humus taken from Fossa alterna pits compared to local top soils

Soil	Nitrogen	Phosphorus	Potassium
Top soils (N = 9)	38 ppm	44 ppm	0.94 ME/100 gms
<i>Fossa alterna</i> (N = 10)	275 ppm	292 ppm	4.51 ME/100 gms
Increase	X 7.2	X 6.6	X 4.8

Enhanced growth of vegetables with “Fossa humus”

Lettuce (left photo) & Spinach (right photo) are shown growing on poor local topsoil (left bucket) and a 50/50 mix of local top soil (right bucket) and Fossa alterna humus.



Enhanced growth of vegetables with “Fossa humus”

Rape (left photo) is shown growing on poor local topsoil (left bucket) and a 50/50 mix of local top soil and Fossa alterna humus (right bucket). Onions grown in the mix have nearly 3 X times the weight of onion grown on poor topsoil alone

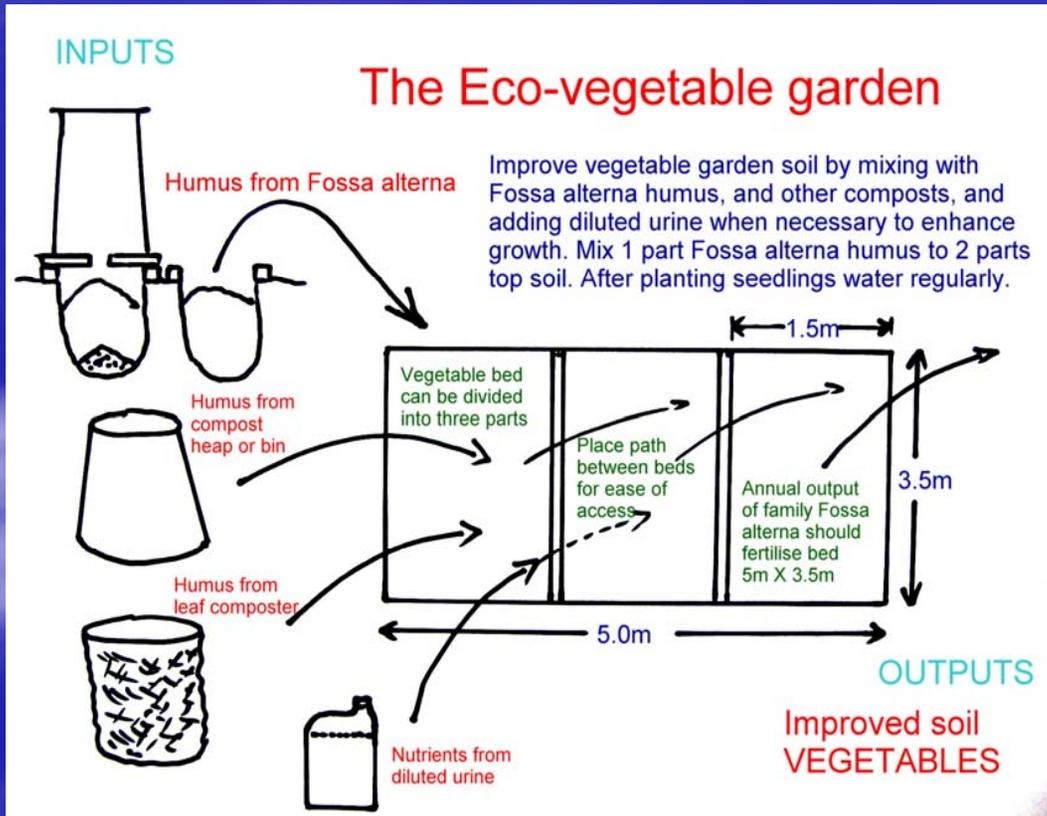


Enhancing vegetable growth with “Fossa humus”

Plant, topsoil and growth period	Weight at cropping Poor top soil only	Weight at cropping 50/50 mix of poor topsoil and FA soil
Spinach on Epworth. 30 days	72 grams	546 grams (x7)
Covo on Epworth. 30 days	20 grams	161 grams (X8)
Covo on Epworth. 30 days	81 grams	357 grams (X4)
Lettuce on Epworth. 30 days	122 grams	912 grams (X7)
Onion on Ruwa. 30 days	141 grams	391 grams(X2.7)
Green pepper on Ruwa. 30 days	19 grams	89 grams (X4.6)
Tomato on Ruwa. 30 days	73 grams	735 grams(X10)

The Fossa alterna garden

A small backyard vegetable garden can be linked to the Fossa alterna toilet. Every year the humus from the toilet is mixed with the topsoil of the garden and the additional nutrients can help to increase production. The addition of garden compost and leaf compost can also help enhance production. The careful addition of diluted urine, can also help production, particularly of green leafy green vegetables.



The Fossa alterna garden

Seedlings of rape and spinach are planted and watered. After about 5 weeks a good harvest of vegetables can be reaped. Below on left, Rape and spinach seedlings being planted on 22nd November 2003. On the right the crop just before harvesting on 30th December 2003.

The garden is linked to the Fossa alterna and the well composted pit humus and other composts from the garden are added to the topsoil to retain soil fertility.



The “long cycle” Fossa alterna

With two permanently sited pits which are slightly deeper (2m) and larger in area we have what might be described as a “long cycle” Fossa alterna. The structure and slab can be moved from one site to the other at varying periods (2 – 5 years) depending on the pit volume and number of users. There are many possible designs.



The recyclable brick superstructure

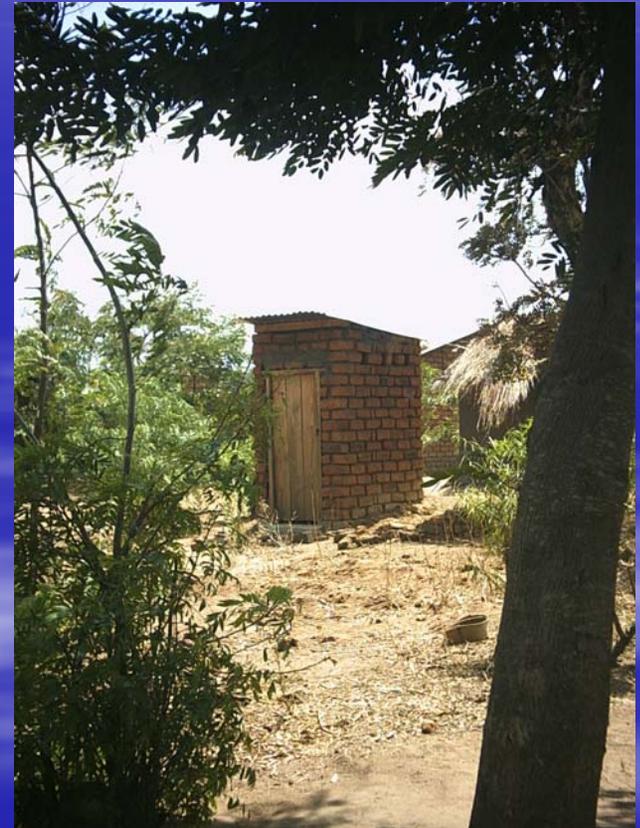
This brick superstructure is built around a steel frame fitted with sprags.

The fired bricks are bonded with weak cement mortar (20:1). The asbestos roof and pipe are long lasting and can be removed and refitted easily. The pedestal is home made from a plastic seat cover, bucket and cement work. A builder can take the unit entirely apart and rebuild in a few hours on a second pit. The contents of the filled pit can then compost over a period of years and can then be excavated when the used pit is filled with excreta, soil, ash and leaves.



This new generation of toilets in which composting is encouraged in alternating pits may solve some of the existing problems of pit latrines.

- *The twin pits are shallower and may pollute ground water less.*
- *Composted pits are more easily excavated by hand compared to normal pits.*
- *Pit latrine sites need not therefore be abandoned.*
- *The addition of soil, ash and leaves also reduces odour and fly breeding.*
- *The humus is a valuable product*
- *THE CONCEPT DEPENDS ON*
- *A combination of excreta, soil, ash and leaves being put down the pit regularly.*
- *The pits not being used for garbage disposal.*
- *There must be an acceptance that the pits are manually excavated. The owner can do this with ease or hire someone.*



Overall conclusions

- Eco – toilets offer a wide range of options suitable to a wide range of potential users.
- Even with the lowest cost options, the toilets can provide far more than a safe sanitary disposal system.
- The humus derived from shallow pit eco-toilets and urine diverting toilets is rich in nutrients and can greatly enhance the production of vegetables when mixed even with the poorest of top soils.
- The urine also has great value as a liquid plant food when diluted with water. It is particularly valuable for green vegetables and maize.
- When harnessed together both eco-humus and urine have enormous potential for enhancing food production in both rural and urban areas. Ecological sanitation offers hope and forms vital links between health, sanitation and agriculture.
- By adopting some of the eco-san principles, some problems with existing excreta disposal methods, such as the pit latrine may be overcome.