NETWAS Uganda

LeaPPS Uganda
Learning for Practice and Policy on household and school sanitation and hygiene
Arborloo and Fossa Alterna

LeaPPS Case: 2008-3

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"How to … build an Arborloo and a Fossa Alterna?"

An Ecological Approach to Sanitation in Uganda using Arborloo and Fossa Alterna [1]

Acknowledgement: Most text from excellent work done by Peter Morgan see [1]

Reference is also made to LeaPPS Case 2008-2: Arborloo and Fossa Alterna. "How to make a simple pit latrine and grow fruit trees!"

Background of Arborloo and Fossa Alterna

Arborloo and Fossa Alterna are two ecological sanitation (EcoSan) technologies that recycle human excreta. These new technologies are an attempt to make EcoSan simple and cost-effective for use by low-income communities in Uganda and most rural areas of Africa. These EcoSan options create strong links between sanitation, agriculture and food production and actually work in practice, and can benefit the users beyond the requirement of providing a latrine alone.

These EcoSan options demonstrate that a family can build effective latrines with very little support from outside. The cost is reasonably affordable: indicative UGX20-40,000[2] for the Arborloo and UGX 40-60,000 for the Fossa Alterna for sub-structure including slab and labour[3]. These shallow pit composting eco-latrines designs are based on the traditional simple pit latrine, the most commonly used latrine in Africa.

The Arborloo is basically a shallow pit latrine that once it is full it is abandoned; the superstructure (latrine house) is removed, the brick or concrete "ground collar" removed to a new pit site and a new shallow pit is dug for use. See illustration below. In the old pit a fruit or other tree is planted. The Fossa Alterna is a permanent system of two shallow pits being used alternately. It is a sound on-site EcoSan system for small plots in rural and urban areas. The pits are usually bigger than for the Arborloo so to last longer (that is 9-15 months).

In the non-in use pit the content of human excreta mixed with ash, dry soil and dry leaves produces safe compost. The pit content is harmless and can be emptied by shovel and used for agricultural purposes; it makes excellent fertiliser. Superstructure and slab are shifted from full to emptied pit while collar may be permanent or be moved as well.

Both EcoSan systems may give an adequate answer to current problems with on-site sanitation due to (i) rocky underground not allowing deep pits; (ii) high groundwater tables and water-logged soils; (iii) flood-prone areas: and (iv) loose soils likely to cause collapsing of deep pits. The main reasons that these two sanitation options may be a lasting solution for the above problems are that the pit is shallow (0.8-1.0m), has a small diameter (about 0.8m) and has a strong 'collar' above the ground. Circular shallow pits do not collapse so easily!

The Arborloo and Fossa Alterna have been developed, field-tested and are now widely adopted as a preferred latrine option in many villages in Zimbabwe, Malawi and Mozambique. Peter Morgan (Zimbabwe) and WaterAid staff in Mozambique and Malawi did much development and research work. Peter Morgan concludes: "It has become clear to me that this story of eco-san is exciting and may have far reaching implications in the future. It adds new dimensions to the rather drab story of conventional sanitation and offers ways to overcome several existing problems".

The Arborloo

Schematically the Arborloo is illustrated in the figure below.

Fig. Schematic illustration of Arborloo and its use

The **Arborloo** is made up from four parts:

1. The **pit**
2. The **"ring beam" or "collar"** to protect the pit
3. The **concrete slab** which sits on the ring beam
4. The **latrine house or superstructure, which** is put on top of the slab.

[1] Reference: Peter Morgan and SEI (2004) An ecological approach to Sanitation in Africa: A compilation of experiences (Aquamor) Harare, Zimbabwe. Also http://www.ecosanres.org/PM_Report.htm

[2] conversion 2008: US$ 1≈UGX1700; €1≈UGX2500

[3] Detailed Bill of Quantities of Fossa Alterna http://www.watsanuganda.watsan.net

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How it works? Operational issues

The **Arborloo** pit fills up with a mix of excreta, soil, wood ash and leaves. Leaves are put in the base of the pit before use and every use some amounts of dry soil and wood ash are added to the pit. Once a day dry leaves are also added to the pit. BUT… no garbage is put down the **Arborloo** pit

When soil, ash and leaves are added to excreta, it changes quite fast into compost. The daily addition of soil and ash also helps to control flies and smells.

When the **Arborloo** pit is full, the toilet is moved to another place and a thick layer of soil and leaves is placed over the pit contents

A young tree is planted in this soil and is watered and cared for and also protected against animals

The toilet is used again in the same way in the new **Arborloo** site. The same process takes place again.

After some years trees will be growing where the toilet was before. A new orchard of fruit trees or a woodlot of gum trees will be growing, using the compost formed from the excreta. In this way our excreta is recycled!

*How **the Fossa Alterna** works!*

Basically, the Fossa Alterna consists of two permanent shallow pit latrines (like the arborloo) that are used alternately. While one is used the excreta-soil-ash-leaves compost mix in other pit decomposes. The fill-up period is some 9-15 months and then the pit is sealed off. The other pit with now ready compost can be emptied, the superstructure be moved and the latrine be used. The compost can be used for any garden purpose.

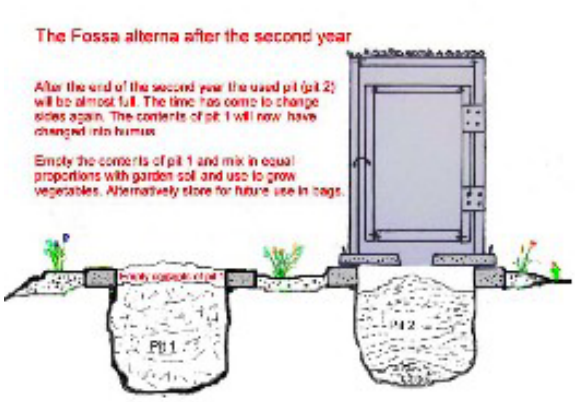

Fig Schematic situation of Fossa Alterna in second year of use

HOW TO BUILD THE ARBORLOO

1. How to make the concrete slab

The concrete slab is made with a mixture of cement and good quality river sand with some wire reinforcing. The mould for the concrete slab is made from a ring of bricks laid on levelled ground. The bricks are laid around a circle marked on the ground, one metre in diameter (radius 50cm).

A sheet of plastic is laid in the mould The squat hole is made by placing a shaped plastic bucket or shaped bricks in the slab mould.

A mixture of fresh cement and very good river sand is now made up.

The mixture is about **5 litres of fresh cement and 30 litres clean river sand** depending on diameter and thickness of slab. River sand is coarse sand and it must be washed to remove mud and organic particles that would make the concrete weak.

If the cement is not fresh or the river sand is not clean it is best to make a stronger mix of 10 litres of cement and 30 litres of river sand.

This is mixed thoroughly in a wheelbarrow before adding water. After mixing the dry sand and cement add water (about 2 - 3 litres) to make a stiff mix. Mix thoroughly again. Add half the mix to the slab mould and spread out evenly.

Add 4-8 reinforcing wires each 3 to 4mm in diameter and 90cm long in a square shape around the squat hole. Then add the rest of the concrete mixture. Spread out evenly. Also ram down hard with a wooden float. Smooth off with a steel trowel. Add two thick wire handles on either side for lifting.

After 3 hours take out the bricks (or bucket) from the squat hole and make the edges neat with a trowel. Cover the slab with a plastic sheet overnight. The following morning - wet down the slab and cover again. The slab must be kept covered and wet for **10 days** before moving

How to make the ring beam

The ring beam helps to keep the top of the pit from falling in. It supports the concrete slab and soil taken from the pit is rammed in place around it to make the toilet safer. The ring beam can be made of bricks and anthill mortar or it can be made from concrete made with a mix of cement and clean river sand.

It is important to raise the toilet base above ground level. The ring beam is made on slightly raised ground where the toilet is to be built.

2a. How to make the brick ring beam

Get some fired farm bricks and mark a circle on the ground 80cm in diameter (radius 40cm). Lay the bricks around the circle.

Now make up some ant hill mortar by breaking up ant hill soil and mixing with water.

Using a trowel add the anthill mortar between and above the bricks. Then add a second layer of bricks on the first layer. The upper layer of bricks should sit on the joint between bricks of the first course. Use the anthill mortar to hold all the bricks together.

Then dig out the pit inside the ring beam

down to 1 metre or even 1.5 metres below ground level. Some of the soil, which comes out of the pit, is placed around the ring beam and rammed hard in place. This will help to make the ring beam strong in its place.

This ring beam and soil helps to raise the toilet above ground level and stops rain getting into the pit. The ring beam and surrounding soil helps to make the toilet stronger

2b. How to make a concrete ring beam

If bricks are not available, but we have good river sand and fresh cement we can make a concrete ring beam to place the slab on. The same mixture for making the concrete slab is used to make the concrete ring beam. That is **5 litres of cement and 30 litres of river sand.** But the cement must be fresh and the river sand very clean. The measurements and the mixes must be exact and **10 days** curing for the cement is required. If the cement is not fresh or the river sand is not clean it is best to make a stronger mix of 10 litres of cement and 30 litres of river sand.

Level off some ground and lay a plastic sheet over the ground. Take some bricks and make two circles of bricks. The concrete ring beam will be made in between the two circles of bricks. Lay the

bricks so the outer and inner circles will make a ring beam in between them, which is **85cm** inside, and **115cm** outside. Thus the width of the ring beam is

15cm all round. Fill the spaces opened up between inner bricks with wet sand. Put a plastic sheet inside to prevent concrete sticking to the bricks.

Once the brick mould has been made, make up the concrete mixture of 5 litres fresh cement with 30 litres clean good river sand (coarse and washed sand). Mix the dry parts thoroughly first then mix with about 3 litres fresh water. Mix thoroughly again.

Add half of this mixture to the mould. Then

take a length of some 3.20m of wire of 3 – 4 mm diameter and place above the concrete mix about half way between the inner and outer bricks.

Then add the remainder of the concrete mix to the mould and level off with a wooden float. Ram hard down with the wooden float. Steel handles can

also be added if required. Finish off with a steel trowel.

Cover with plastic sheet and leave

overnight. The following morning, wet the ring beam and keep wet and covered for 10 days. After 10 days the ring beam can be lifted and put into place.

Dig down the pit inside the ring beam to 1m or more below surface and place soil around the ring

beam and ram in place hard.
Now the pit is ready and ring beam is well raised and well rammed to prevent erosion and flooding.

Empty a full sack of dry leaves to the pit. The leaves will help the contents of the pit to compost.

Putting the slab and brick ring beam together

Once the slab has had time to cure (10 days) and become strong it can be moved into the place where the toilet will be built.

It is best to lay the slab in some mortar placed on the ring beam. This can be made of anthill mortar or weak cement and sands (20:1).

Building the toilet house (superstructure)

We now build the house over the ring beam and slab with local materials like poles and grass.

For instance with local poles as a framework:

The house structure is used to make the

place private. Local materials could be used. The cost of such a superstructure is minimal. However, durability of materials is limited and there is no protection against sun and rain. Gradual upgrading of this super structure (the 'house') is possible as people may demand more privacy, protection etc.

There are many ways of making the house structure. It is best to make a roof to fit over the structure for shade and to keep the rain out.

HOW TO USE THE ARBORLOO

When using the **Arborloo** we add dry soil, wood ash and leaves to the pit as well as our excreta. This mix of excreta, soil, ash and leaves helps to make good compost in the pit.

- Add some ash (handfull) and a small cup full of soil after every visit to deposit faeces, but not after a 'short call' (urination).
- For a family, once a day add a few hands full of dry leaves.
- Keep the toilet clean; urinate in the pit and not on the slab; make sure you do not soil the slab. If – by accident you did – cover it with ash and dry soil and brush it into the pit, and sprinkle some ash on any faeces left on slab.
- Do not put rubbish down the pit like plastic and rags
- From time to time spread the pit content with a tall stick
- Use the toilet until the pit is nearly full (about 30 cm from rim).

When the pit is nearly full it is time to move the Arborloo to a new place.

- We take away the house or take it apart.
- We remove the concrete slab and ring beam. If it is a brick ring beam
- We take the bricks apart and re-use them in the new site.
- We cover the contents of the old pit with leaves and a thick layer (150mm deep) of good soil.
- We now rebuild the brick ring beam in a new place.
- If we are using the concrete ring beam it just needs to be moved
- We dig a new pit inside the ring beam and surround the ring beam with soil and ram hard.
- We add a sack of leaves to the bottom of the pit
- We place the slab on the new ring beam and build the house as before
- Then we can then start to use the new toilet.

For the old pit

We have covered the pit contents with leaves and plenty of soil
We can leave this pit to settle and wait for the rains before planting a new young tree
OR

We can plant a young tree in the soil and look after it. It will require protection from animals and frequent watering

Planting trees

Good trees for this **Arborloo** pit are mulberry, guava, mango, paw paw and banana. But we can plant many other trees

Plant the young tree in the soil above the compost. The young trees must be cared for. They must be protected from animals and must be watered often. In time the tree will grow big and provide many fruits.

Once the tree is established we can fertilise the tree with a mix of urine (2 litres) mixed with water (10 litres) and a mug full of wood ash every month to help it grow more.

The Arborloo will move about in the garden and will help to make many new trees. It can be used to make a new **orchard** of fruit trees or a **wood lot** of, for instance, gum trees. It can also be used to make shade or ornamental trees.

The time to fill the Arborloo pit depends on the depth of the pit and the number of users. It will be between 6 and 12 months.

Larger slabs and ring beams can be made for the Arborloo. The slabs can be 1.2 metres in diameter and fit over larger ring beams constructed over pits 1 metre in diameter. Then the pit will take longer to fill up. Larger slabs and ring beams cost more to make because they use more cement.

Making compost

If we wish to make compost in the pit for use on the vegetable garden, we can use the same small slab and ring beam. But we need to make another two ring beams and put in place so there are a total of 3 ring beams (with pits) in our garden. The slab and toilet house will move from the pit 1 to pit 2 and then to pit 3, as the pits fill up with the mix of excreta, soil, ash and leaves. When pit 3 is full we empty pit 1 of the compost (after 12 months or more of composting). This compost is fertile and can be mixed with garden soil and used to grow vegetables. Mix one part compost with two parts topsoil. Also add leaf compost or garden compost if available. The slab and the house can then be put back on the pit 1 which has been emptied.

So we can rotate the slab and toilet between the three pits in the garden. The ring beams stay in place permanently. This way we can "harvest" the good compost from each pit every year, and use it to grow better vegetables. It is important that the pit be left for one full year to compost before being dug out. So with our toilet we can grow trees or we can make good compost for the garden**.**

UPGRADING FROM ARBORLOO TO FOSSA ALTERNA

The system, which has been described, is designed to be simple and low cost. The slabs and ring beams are small and are mounted over pits, which have a small capacity (about 0.5 m^3). This is ideal for the **Arborloo** concept, and even with three small composting pits used on a rotation basis, a never-ending source of compost can be made. The ring beam concept works well on a great range of soils, but obviously it will not work in very loose sandy soils. Ring beams of this type must be used with lightweight toilet houses, like poles and grass or other light materials.

PROBLEM AREA: UNSTABLE SOILS OR HEAVY SUPERSTRUCTURE (for instance made of bricks)

It is very unwise to build a brick house around a pit lined with a ring beam only. The weight of the bricks may lead to pit collapse. Pits should be **fully lined** with bricks if a brick structure is used. This method however will be unsuitable for the **Arborloo** that is moved often from one location to the other.

However once a strong 1 metre diameter slab and matching concrete ring beam have been made, it is possible to use these same components on larger or even brick lined pits in the future. It is possible, for instance, to cast a larger ring beam with an internal diameter of 1 metre and an outer diameter of 1.3 metres using a mix of 6 litres of cement and 35 litres clean river sand. When the pit is dug down to one metre inside this larger ring beam the pit size in increased by about 1.5 times, compared to the 0.85m diameter pit. If the pit is dug down to 1.3 metres, the capacity of the pit is nearly doubled.

To use the smaller slab, which has already been made, the smaller ring beam can be placed on the larger ring beam and then the small slab placed on top. In the same way bricks ring beams can be stepped in (corbelled) so that the diameter of the lower courses is greater than the upper courses. This method is used a lot in Malawi.

When pits are dug with greater capacity they take longer to fill, and thus the movement of the slab and toilet house needs to take place less often. This may be seen as an advantage to many families. Pits can be dug deeper as well as wider to increase capacity. The conversion of excreta to compost will still take place if generous amounts of soil, wood ash and leaves are placed down the pit together with excreta.

FOSSA ALTERNA: ALTERNATING BETWEEN TWO PITS

If the pits are wider in diameter (one metre) and dug deeper (1.2 – 1.5 metres), a family will take a year or more to fill the pit, even when soil, ash and leaves are added. In this case it is possible to make two permanently sited pits and alternate between them at yearly intervals. Fertile compost can be dug out and used on the garden once a year. This is a system called the **Fossa Alterna.**

A pit 1 metre in diameter and 1.3 metres deep has a capacity of just over one cubic metre, about twice the capacity of an **Arborloo** pit 0.8m in diameter and one metre deep. This capacity is ideal for the use of the **Fossa Alterna.** The effect is the same as the system described earlier with three smaller pits used in rotation. With the **Fossa Alterna,** it is only necessary to dig two pits, each of one cubic metre capacity, and these two can be used alternately for many years on one site. Once a year the compost is dug out of one pit and the slab and toilet house placed back on the emptied pit. In some cases the two pits can be dug and enclosed inside a single permanent toilet house. This method is popular in Malawi and Mozambique.

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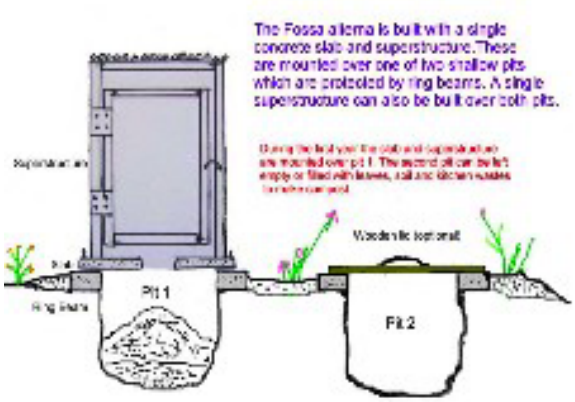
Once again, plenty of dried leaves are added to the base of the pit before use. Dry soil and ash are added to the pit after every 'defecation' use (not after urination) and leaves every day; as described in the Arborloo section.

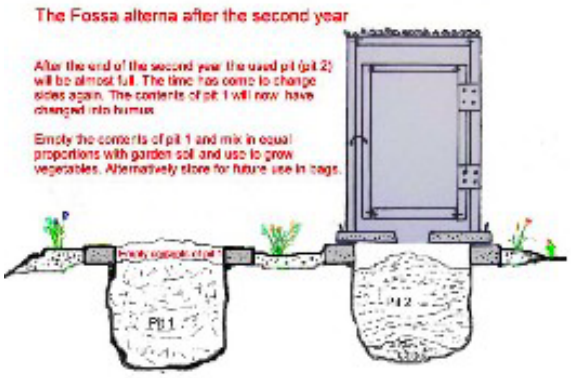
When the pit is nearly full (30 cm from rim), the superstructure and floor slab are moved to the second pit. If that had been used before it is emptied just before moving.

The compost dug out of the pit can be mixed with topsoils to increase its fertility and humus content. When mixed with poor sandy soils in equal proportions the compost can increase vegetable growth considerably.

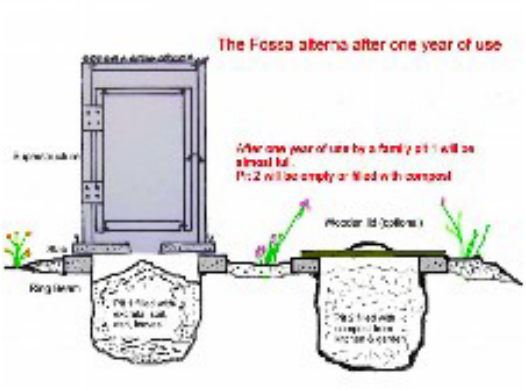
Using the systems described here it is possible to start off in a very low cost and simple way and over the years upgrade the system to suit the needs of each family.

The ***Fossa Alterna*** is illustrated in the three illustrations below, giving the phases and uses of the two pits.





More examples of possible variations: Fully lined pit and larger pit



Further information

Peter Morgan and SEI (2004) An ecological approach to Sanitation in Africa: A compilation of experiences (Aquamor) Harare, Zimbabwe. Chapter 4 (Arborloo); Chapter 5: Fossa Alterna
Also http://www.ecosanres.org/PM_Report.htm
Also: http://www.watsanuganda.watsan.net/page/442
and http://www.irc.nl/sanitation
Or contact netwasuganda@gmail.com (Brenda Achiro), phone 0414 577 463 or general@irc.nl (Jo Smet)
See also LeaPPS Case 2008-3 ***How to … build an Arborloo or Fossa Alterna?***
Forthcoming: ***Rural Sanitation and Compost – a one-pager on Arborloo and Fossa Alterna***
Forthcoming: ***Steps in constructing Arborloo and Fossa Alterna- for village builders***