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About ATC

The Appropriate Technology Center (ATC) was established by the Ministry of Water and Environment in 2010 to undertake action research, development and promotion of appropriate technologies in the water and sanitation sector through activities within five main objectives;

(i) Applied research and development in appropriate technologies and approaches for water and sanitation,

(ii) Carry out capacity building for sector actors,

(iii) Build up the profile of appropriate technology for sustainable water supply and sanitation options by popularizing the appropriate technology practices

(iv) Accelerate public/private investment through innovative financing mechanisms and demonstration of acceptable innovative practices and

(v) Continuously identify challenges facing the adaptation of appropriate technology in the water and sanitation sector.

Executive Summary

The management of the centre was contracted to Network for Water and Sanitation for a period of three years upon which the centre is expected to be self sustaining.

Fossa alterna is a low cost ecological sanitation latrine. Two pits are excavated and used in an alternating manner one after the other. It works on the principle of applying ash and soil every time the latrine is used. Fossa alterna can be constructed using a variety of locally available materials. The cost of a complete double pit latrine ranges from as low as 315,000/- to over 800,000/- depending on the materials used. If some of the materials for example timber is locally provided by the family without buying, the cost of a complete low cost latrine facility can reasonably go down by 72,000/-. If family labour is used to excavate the pits, the total cost would further reduce by 30,000/-

Users of fossa alterna latrine hail it for being a suitable option especially for people in problem areas such as areas with high water table and areas infested with termites which attack and destroy ordinary pit latrines. It is cost effective and also a source of manure to boost agriculture. Such qualities make fossa alterna a popular latrine option. In Kikandwa, Mukono district where it was introduced, the community was presented which a number of latrine options but chose the fossa alterna because of its special attributes.

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INTRODUCTION

Fossa alterna is a type of ecological sanitation latrine. The concept of ecological sanitation was popularized in Africa by Peter Morgan as an option to improve personal, family health and wellbeing together with safe reliable water supply and the practice of personal hygiene[1]. Ecological sanitation latrines work on the principle that human excreta are not waste but contain nutrients required to fertilize land.

Fossa alterna is an adoptable, affordable and easily replicable sanitation option. It is suitable for places that have rocky grounds and high water table which would lead to collapsing of pit latrines. In Uganda, these latrines are being promoted by NGOs such Network for Water and Sanitation (NETWAS Uganda). In a way of usage, fossa alterna latrines differ from traditional pit latrines i.e., before use, a sack of decomposable dried leaves is poured in the latrine to stimulate compositing as soon as the latrine becomes operational. *"Composting takes longer if excreta fall on barren soils at the base of the pit"* [2] thus, adding dried leaves before use fastens the composting process from the moment fresh excreta is added. As a routine, soil and ash is applied each time the latrine is used. Fossa alterna latrine option has success stories not only in Uganda but also in Malawi and Mozambique.

[1]Morgan (2007).
[2]Ibid (2007: Pp 35)

1. Latrine Construction And Maintenance

A complete fossa alterna latrine must have; two alternating pits, ring beam, slab, either a squat hole or seat pan, a roofed superstructure and door.

1.1. The alternating pits

A fossa alterna latrine is constructed with two alternating pits which are used interchangeably. The two pits are constructed at the same time and one is covered for use when the first one is full. The pits can either be rectangular or circular, excavated to a depth of 1.5m as illustrated in the figure below.

Figure 1: Rectangular (left) and circular (right) alternating pits

The rectangular pit should have a width of at least 1.0m and length of 0.7m. Between the two alternating pits, there should be a minimum of 0.5m apart. Pit excavation does not need specialized skills; it can be done by anyone such as the latrine owner. If it is done commercially, it can cost between 20,000 - 30,000/-.

1.2. Ring beam

The ring beam takes the shape of the pit excavated and is permanently placed on the pit. It is usually larger than the actual pit. For example, if the actual pit is 1m wide and 0.7m length, the ring beam should be 1.3m wide and 1m length[3].


Figure 2: Construction of ring beams using steel bars

A ring beam is constructed using sand, cement, aggregate, steel bars, water, binding wire and a wooden mould is needed for formwork. After construction, the ring beam should be left for 7 days to cure before other construction work starts. For one latrine, two ring beams are constructed.

[3]Morgan (2007)

Table1: Materials needed to construct 2 ring beams using steel bars

No.	Material	Quantity	Unit cost	Total cost(UGS)
1.	Sand	1/10 Elf	4,000	4,000
2.	Cement	1 bag	29,500	29,500
3.	Steel bars (8mm)	6	12,000	72,000
4.	Water	3 jerrycans	-	-
5.	Binding wire	1kg	6,000	6,000
6.	Timber for wooden mould[4]	3pcs	4,000	12,000
7.	Nails	0.25kg	5,000	5,000
8.	Steel bars (6mm)	4	7,000	28,000
	Total			**156,500/-**

Elf= 3tons

The cost in table 1 above is considerably high to some low income people. However, if timber is not bought but provided by the family, the total cost of constructing steel the ring beams slightly reduces. To relatively reduce the cost, ring beams can be constructed without using steel bars. A simple ring beam can constructed using bricks, sand, water and cement only, as shown in figure 3 below.

Figure 3: Construction of ring beam using bricks

Table 2: Materials needed to construct 2 ring beams using bricks

No.	Item	Cost
1	100 bricks	10,000
2	1 bag of cement	29,500
3	1/10 of elf-sand	4,000
4	Water	-
	Total	**43,500/-**

Construction of ring beams with bricks, sand and cement reduces the cost from 156,500/- (Table 1) to 43,500/- (table 2). This cost is essentially for two pits. The low cost ring beams shown in figure 3 are equally strong, durable and quite appropriate especially if used in circumstances where the soils are stable.

1.3. The slab

The slab takes on the shape of the pit and the ring beam and should be mobile to allow pit emptying take place. Each pit should have a slab. Different design options can be considered while making a slab. For example, each slab should have carrying handles; drop hole and may have a vent. All openings are covered at the time when the pit is not in use. In this case, the slab will not be moved from one pit to another except when emptying the pit. This offers users the extra benefit of not having to lift the slab immediately after the latrine gets full.

The alternative is where two slabs are made but one has no drop hole, it means that the two slabs will always be moved between the alternating pits i.e., the pit in use will have a slab with a drop hole and the reserve or filled pit will always be covered with the completely closed slab.

Figure 4: Slabs for the two alternating pits

The slab should be 0.9m in width and 1.2m length. The shape and size of the drop hole on the slab is determined by whether the user wants a squat type or a seat pan. For two alternating pits, two slabs must be constructed.

Table 3: Materials needed to construct 2 slabs for alternating pits

No.	Material description	Quantity	Unit cost	Amount
1	Cement	¾ bag	29500	29,500
2	Sand	1/20 Elf	2000	2,000
3	Timber for mould	2	4,000	8,000
4	Nails	0.25kg	5,000	5,000
5	Water	2 jerrycans	-	-
6	Binding wire	0.25kg	6,000	6,000
7	6mm round bars	3	7,000	21,000
	Total			**71,500/-**

1.4. Seat pan

A seat pan is optional and may be more relevant for families with the disabled or elderly with squatting problems. The seat pan is made using local materials i.e., plastic bucket, cement, sand, binding wire and water. A rectangular mould is needed to make a pedestal.

The seat pan is highly appreciated because of the comfort it adds but at the same time; some families are uncomfortable letting children use it because they might end up soiling it by dropping faeces on top.

Figure 5: Seat pan

Table 4: Materials needed to construct a seat pan

No.	Material description	Quantity	Unit cost	Amount
1	Cement	0.25 bags	29,500	29,500
2	Sand	0.025 Elf	1,000	1,000
3	Timber for mould needed for the pedestal	1pc	4,000	4,000
4	Nails	0.25kg	5,000	5,000
5	Water	1 jerrycan	-	-
6	Binding wire	2 kg	6,000	12000
7	Plastic bucket	1	5,000	5,000
	Total			**56,500/-**

1.5. Superstructure

The fossa alterna superstructure can either be mobile whereby it is built once and just moved from one pit to another depending on need. Another option is to have a superstructure that can be demolished when one pit is full and rebuilt on the alternative pit. This is however cumbersome and might not be sustainable for poor families. The third option is to have a permanent superstructure whereby the two alternating pits are housed in one superstructure and only the slabs that are interchanged accordingly. This option is however costly because a lot more resources i.e. bricks, cement and sand are needed. The mobile superstructure has an advantage because it can be constructed using light materials and is movable from one pit to another without incurring any additional costs. The mobile superstructure can be constructed using materials like papyrus, plywood, iron sheets and wire mesh, cement and sand (Ferrocement). Tables 5 – 8 below give a simple calculation of the requirements for constructing a preferred superstructure. Materials needed for construction of a superstructure depend on users' preference.

Table 5: Superstructure made of Plywood

No.	Material description	Quantity	Unit cost	Amount
1	Ply wood	4	19,000	76,000
2	Anti termites treatment	5ltr	2,250	11,250
3	Wood/Timber	12	4,000	48,000
4	Nails	1kg	5,000	5,000
5	Iron sheets	1.5	21,000	42,000
6	Latch	1	3,000	3,000
7	Lock (external)	1	4,000	4,000
8	Roofing nails	1/2kg	5,000	5,000
	Total			**194,250/-**

Figure 6: Superstructure made of plywood

Table 6: Superstructure made of papyrus

No.	Material description	Qty	Unit cost	Amount
1	Papyrus	3 pcs	9,000	27,000
2	Anti termites treatment	5ltr	2,250	11,250
3	Timber	12	4,000	48,000
4	Nails	1kg	5,000	5,000
5	Sisal	1Roll	5,000	5,000
6	Roofing nails	1/2kg	5,000	5,000
7	Iron sheets	1.5	21000	42,000
8	Latch	1	3,000	3,000
9	Lock (external)	1	4,000	4,000
10	Ply wood	1	19,000	19,000
	Total			**169,250/-**

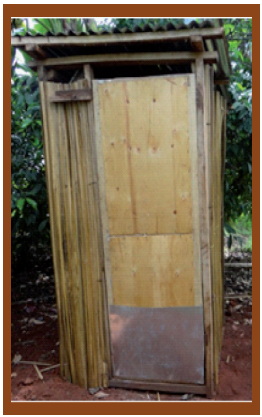

Figure 7: Superstructure made of papyrus

Table 7: Ferrocement superstructure

No.	Material description	Quantity	Unit cost	Amount
1	Sand	1/10 Elf	4,000	4,000
2	Cement	1bg	29,500	295,00
3	Timber	12	4000	48,000
4	Nails	1kg	5000	5,000
5	Wire mesh	10pcs	4000	40,000
6	Nails 1'2"	1kg	5000	5,000
7	Iron sheet	1.5	21000	42,000
8	Latch	1	3,000	3,000
9	Lock (external)	1	4,000	4,000
10	Ply wood	1	19,000	19,000
	Total			**170,000/-**

Figure 8: Superstructure made of ferrocement

Table 8: Superstructure made of iron sheets

No.	Material description	Quantity	Unit cost	Amount
1	Iron sheets	4	21,000	84,000
2	Timber	12	4,000	48,000
3	Nails	1kg	5,000	5,000
4	Roofing nails	1kg	8,000	5,000
5	Latch	1	3,000	3,000
6	Lock (external)	1	4,000	4,000
7	Timber	12	4000	48,000
	Total			**197,000/-**

In all the quotations above, labour costs are not included; they vary from 20,000/- to 100,000/- depending on bargaining power and accepted local cost for labour. Timber for all the undertakings can be locally provided by the family i.e., from their garden, the total cost for all the above latrine options would significantly reduce by 72,000/-.

1.6. Other superstructure options

The superstructure can be constructed using either burnt bricks or Interlocking Soil Stabilizing Blocks (ISSB) as shown in the figure below. It can be demolishable or both alternating pits can be housed in one super structure.

The cost for these two options is relatively high. Among other impediments, the machine that makes ISSBs is not readily available in the local communities. The second portion in figure 9 requires a lot of bricks and cement that would significantly raise the total latrine cost to over 800,000/-.

Figure 9: Demolishable superstructure constructed using ISSB (left) and two pits in one superstructure (right) constructed using ordinary burnt bricks

1.7. Summary of latrine cost comparing use of different material options

Table 9: Cost of a complete latrine with seat pan and ring beam made of steel bars

Item	Super-structure with iron sheets	Superstruc-ture with ply wood	Superstruc-ture with papyrus	Super structure with ferro cement
Pits	30000	30000	30000	30000
Ring beams	156,500	156,500	156,500	156,500
Slab	71,500	71,500	71,500	71,500
Seat pan	56,500	56,500	56,500	56,500
Super struc-ture	197,000	194,250	169,250	170,000
Total	**511,500/-**	**508,750/-**	**483,750/-**	**484,500/-**

Table 10: Cost of a complete latrine with drop hole and ring beam made of bricks

Item	Super-structure with iron sheets	Super-structure with ply wood	Super-structure with papyrus	Super structure with ferro-cement
Pits	30000	30000	30000	30000
Pit lining	43,500	43,500	43,500	43,500
Slab	71,500	71,500	71,500	71,500
Super structure	197,000	194,250	169,250	170,000
Total	**342,000/-**	**339,250/-**	**314250/-**	**315,000/-**

2. USER EXPERIENCE

2.1. Mr. Kironde Yunus

Mr. Kironde Yunus's household is one of the homes using a fossa alterna latrine in Kikandwa. He is proud of the facility and hails the technology for coming to the rescue of the poor people living in constrained soil conditions. He narrates how his household had a number of hygiene and sanitation challenges before and the new status acquired having constructed a fossa alterna latrine. .....

"My household had a poor old pit latrine made out of mud and sticks. It was a temporary risky latrine that would easily sink. This place has soft soils and people's latrines often collapse as a result. Since we had no option, we kept on entering and using the poor latrine we had despite the risks involved. Some family members who would fear to take the risk kept on littering their feaces anywhere in the plot. It was hard for us to maintain and practice excellent sanitation and hygiene". Visitors would move around my home alarmed because of the littered feaces.

Kironde hails the fossa alterna latrine technology for luring his family members to stop open defecation. *"Of late, it is rare to find feaces littered in my plot because all family members use the new latrine. It is such a relief....."*

Operation and maintenance of the latrine is easy. Each user is responsible to pour ash after use and the elder son is the overall supervisor who is supposed to make sure that the latrine has enough ash all the time, the path is not bushy, there is soap and water for hand washing, inside and outside the latrine is clean. The latrine is cleaned three times a week. *"For the love I have for this new latrine, I would be cleaning it myself but bending is hard because of old age that is why I deligated all the responsibilities to my son who does all the maintenance"*.

2.2. Ms. Teo Najjombwe

Najjombwe is 67years of age and stays home with two grand children; Ema Kazibwe (7years) and Angel Nambaziira (5years) respectively. This family had a traditional pit latrine before, built with mud and reeds. The latrine was destroyed by termites, that blocked the entrance of the two roomed 'convenience house' and finally turned it into an anthill (see picture on cover page) that stands out prominently in her plot to date.

Recounting her tale, Najjombwe explicates that;

> *I wasted a lot of my meagre resources trying to fight the termites but they were stubborn and determined to take over the latrine. At first the termites attacked my house, destroyed the sitting room and bedroom. We kept on digging out the queen termite but they also kept on coming back.*

Slowly, we overpowered them and managed to chase them from the house that is when they started attacking the latrine. We tried more than four times to dig out the queen but our efforts were futile as the latrine gradually turned into an anthill. ... At my age it is demeaning to ease myself in the open but what could I do without an alternative? Do not think I never tried. I did what I could to dig another pit latrine but failed to raise money to construct the superstructure. For more than three years we were using the pit latrine without a superstructure... Apparently we are happy having obtained a decent fossa alterna latrine promoted by ATC and all I can say is that; I have finally defeated the 'greatest enemy' the termites. comparing the two latrines (the former and later), I am convinced that the problem is no more. Optimistically, I am sure my enemy 'the termite' will not eat up my new latrine because it is stronger for them. I am so determined to keep it clean and in shape ... I do the cleaning up myself and ensure that ash for application after use is readily available. Sometimes neighbours use my latrine, I do not refuse them but keep it closed to avoid mismanagement and only open on request.

Najjombwe is teaching who ever bothers to pay attention and is encouraging them to build the same latrines; *"I am telling everyone out there to make sure they build these toilets because they are the best. If all of us can have these latrines in our homes, funny diseases that make us spend money on drugs would be overpowered.*

With those poor old latrine options we easily catch diseases like dysentery and typhoid…

I have to work hard to maintain the new standards by improving the hygiene and keep the entire home tidy. In her conclusion, Najjombwe re-echoes that the traditional pit latrines are old fashioned; people should know, destroy them and adopt the trendy fossa alterna that are environmental friendly.

2.3. Miiro Elisa

In the village history, Miiro's home had never had a decent latrine. During community meetings his home was always an Open Defecation (OD) referral home but this status changed positively when they acquired the fossa alterna latrine with both pits housed in one super structure. Justine Nakabugo, the wife of Miiro is so excited about the double pit latrine mainly because she anticipates getting fertilizers. She pointed out that; "*it is a good idea to have such multipurpose latrines in our homes because they give us free fertilizers for our gardens*". In agriculture excreta stimulates production by improving the nutrient content and water retention capacity of the soil. Faeces are a good soil conditioner i.e., increases the water holding and ion-buffering capacities of soils which improves soil structure and stimulates microbial activity[4]. The family is very strict to make sure that no user messes up with their fertilizers unknowingly.

[4]EcosanRes Uganda knowledge node (2010)

For example, they wrote rules and guidelines and pinned them in the latrine. This helps visitors and first time users to use the facility appropriately. The idea of putting up rules and guidelines is highly recommendable.

Miiro himself tells a story of how the toilet gave him determination to improve the outlook of his entire home.

For years, I had bricks lying idle and a plan to construct a house but was failing to start off because I did not have money and also problems like sickness that would come one after another. These problems did not disappear suddenly but when I got the new unique latrine, it looked so awesome and inspiring. I keep on receiving visitors who come to learn about my latrine. Being that my house is too old compared to my adorable latrine; I felt embarrassed and got determination to start construction of a new house to match my newly acquired status and thus, I have raised the four roomed house for my family.

2.4. Potential for Technology Replication

For any latrine technology to be appreciated and eventually taken on by the communities, it has to be appealing, cost effective and easily adoptable. The double pit fossa alterna has all these qualities besides being a low risk latrine option. In Kikandwa, users were presented with a number of latrine options such as lined pit latrines, Urine Dry Diversion Toilet (UDDT) but chose fossa altena because of its special attributes i.e., being cheap, and usage not so much different from the ordinary pit latrine.

Haruna Lwanga a youth counsellor in Kikandwa village is a very resourceful person. He is a leader in one of the NAADS-National Agricultural Advisory Development Services programmes and a carpenter. Haruna has been involved in training and construction of the fossa alterna latrines using different local materials. He commends the technology and works hard to spread its gospel. In most of the NAADS group meetings, he teaches people about the new latrines. He said, so far the idea has been disseminated to NAADs members from within and outside Kikandwa. A number of people from Kalyoowa, Ssinda and Sejjobbe village have showed interest. So far; "*I have seven orders from the people I taught about the double pit latrine. Being a youth is a factor that has helped me make people appreciate the unique latrine technology. Even if the old people may reject the idea, I know if I talk to the youth in the future they will build the toilets in their homes. The young people are able to do anything because they have time and energy*." Haruna refers to the double pit latrines as 'free of cost latrines' because, "*they are so cheap and priceless*".

He however feels that they are too shallow for extended families with relatively bigger population because they would fill up fast i.e., in a month or two. Much as people need cheap latrine options, they should be able to last longer so that they don't have to suffer.

The duration a fossa alterna latrine takes to fill at a household is subject to debate but surely it is more than two months.

If the pit is 1m in diameter and 1.2m deep, it will take a family of 6-8 people a minimum of one year to fill even when soil, ash and leaves are added[5].

2.5. Conclusion

In the world we live today, there are a number of challenges leading to environmental degradation. Among the factors, poor sanitation technology options cannot escape the blame. However, innovation and research have bled in more suitable and sustainable technology i.e., fossa alterna latrines hoped to protect the environment. It is thus the work of sector actors to escalate appropriate technology diffusion into the user communities. Evidence from Kikandwa shows that the will for communities to take up such low cost and environmentally friendly latrine options is high however, action may not be immediate due to financial constraints.

[5]Leapps Action Research Uganda, 2008

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ECOLOGICAL SANITATION

Construction, Cost Analysis and Users' experience of Fossa Alterna Latrine

Ministry of Water and Environment

NETWAS Uganda

APPROPRIATE TECHNOLOGY CENTRE FOR WATER AND SANITATION

ATC premises
in Mukono, Upper Kauga