

Fossa alterna for household sanitation Arba Minch, Ethiopia



Fig. 1: Project location

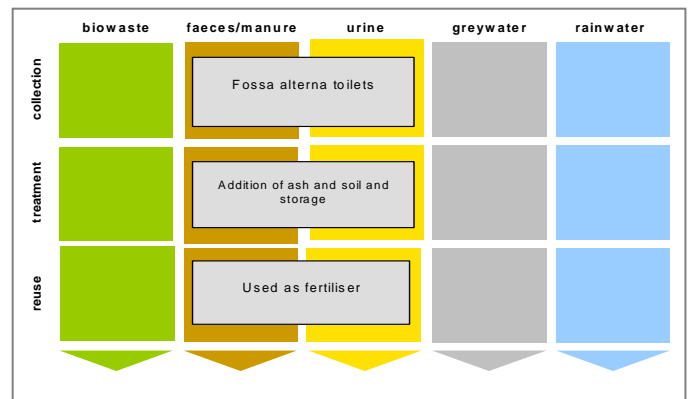


Fig. 2: Applied sanitation components in this project

1 General data

Type of project:

Fossa alterna for household sanitation in Arba Minch, Ethiopia (pilot scale)

Project period:

Start of construction: 1 April 2007
End of construction: 30 March 2009
Start of operation: 30 March 2009

Project scale:

Number of fossa alternas built for households: 30
Number of inhabitants covered: 177
Total investment (in EUR) 2600

Planning institution:

Arba Minch Town Water Supply and Sewerage Enterprise (ARB)
Arba Minch University (AMU)

Executing institution:

Arba Minch Town Water Supply and Sewerage Enterprise (ARB)
Arba Minch University (AMU)
Jupiter construction micro and small enterprise
Daylight construction micro and small enterprise

Supporting agency:

European Union (EU)



The work was carried out within the project ROSA (*Resource-Oriented Sanitation concepts for peri-urban areas in Africa*; Contract No. 037025-GOCE; duration: 1.10.2006 – 31.3.2010), a Specific Target REsearch Project (STREP) funded within the EU 6th Framework Programme, Sub-priority "Global Change and Ecosystems".

2 Objective and motivation of the project

The EU-funded project ROSA (Resource-Oriented Sanitation concepts for peri-urban areas in Africa) proposes resource-oriented sanitation concepts as a route to sustainable sanitation and to meet the UN MDGs. The main objective of the project is to develop adaptable, affordable and replicable solutions for sanitation.

The Fossa alterna is one sanitation option which is easy and affordable for many inhabitants of Arba Minch. Such construction would provide improved sanitation in places facing problems with rocky ground and pit collapsing as is the case in central parts of town.

3 Location and conditions

Arba Minch town has an estimated population of about 80,000 with 4.5% annual growth rate. It is located 500 km south of Addis Ababa in southern Ethiopia.

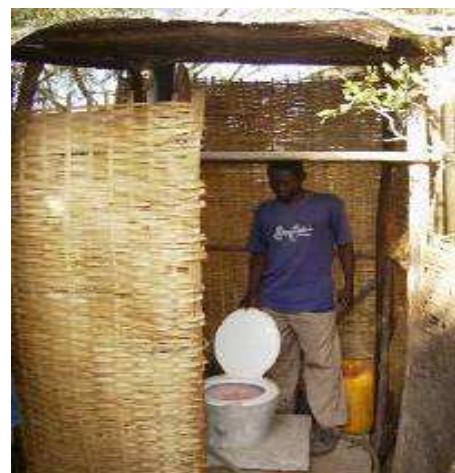


Fig. 3: Fossa alterna with urine diversion (source: ROSA project, Arba Minch, 2008)

Arba Minch is one of the fastest growing towns in Ethiopia. However, there are wide ranging sanitation problems in the town. And these are expected to grow even worse with the rapid population growth. The town does not have pit desludging services forcing residents to dig another pit, or manually desludge the pit, which is unacceptable practice from health and hygienic point of view. 10% of the population

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practice open defecation. There are portions of the town that have congested settlements with rented houses in which land is not available for digging pits and people either share a single latrine, defecate open or use flying toilet.

A significant portion of the town has loose black cotton soil in which pit collapse is a major problem. Others have rocky ground where digging is very difficult. These problems urge to look for better sanitation options to be implemented in the town.

In Ethiopia, the under-five child mortality rate is currently¹ 104 children per 1,000 (compared to 210 per 1,000 in 1990).

4 Project history

The ROSA project started in October 2006. On the basis of the overall goal of developing and disseminating "Resource-Oriented Sanitation Concepts in Peri-Urban areas, like Arba Minch town, the project conducted research including a baseline study and demand assessment on sanitation. The project identified different sanitation options (involving safe disposal and re-use) through research conducted by Arba Minch University and other international partners, discussed and prioritized feasible options with active involvement of the local administration and community groups, undertook pilot experiments of the different options and disseminated them through practical demonstration, The project also supported to scale-up implementation in the local community, and provided skill training to ensure proper management and operation.

5 Technologies applied

Since its inception in October 2006, the ROSA project has introduced different resource oriented sanitation systems that include three types of toilets, greywater treatment units, a biogas unit and composting schemes. At the moment there are 15 urine diversion dehydration toilets (UDDTs), 30 Fossa alternas, 9 Arborloos, 9 greywater towers, 1 biogas unit and more than 5 composting schemes.

In this case study Fossa alternas are described. It is a double pit compost toilet and is made up of six parts (Morgan, 2007):

- Two pits
- Two ring beams to protect the two pits
- A single concrete slab which sits on one of the ring beams
- The toilet house which provides privacy

In this type of toilet urine is not separated from faeces. Three cups of soil and one cup of ash are added after every use. One pit fills up first. During the first season the second pit is unused. After the first one or two years, depending on the number of users, the first pit will get filled. When the first pit is full, the toilet slab and structure are moved on to the second pit and top soil is placed over the contents of the first pit which is then left to compost. The second pit is then put to use whilst the contents of the first pit are composting.

When the second pit gets filled, the first pit will be ready for emptying the compost of the pit. After the original pit is emptied, the toilet slab and structure can be placed back again over the empty pit and the recently filled pit is covered with soil and left to compost for a further year. This changing of the pits can continue for many years in the same site.

6 Design information

The pits

The two pits dug for fossa alterna are having a depth of 1.5-1.8 m and have a square section of 90 cm x 90 cm.

The ring beams

Square ring beams, made of hollow concrete blocks, are cast on the pits. The external measurements of the beam are 1.3 m x 1.3 m and the internal measurements - the size of the hole - are 0.9 m x 0.9 m (refer Fig. 4.).



The reinforced concrete slab

The reinforced slab has 5 cm thickness and a dimension of 1.2 m x 1.2 m. It can be cast onsite or be cast at a central place and transported to the construction sites. A mould of wooden purlin (5 cm x 7 cm) was used to cast the slab.

Materials used for casting five rectangular reinforced concrete slabs for Fossa alterna were:

1. Cement = 2 bags (100 kg)
2. Sand = 0.14 m³
3. Gravel = 0.28 m³
4. Reinforcement dia. 6 mm = 44 m (9.8 kg)
5. Canvas = 9 m² (Reusable)
6. Wooden form work cross-section (7 cm x 5 cm) and length 4 m =6 pcs (Reusable)



Fig. 5: Fossa alterna slabs during construction (source: ROSA Project, Arba Minch 2007)

¹ The under-five mortality rate is the probability (expressed as a rate per 1,000 live births) of a child born in a specified year dying before the age of five if subject to current age-specific mortality rates. (<http://www.childinfo.org/mortality.html> and <http://www.childmortality.org>).

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The toilet superstructure

The toilet superstructure is portable and is made of 'karta' (woven bamboo), canvas or corrugated iron sheet (refer Fig. 6).



Fig. 6: Fossa alterna toilet superstructures (source: ROSA Project Arba Minch, 2008)

In cases where digging even a shallow pit is difficult, Fossa alternas can be constructed above ground (refer Fig. 7.).



Fig. 7: Fossa alternas above ground (source: ROSA project Arba Minch, 2009)

7 Type and level of reuse

The regular addition of soil and ash to the pit helps the composting process considerably. The pit compost is removed by a shovel when the pit in use is full (after 4 to 6 months) and applied on plants. The existing practice in Arba Minch is using the pit compost in the respective compounds. There is also a possibility of selling the compost in the future.

Flowers or plants that can be harvested in 3 to 6 months can be grown on the filled pit while it is undergoing composting. One of the households planted plants on the filled pit (refer Fig. 8).



Fig. 8: Plants on the filled pit (source: ROSA project, Arba Minch, 2009)

8 Further project components

The absence of credit facilities for households which are interested to construct the demonstrated innovative toilet options has constrained efforts for further scaling-up of the implementation. The project has recently worked to generate seed money from other sources with a 50 % grant scheme from the Dutch government and 50 % loan arrangements to facilitate credit access to households who are willing to construct the toilets. The total amount of money is about one million Euro and this money will be used as a revolving fund.

9 Costs and economics

The details on investment cost for constructing one Fossa alterna is given in the table below.

Table 1: Investment cost for constructing one Fossa alterna.

S. No.	Item	Unit	Qty	Unit Price in Birr	Total in Birr	Total in Euro
1	Cement	Qtl.	1	350	350.00	18.92
2	20 cm HCB	Pcs.	24	10	240.00	12.97
3	Eucalyptus dia. 8 mm	No.	6	15	90.00	4.86
4	Eucalyptus dia. 10 mm	No.	4	20	80.00	4.32
5	Nails #8 mm	Kg	0.5	25	12.50	0.68
6	Nails # 10 mm	Kg	0.5	25	12.50	0.68
7	Sand	m3	0.04	120	4.80	0.26
8	Aggregate 02	m3	0.06	180	10.80	0.58
9	6 mm dia. bar	Kg	2.7	25	67.50	3.65
10	7 cm x 5 cm wooden Formwork	Pcs.	2	9	18.00	0.97
11	Φ110 mm PVC Pipe	Pcs.	1	175	175.00	9.46
12	Φ 110 mm Vent cap	Pcs.	1	45	45.00	2.43
13	Φ50 mm PVC Pipe	Pcs.	1	85	85.00	4.59

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S. No.	Item	Unit	Qty	Unit Price in Birr	Total in Birr	Total in Euro
14	Φ50 mm PVC Elbow	Pcs.	1	15	15.00	0.81
15	CIS Nails	Kg	1	25	25.00	1.35
16	Door hinge	Pcs.	2	6	12.00	0.65
17	Door lock	Pcs.	2	7	14.00	0.76
18	'Karta' (wooven bamboo) for walling	Pcs.	4	10	40.00	2.16
19	CIS for roofing	Pcs.	2	100	200.00	10.81
20	CIS for door	Pcs.	1	100	100.00	5.41
	Total				1597.10	86.33

Labor cost is EUR 20 for construction of one Fossa alterna. If the wall is constructed by corrugated iron sheet (CIS) the material cost will be EUR 117. If the Fossa alterna is constructed above the ground the cost of one vault is EUR 50.

There are thirty Fossa alternas in Arba Minch. The total number of users is 177 out of which 78 are male and 99 female.

Two of the Fossa alternas were built for demonstration purposes making use of different designs and different materials. These units were considered as first testing units and the construction cost was covered fully from ROSA project budget. The other twenty eight Fossa alternas were built with cost sharing whereby 75% of the total construction cost was covered by the households and the remaining 25% was covered from ROSA project budget. The operation and maintenance cost is about EUR 4 as of 2008. This cost is basically to move the slab & the toilet structure and remove the pit contents.

10 Operation and maintenance

In Fossa alternas the contents of the filled pit can be emptied easily and applied in the compound of the household as compost. If there is no space for applying this compost in the household's compound it will be collected by solid waste collectors. In this case the solid waste collectors should buy the compost when awareness is raised among the community. After buying it, the solid waste collectors sell it to other persons who need compost.

The feedback from the users indicates that using the compost in the compound is the best option. No solid waste collectors bought the compost generated by the Fossa alternas so far. The reason may be the suspicion of the solid collectors on the profitability.

11 Practical experience and lessons learnt

- Compared to the other types of resource oriented toilets tested in Arba Minch the Fossa alterna has been accepted to a larger extent. The main reason is the similarity of the toilet to the traditional toilet.
- One of the users, Ms. Meselech Geda, started selling a locally produced alcoholic drink called 'tej'. The number

of customers who urinate in the Fossa alterna are a lot. Therefore, upon her request, a waterless urinal was installed. The filling rate is high (2 to 4 jerry cans per week). She changes the filled jerry cans by herself. She is paying Eur 5 per month for transporting the urine to a micro and small enterprise called 'Wubet le Arba Minch' Solid Waste Collectors Association for transporting the urine and for using it as a fertilizer. Refer Fig. 9. for the urinal installed in her compound.



Fig. 9: Waterless urinal (source: ROSA project Arba Minch, 2009).

- At the Fossa alterna of Ato Belay Mamo, a modification was made to divert the urine from the Fossa alterna in order to utilise urine separately for agriculture. The sitting pan was made of a used bucket, chicken wire mesh reinforcement (6 mm in diameter) and concrete (refer Fig. 10).
- Some users want the foot seat to be raised because they are used to such types of foot seats.
- The users of two Fossa alternas are Muslims and are washers. In these toilets most of the time the pit contents become wet. For these households, an additional hole should be provided on the slab for the anal cleaning water and a separate pit (ca. 0.5 m³) should be dug and filled with gravel to treat and infiltrate the anal washwater.

12 Sustainability assessment and long-term impacts

A basic assessment (Table 2) was carried out to indicate in which of the five sustainability criteria for sanitation (according to the SuSanA Vision Document 1) this project has its strengths and which aspects were not emphasised (weaknesses).

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Table 2: Qualitative indication of sustainability of system. A cross in the respective column shows assessment of the relative sustainability of project ('+' means: strong point of project; 'o' means: average strength for this aspect and '-' means: no emphasis on this aspect for this project).

Sustainability criteria	collection and transport			treatment			transport and reuse		
	+	o	-	+	o	-	+	o	-
• health and hygiene		X		X				X	
• environmental and natural resources	X				X		X		
• technology and operation	X			X				X	
• finance and economics	X			X			X		
• socio-cultural and institutional		X			X			X	

Sustainability criteria for sanitation:

Health and hygiene include the risk of exposure to pathogens and hazardous substances and improvement of livelihood achieved by the application of a certain sanitation system.

Environment and natural resources involve the resources needed in the project as well as the degree of recycling and reuse practiced and the effects of these.

Technology and operation relate to the functionality and ease of constructing, operating and monitoring the entire system as well as its robustness and adaptability to existing systems.

Financial and economic issues include the capacity of households and communities to cover the costs for sanitation as well as the benefit, such as. from fertiliser and the external impact on the economy.

Socio-cultural and institutional aspects refer to the socio-cultural acceptance and appropriateness of the system, perceptions, gender issues and compliance with legal and institutional frameworks.

For details on these criteria, please see the SuSanA Vision document "Towards more sustainable solutions" (www.susana.org).

With regards to long-term impacts of the project, the main expected impact of the project would be improved public health. This was however never formally assessed.

13 Available documents and references

1. Morgan, P., (2007): Toilets That Make Compost: Low-cost, sanitary toilets that produce valuable compost for crops in an African context. EcoSanRes Programme, Stockholm Environment Institute: Stockholm, Sweden. <http://susana.org/lang-en/library?view=ccbktpeitem&type=2&id=195>
2. ROSA AMU, ROSA ARB (2009) Arba Minch Town ROSA Project booklet, Arba Minch, Ethiopia, <http://www.susana.org/lang-en/library?view=ccbktpeitem&type=2&id=1189>
3. ROSA AMU, ROSA ARB (2007) Baseline study report of Arba Minch Town, Arba Minch, Ethiopia.

14 Institutions, organisations and contact persons

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