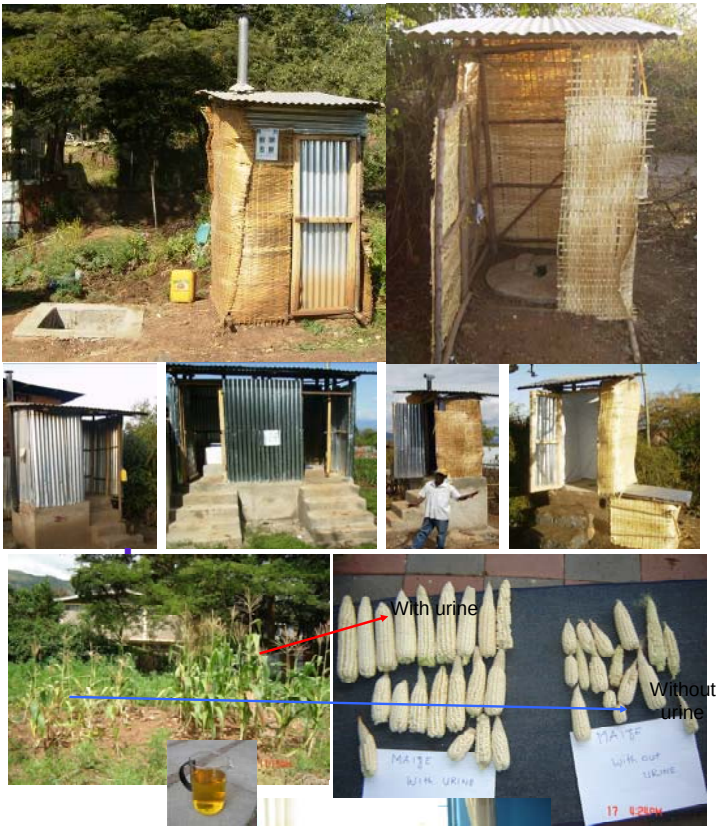
ARBA MINCH TOWN

ROSA PROJECT



May 2009

Arba Minch

Ethiopia

ROSA-ARB and ROSA-AMU staff group photo

Message from the ROSA-ARB project coordinator

It is known that all towns in our country except Addis Ababa have not been able to provide sewerage and sewage treatment facilities. Lack of adequate municipal finance and the low priority this facility has received are probably the main important reasons. This indicates the need for low cost, innovative and sustainable decentralized sanitation systems for our towns. As part of this overarching objective, the ROSA project has been working on promoting resource oriented sanitation systems that focused on implementation of simple, cost effective and affordable sanitation units and carrying out researches on these pilot units. This booklet attempts to provide practical information about the activities carried out by Arba Minch town ROSA project in the past 30 months of the project period.

I am thankful to all our ROSA team members who were engaged in the preparation of this booklet and those who have sent their comments for the improvement of the booklet. I would also like to acknowledge my gratitude to Dr. Gunter Langergraber, coordinator of ROSA project, for his successful planning, coordination and supervision of the ROSA project works in all the four African towns including Arba Minch.

I am certain that this booklet will be useful to planners, engineers, decision-makers, professionals and practitioners working in the area of sanitation in Arba Minch in particular and peri-urban areas of developing countries in general and I wish them all success.

Wudneh Ayele

Message from the acting ROSA-AMU project coordinator (package leader)

Ladies and Gentlemen,

Now it is 30 months since the start of ROSA in Arba Minch. Our town is very lucky to have ROSA involved in solving our sanitation problems in ecological way. We are introducing resource oriented sanitation concepts in the town and implemented different software and hardware. Research is also undergoing in greywater, WHO guideline, operation and maintenance, financing sanitation, integration of resource oriented sanitation into settlements and crop trial to fill the gaps. The Local ROSA AMU and ROSA ARB were working together to achieve what we have achieved along with European partners.

We are left with very important and demanding part of the ROSA activity to close the loop between sanitation and agriculture successfully.

Besides, with ROSA project, we have learned how to approach the community, what relevant research to do, and how to work with different stakeholders in the town.

I thank all the partners from Africa and Europe including the European Union for their assistance and I hope this will continue to the end. With 30 month progress meeting, I expect useful outputs and experiences that will make ROSA successful in the coming months.

Kinfe Kassa

Acronyms

AMU	Arba Minch University
ARB	Arba Minch Town Water Supply Enterprise
EcoSan	Ecological Sanitation
EU	European Union
ESE	Ecological Sanitation Ethiopia
HH	Household
KAP	Knowledge attitude and practice
MDG	Millennium Development Goals
MSEs	Micro and Small Enterprises
NETSSAF	Network for the development of Sustainable Approaches for large scale implementation of Sanitation in Africa
O&M	Operation and Maintenance
ROSA	Resource Oriented Sanitation concepts for peri-urban areas in Africa
SPA	Sanitation Project in Africa
SSWP	Strategic Sanitation and Waste Plan
UA	Urban agriculture
UDDT	Urine Diversion Dry Toilet
UN	United Nations
WHO	World Health Organization

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1 Introduction

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.

Adaptable, affordable and replicable solutions for sanitation of peri-urban areas in the pilot cities shall be developed. All pilot cities, (Arba Minch, Ethiopia; Nakuru, Kenya; Arusha, Tanzania; and Kitgum, Uganda), have common problems, e.g. the lack of sanitation and waste management and that people in the peri-urban areas are poor. Another common problem for all cities is the high growth rate of the population. For sustainability of the implemented solutions integrated stakeholder based management concepts will be developed and tested including end-users, service providers and authorities. This booklet describes the activities, achievements and research outputs of Arba Minch town with in the framework of ROSA project.

Arba Minch town, with a population of about 75000, is administratively located in Gamo Gofa zone of the Southern Nations, Nationalities and Peoples Region at about 500 km south of Addis Ababa (capital of the country) while 275 km south of Hawassa (capital of the region). Most households use a pit latrine for excreta disposal, with a superstructure made of local material, a privacy cover of old clothes or pit without any privacy cover. Gorges and jungle sites are potential open defecation areas and solid waste disposal sites. About 10% of the households in the town practice open defecation.

It is unlikely that sewerage will become a predominant sanitation option of choice in developing countries in the foreseeable future due to water scarcity and unreliability of water supply services and for financial, economic and resource reasons. Due to growing pressures on public health systems,

environment and natural resources, a variety of reuse-oriented on- and off-site systems have been developed and implemented at an increasing rate. These comprise urine diverting toilets, composting toilets, anaerobic (yielding biogas) and aerobic treatment of excreta and separate greywater treatment systems (WHO, 2006).

Different resource oriented sanitation systems, which are derived from the SSWP, have been built in Arba Minch town that include 15 urine-diversion dry toilets(UDDT), 28 Fossa alternas, 9 Arborloos, 7 greywater towers, 1 biogas unit and more than 5 composting schemes and researches are being made to evaluate these units. Therefore, there are about 65 systems that are implemented by ROSA project in the past 30 months of the project period. Applied researches have been made in the five thematic research areas. In the subsequent sections an attempt is made to describe the concepts and construction methodologies adopted by Arba Minch ROSA project team to construct these resource oriented units and the outcomes of the researches to share our knowledge based on the experience we acquired in the past 30 months of the project period.

2 Objectives of ROSA project

The ROSA project aims to develop sustainable resources-oriented sanitation systems for four cities in Eastern Africa. In all these cities the local project consortium comprises the municipality administration and/or the entity responsible for sanitation issues and a local university.

The overall objectives of the ROSA project can be summarized as follows:

1. to add to the current efforts for promoting resource-oriented sanitation concepts as a route to sustainable sanitation and to fulfill the UN MDGs,

2. to research the gaps for the implementation of resource-oriented sanitation concepts in peri-urban areas,
3. to develop a generally applicable and adaptable framework for the development of participatory strategic sanitation & waste plans (SSWPs), and
4. to implement resource-oriented sanitation concepts in the four pilot cities in East Africa

The specific research objectives addressed in the ROSA project are focused on applied research and include:

- an implementation study of the updated WHO-guidelines for use of waste and excreta in agriculture (released in September 2006) in peri-urban areas
- the development of operation and management strategies
- the development of local structures for financing of sanitation
- the development of decentralized (household) solutions for greywater treatment in arid and semi-arid areas
- the integration of resource-oriented sanitation into local settlement structures

3 The ROSA Approach

Resources-oriented sanitation systems recognize human excreta and waste water from households as a resource (and not as a waste), which should be made available for re-use. These systems are based on the closure of material flow cycles (Figure 1) and on collecting and treating the different wastewater flows separate to optimise the potential for reuse (e.g. Wilderer, 2001). When implementing resource-oriented sanitation systems single technologies are only means to an end and are not ecological per se but only in relation to the observed environment. The applied technologies may range from natural wastewater treatment techniques to compost toilets, simple household installations to complex, mainly

decentralized systems, but will include also low-cost sewerage and on-site sanitation systems.

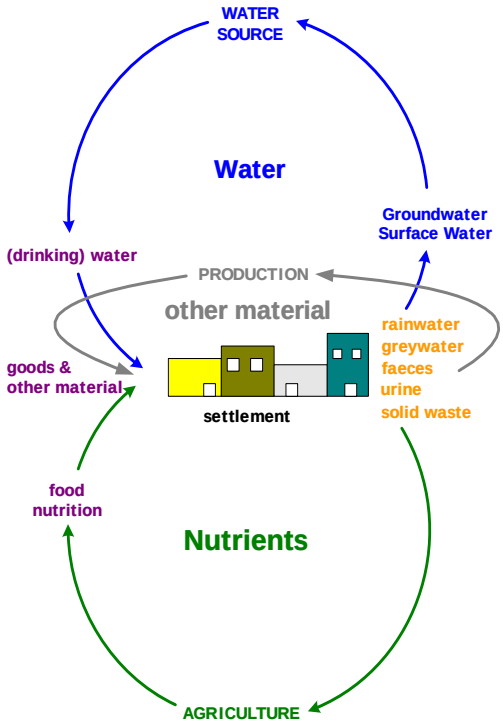

Figure 1 Resource-oriented or ecological sanitation system (Langergraber and Müllegger, 2005)

4 Implemented systems

4.1 Urine Diversion Dry Toilet

4.1.1 Technical system description

Urine-diversion dry toilets are toilets that use a special pedestal or squat plate in which the urine enters the front part of the pedestal and is then diverted through a pipe and is thus separated from the faeces which fall directly downwards into a vault or container. Some wood ash is added to cover the faeces after every visit. This covers the deposit and helps to dry out the surface of the faeces and makes them easier to handle and transfer. The distinct advantage of this method is that the urine can be collected separately, making it available as a liquid fertilizer. Also the solid component, being in a semi dry state, is much easier to handle and is safer from the beginning, even if it does initially contain pathogens. Being semi dry, it does not smell so much and its potential as a fly breeding medium is much reduced compared to the mix of urine and faeces. Eventually the faeces become completely composted.

There are many types of urine-diverting toilets available for use. The ROSA project in Arba Minch town implemented two different types

1. A UDDT that uses a single vault in which the urine is collected by PVC pipe and stored in a storage plastic tank and the faeces, together with the added ash, is collected in a 110 litre barrel held in the vault. When the barrel gets filled, it is closed with a lid and put under a shade. And an empty barrel is replaced in the vault.
2. A UDDT that uses double vaults in which one vault is used first and when full the second vault is used. When the second vault is full the first is emptied and can be used as soil conditioner.

4.1.2 The UDDT pan

Urine diversion requires a specially designed seat-riser or squatting slab or pan that is functionally reliable and socially acceptable. The basic idea of how to avoid mixing urine and faeces is simple: the toilet user should sit or squat over some kind of dividing wall so that faeces drop behind the wall and urine passes in front of the wall through pipes. In recent years several factories have started producing squatting pans as well as seat-risers with urine diversion. The ones installed in the UDDT toilets in Arba Minch are squatting pans. There are five options which are made available for the community. Refer Figure 2.

1. A UDDT pan made of fibreglass which is manufactured by Ethio-fibreglass Factory in Ethiopia.
2. A UDDT pan made of plastic which is manufactured by Hawassa Tabor Ceramic Factory in Ethiopia.
3. A UDDT pan made of plastic material which is manufactured by AquaSan Manufacturing Ethiopia Plc.
4. A UDDT pan made of reinforced concrete which is cast in ROSA project office compound.
5. A urine diversion pan cast on the toilet slab making use of concrete

Figure 2 UDDT squatting pans

In addition, one sitting type UDDT pan, manufactured by Ethio-Fibre glass factory, is installed at the ROSA office toilet. Refer Photograph 1.

Photograph 1 UDDT sitting pan

4.1.3 Feaces collection container

As mentioned above a barrel or a woven basket is used in a single vault system (refer Photograph 2). Photograph 3 shows the double vault system where the fecal matter is collected in the vault itself.

Photograph 2 Single vault system

Photograph 3 Double vault system

4.1.4 Waterless urinal

In all Urine Diversion Dry Toilets, waterless urinals are installed for men. The male urinals, Photograph 4, are connected by a pipe to the urine storage tank. In some cases a urinal is locally

prepared from used small and big jerry cans. An ecolily, a waterless female urinal where women can urinate in a standing position, was also installed in one of the toilets for trial. Refer Photograph 5.

Photograph 4 Men waterless urinals

Photograph 5 Ecolily

4.1.5 Urine Storage Tanks

Two types of urine storage tanks are used. One type is a 110L plastic barrel. In some cases where higher amounts of urine are produced 250L tanks are used. In both cases when the urine gets filled a hose which is fixed at the bottom of the tanks is used to empty the urine from the tank to a jerry can put at lower position. The hose can also be used as urine level indicator. Refer Photograph 6.

Photograph 6 Urine collecting mechanism

4.1.6 The UDDT house structure

All the UDDTs are constructed above the ground. The slab is usually fixed on 10cm reinforced concrete slab. In some house holds a wooden log which is covered by concrete was also used. Two types of material, woven bamboo locally called 'karta' with canvas and corrugated iron sheet, were used for the super structure above the slab. Four types of construction material were used for constructing the wall structure below the slab namely: Hollow concrete wall, Stone masonry wall, Brick wall and Mud wall. Photograph 7 shows some of the UDDT structures constructed in Arba Minch town showing the different types of construction materials used.

Photograph 7 some of the UDDTs constructed with different material

4.1.7 Site and system selection

There are fifteen UDDTs in Arba Minch. The total number of users is 447 out of which 248 are male and 199 female. Refer Table 1 for the details. Six units 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 form ROSA project budget. The other nine toilets were built with cost sharing whereby 75% of the total construction cost was covered by the households or the institutions and the remaining 25% was covered from ROSA project budget.

The site selection of the six demonstration units was made together with the respective kebele chairmen and the sites selected were households/institutions which fulfill the following conditions

- not having toilet in the compound
- willingness to have a UDDT
- capability to use the urine and feaces in the compound and
- voluntary to show the units to whoever is interested to see the constructed units

The other nine units were constructed based on the preference of the households. The main criteria for selecting UDDT were the household's or the insttutions preference, affordability and site/existing condition of the compound.

Table 1 List of UDDT sites

S. No	Name of the Household	Number of users			Sub city	Kebele
		Male	Female	Total		
1	Rosa Project office	6	2	8	Secha	Bere
2	Ato Yigebahal Shamena	4	6	10	Secha	Chamo
3	Nelson Mandela School	119	94	213	Secha	Chamo
4	Chamo Elementary school	28	33	61	Secha	Chamo
5	Condominium Construction site(Constructed by ESE)				Secha	Chamo
6	Ato Agafari Koso	5	5	10	Sikela	Dil fana
7	Sajin Bogale Borko	9	6	15	Secha	Doisa
8	Memire Zerihun Mekuria	2	4	6	Sikella	Menahari a
9	W/ro Almaz Folla	3	6	9	Abaya	Woze
10	Arba Minch Water Supply & Sewerage Enterprise	44	21	65	Nech sar	Wuha Minch
11	United Garage	12	5	17	Nech sar	Wuha Minch
12	Hibret lelmat Elementary School	14	11	25	Nech sar	Wuha Minch
13	W/ro Tsehay Belayineh	1	4	5	Nech sar	Wuha Minch
14	W/ro Wolanssa Tesfa	1	2	3	Nech sar	Wuha Minch
15	Ato Abebe Audie				Nech sar	Wuha Minch
Total		**248**	**199**	**447**		

4.1.8 Operation and maintenance

The operation and management of the units will be made by the existing micro and small enterprise called 'Egnan New Mayet Compost Association' together with the other four MSEs which were organized to collect solid waste. Priority is given to the household/institution, which is having the toilet, to use the urine and feaces in the compound. The urine and feaces which is not utilized will be transported by the solid waste collectors. The households/institutions should pay for the solid waste collector. The amount of money will be estimated with negotiation as it is made for other domestic wastes. The urine will be stored in two places one in the upper town(Secha) and the other in the lower town (Sikela) and will be transported to MSEs involved in urban agriculture, State farm and other farms which are found inside and nearby the town. The users of the urine would pay for the urine.

The feaces will be transported to 'Egnan New Mayet Compost Association' for co-composting. The compost association will sell the final compost.

For the time being one hand driven cart and one light-weight donkey cart for transporting the urine and faeces was purchased and given to one of the micro and small enterprises called' Wubet Le Arba Minch association'. Refer photograph 7a and 7b. An agreement was signed between ROSA office, the MSE and the Arba Minch town MSE office on the use of the carts.

Photograph 7a Hand driven cart

Photograph 7b Light-weight donkey cart

Other strategies for sustainable operation and management of UDDTs will be derived from the ongoing O&M research of the ROSA project.

4.1.9 Challenges

The main challenge which may arise if up-scaling of UDDT is the use of urine. All the urine produced may not be consumed by the farms found in the town. The other issue is the willingness of the users to pay for urine.

4.2 Fossa alterna

4.2.1 Technical system description

Fossa alterna, a double pit compost toilet, is made up of six parts (Peter 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 feaces. 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 to empty the compost in 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 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.

4.2.2 The pits

The two pits dug for fossa alterna are having a depth of 1.5-1.8m and have a square section of (90cmX90cm). Refer Photograph 8.

Photograph 8 Fossa alterna pits

4.2.3 The ring beams

Square ring beams, made of hollow concrete blocks, are cast on the pits. The external measurements of the beam are 1.3m X 1.3m and the internal measurements are 0.9mX0.9m. Refer Photograph 9.

Photograph 9 Fossa alterna ring beams

4.2.4 The reinforced concrete slab

The reinforced slab has 5cm thickness and a dimension of 1.2mX1.2m. It can be cast on site or be cast at a central place and transported to the construction sites. A mould of wooden purlin (5cmX7cm) was used to cast the slab. Refer Photograph 10.

Photograph 10 Casting Fossa alterna slabs

Out of the 28 Fossa alternas constructed in Arba Minch, there is one Fossa alterna with a urine diversion sitting pan. Refer Photograph 11. The sitting pan was made of a used bucket, chicken wire mesh, reinforcement (6mm in diameter) and concrete.

Photograph 11 Fossa alterna with urine diversion

4.2.5 The toilet house

The toilet superstructure is portable and is made of either woven bamboo or corrugated iron sheet. Refer Photograph 12 to see some of the units constructed in Arba Minch.

Photograph 12 Fossa alternas constructed with different material

4.2.6 Site and system selection

There are twenty eight Fossa alternas in Arba Minch. The total number of users is 167 out of which 73 are male and 94 female. Refer Table 2 for the details.

Two 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 form ROSA project budget. The other twenty six 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. Like that of the UDDT sites, the same criteria for site selection and implementation were used.

Table 2 List of Fossa alterna sites

S.No	Name of the Household	Number of users			Sub city	Kebele
		Male	Female	Total		
1	Rosa office	6	2	8	Secha	Bere
2	Ato Yehulashet Bombolo	1	1	2	Secha	Bere

S.No	Name of the Household	Number of users			Sub city	Kebele
		Male	Female	Total		
3	W/ro Emebet Taye	2	2	4	Secha	Chamo
4	Ato Shagole Salile	3	3	6	Secha	Chamo
5	W/ro Werkuwha	1	2	3	Nech Sar	Chamo
6	Ato Kanko Kassa	3	1	4	Secha	Doisa
7	Ato Geremew Dube	1	1	2	Secha	Doissa
8	W/ro Belaynesh Bekele	2	5	7	Secha	Doyisa
9	Ato Reta Tilahun	1	4	5	Secha	Doyissa
10	W/ro Banchi Mersha	3	3	6	Secha	Doyissa
11	W/ro Nigatwa Orkayido	5	4	9	Nech Sar	Idget ber
12	Ato Belayneh Mamo	3	13	16	Nech Sar	Idiget ber
13	Ato Orkaydo Belew	4	8	12	Nech Sar	Idiget Ber
14	Ato Mamo Urballa	2	3	5	Nech Sar	Idiget Ber
15	Ato Tegegn Seifu	1	2	3	Abaya	Kulfo
16	W/ro Meselech Geda	1	3	4	Abaya	Kulfo
17	Ato Tefera Aychew	1	2	3	Nech Sar	Mehal Ketema
18	Ato Teshome Bogale	8	5	13	Sikela	Menahari a
19	Ato Abebe Eshete	5	2	7	Sikela	Menehari ya
20	Ato Gemeda Tabo	5	3	8	Sikela	Menehari ya
21	Ato Mehamed	3	8	11	Sikela	Menehari ya
22	Ato Geresu zadha	4	2	6	Nech	Wuha

S.No	Name of the Household	Number of users			Sub city	Kebele
		Male	Female	Total		
					sar	Minch
23	Ato Wubayehu Tizazu	1	5	6	Nech Sar	Wuha Minch
24	Ato Adane Muluneh	3	2	5	Nech Sar	Wuha Minch
25	St Medaniyalem Church				Nech Sar	Yewuha Minch
26	Ato selomon Tafese	1	4	5	Nech Sar	Yewuha Minch
27	Ato Adane Ejigu				Nech Sar	Yewuha Minch
28	w/ro Tezerash & Abate	3	4	7	Sikela	Menehar iya
Total		**73**	**94**	**167**		

4.2.7 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 like the fecal matter in the UDDTs. 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.

4.2.8 Challenges

One of the challenges if up-scaling is made is the cross-contamination. In some cases due to negligence some users may not add sufficient soil and ash in the pits after defecation. Therefore the next pit may be contaminated with fresh pathogens. The other challenge is the depth issue. As it was

seen in the implementation sites, the households prefer to dig deep pits which are more than the recommended depth. In such cases the pits may collapse.

4.3 Arborloo

4.3.1 Technical system description

The *Arborloo,* a single simple pit compost toilet, is made up of 4 parts (Peter Morgan, 2007):

- A pit
- A sheet metal or a half barrel to protect the pit
- A concrete slab
- A toilet house

Like the Fossa alterna three cups of soil and one cup of ash are added after every use. When the Arborloo pit is full, the parts of the toilet are moved to another place, rebuilt and used in the same way again (Photograph 13). A thick layer of soil is placed over the filled pit. A young tree is planted in this soil and is watered and cared for. Refer Photograph 14. The content will decompose by different biological processes over time and utilized by the planted tree.

Photograph 13 Portable toilet house

Photograph 14 Papayas grown on filled Arborloo pit

4.3.2 The pit

The pit dug for Arborloo is shallow and has a depth of 1.2m. It is circular and has a diameter of 80cm.

4.3.3 Pit protection

To prevent a pit from collapsing, a sheet metal or a half barrel is used. Refer Photograph15. In stable soils protection was not used.

Photograph 15 Arborloo pit protection

4.3.4 The slab

The slab used for the Arborloo is made of concrete and has a dome shape as shown in figure. The slab has 1m diameter and 5cm thickness. A pile of sand is used to create the dome shape and a 5cm wide sheet metal is used as a mould. Reinforcement was not used. Three slabs are cast from one bag of cement. The steps followed are shown in Photograph 16.

Photograph 16 Arborloo slab construction

4.3.5 The toilet house

Easily movable shelter is placed on top of the hole. In most of the Arborloos, the material used for the superstructure is a locally available and cheap material 'karta'. Refer photograph 17.

Photograph 17 Typical Arborloo in Arba Minch

4.3.6 Site and system selection

There are nine Arborloos in Arba Minch. The total number of users is 33 out of which 15 are male and 18 female. Refer Table 3 for the details. All the nine toilets were built for demonstration purposes. These units were considered as first testing units and the construction cost was covered fully form ROSA project budget. Like that of the UDDT and Fossa alterna sites, the same criteria for site selection and implementation were used.

Table 3 List of Arborloo sites

S.No	Name of the Household	Number of users			Sub city	Kebele
		Male	Female	Total		
1	W/ro Asnakech Addisu	3	5	8	Nech Sar	Edget ber
2	Rosa Office	6	2	8	Secha	Bere
3	Ato Hailu Jira	1		1	Secha	Doissa
4	Ato Gebre Mariam Bekele	3	2	5	Sikela	Menaheria
5	W/ro Amsal Azazh	1	3	4	Sikela	Gurba
6	W/ro Anose Okie		1	1	Abaya	Woze
7	W/ro Ochache Oltisa		1	1	Abaya	Woze
8	Ato Yilma Kebede				Nech Sar	Wuha Minch
9	W/ro Yeshi	1	4	5	Nech sar	Wuha Minch
	Total	**15**	**18**	**33**		

4.3.7 Operation and maintenance

The operation and management of the Arborloo toilets is simple and can be carried out by the user. When the Arborloo pit is full, the parts of the toilet are moved to another place, rebuilt and used in the same way again. A thick layer of soil is placed over the filled pit. A young tree is planted in this soil and is

watered and cared for. The content will decompose by different biological processes over time and utilized by the planted tree. The household may only pay for a daily laborer to dig the new pit and move the shelter.

4.3.8 Challenges

The following are the main challenges which may arise if up-scaling of Arborloo is made.

1. The users may not like the toilet because of the shallow depth of the pit. Some users do not add ash and soil after defecation fearing that the pit may get filled in short period of time. From observations made up to now, people are interested in toilets which can be used for a long time i.e. about two years and above.
2. Getting seedlings (young trees) may be difficult.
3. Most of the times there is a chance of not taking care of the plants planted on the filled Arborloo pits and the plants may die and hence the composted excreta may not be utilized.

4.4 Greywater tower

4.4.1 Technical system description

Greywater tower is not a new idea. It is derived from what was made in South Africa. The unit has the capability to save the water that has been used for washing clothes and utensils and feet, so-called greywater, and use it for gardening. Leafy plants are grown in a column of soil, compost and ash mixture that fills a bag. Each day the available grey water is poured into the bag and the vegetables are planted in holes cut in the sides of the bag itself. The results speak for themselves. Refer photograph 18.

Photograph 18 Typical Greywater tower in Arba Minch

4.4.2 Materials required

The materials required for the construction of one greywater tower are listed below

- Bucket with no bottom
- Five poles 2m in height
- 1.2mX2.5m shade cloth
- 0.05 m^3 soil
- 0.2m^3 compost
- 0.14 m^3 ash
- 0.085 m^3 gravel

4.4.3 Steps followed (refer Figure 3)

- Mark out a circle which has a radius of 40cm
- Dig out the bottom layer of the tower
- Plant the side poles or droppers firmly into the bottom
- Wrap the shade cloth around the poles
- Roll the sides of the shade cloth cylinder down out of the way before filling
- Place the bucket on the ground in the middle of the tower
- Pack the gravel in the bucket to make sure that the water does not run through too fast
- Backfill around the bucket with the soil mixture (3 parts soil, 2 parts compost and 1 part ash)
- Pull the bucket partially out, leaving the gravel in position.
- Fill the bucket again with gravel and backfill with the soil mixture. Repeat for each layer.

Figure 3 Steps followed to construct a Greywater tower

4.4.4 Site and system selection

There are seven Grey water towers in Arba Minch. The total number of users is 37 out of which 18 are male and 19 female. Refer Table 4 for the details. Two units were built for demonstration purposes. These units were considered as first testing units and the construction cost was covered fully from ROSA project budget. The other five units 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 sites of the first testing units were selected by ROSA project team members as convenient sites for demonstration. The other five units were constructed based on the preference of the households. The householders saw the demonstration units in their own time and getting convinced with the advantages of the units they contacted the ROSA office to have grey water towers in their compounds.

Table 4 List of Grey water sites

S.No	Name of the Household	Number of users			Sub city	Kebele
		Male	Female	Total		
1	Rosa Office	6	2	8	Secha	Bere
2	Ato Tegegn Seifu	1	2	3	Abaya	Kulfo
3	Memihre Zerihun Mekuria	2	4	6	Sikela	Menaharia
4	Ato Adane Muluneh	3	2	5	Nech Sar	Wuha Minch
5	Ato Kinfe kassa				Nech Sar	Wuha Minch
6	Ato Ayele Shewa	5	5	10	Nech Sar	Wuha Minch
7	W/ro Yeshi	1	4	5	Nech Sar	Wuha Minch
Total		**18**	**19**	**37**		

4.4.5 Operation and maintenance

The units can be operated and managed by the users. There is no any waste which is coming out of the unit. The unit can serve for more than one year without any problem. After one year strengthening the unit and planting new leafy plant seedlings may be required and it can all be done by the household.

4.4.6 Challenges

The following are the main challenges which may arise if up-scaling of greywater tower is made.

1. Some users may add too much greywater and the units may not function well.
2. Getting seedlings (leafy plants like spinach, lettuce, cabbage etc.) may be difficult.

4.5 Biogas plant

4.5.1 Technical system description

One biogas plant has been constructed in Arba Minch University. The biogas unit had just the right size to utilize the waste generated by the staff canteen kitchen (around 8 kg per day) and at the same time it could provide an additional energy source for the kitchen. A construction site was easily found behind the kitchen, where a green stretch of 600m^2 was available to use the expended slurry. Everyday the kitchen waste together with 10kg of cow dung is added in the digester. The biogas is used in the kitchen as an energy source for boiling and cooking. Refer Photograph 21.

Six 200-L drums are welded together to make the biogas digester. Refer Photograph 19 and Photograph 20.

Photograph 19 parts of the digester before welding

Photograph 20 Parts of the digester after assembling all parts

Photograph 21 the biogas in use (AMU)

4.5.2 Operation and maintenance

The main tasks to operate and manage the biogas unit are

- Collecting food waste and cow dung every day,

- Chopping the food waste in it into small pieces if necessary or crushing it to get homogenous mass.
- Mixing the cow dung and the food waste with water and filling it in to the biogas unit
- Collecting the slurry in a bucket and transporting it for application or composting
- Checking the gas pipes

The above mentioned tasks are being done by hired daily laborers who are paid from ROSA project budget. In the future the scheme will be handed over to the University.

4.5.3 Challenges

Some the challenges that can be faced if up-scaling is done are described as follows

- The gas production of the biogas unit which is constructed as the first testing unit is low. Hence recovering the investment cost may take very long time.
- Lack of qualified persons in Arba Minch who can construct biogas units
- If excreta is used for biogas production, the slurry may not be used as fertilizer for vegetable crops, because of the possible contamination with pathogens. The slurry requires further treatment which will increase the O&M cost of the unit.
- In Arba Minch town the biogas can only be used for cooking. There is electricity for lighting.

As it was seen in the demonstration unit, addition of cow dung is necessary for the proper functioning of a biogas unit. Therefore when a household needs to have a biogas unit, he has to make sure that there is cow dung.

4.6 Composting

4.6.1 Technical system description

There are five composting sites in Arba Minch. They are listed below.

1. ROSA office compound
2. W/ro Yeshi's compound
3. Ato Agafari's garden
4. 'Engan new mayet' compost Association compound
5. AMU compond

All the sites were chosen by ROSA team members to demonstrate composting and co-composting activities to the community of Arba Minch. The main criterion for selecting these specific first testing sites is the availability of decomposable waste. Different methods of composting were followed for demonstration. In ROSA office and AMU composting above ground and below ground were made. In W/ro Yeshi's compound composting was made above ground. In 'Engan New Mayet, compost association compound and in Ato Agafar's compound, composting have been made above ground. The reason for choosing different methods at different sites is to compare and contrast the methods and come up with the suitable method.

In addition to the different methods used, the materials used for preparing the compost were different. Refer table 5.

For storing produced compost in AMU a shade of size 12mX7m was constructed.

Table 5 Materials used for composting

S.No	Site name	Method of composting	Materials used for composting
1	ROSA office	Above ground and pit composting	Solid waste from town, agricultural waste, urine and fecal matter
2	W/ro Yeshi	Above ground	Food waste, kitchen waste sweepings from the compound
3	Ato Agafari	Pit composting	Fecal matter, urine, horse dung and agricultural waste
4	'Engan new mayet' compost Association	Pit composting	Cow dung, green plants, dry feaces and urine
5	AMU	Above ground and pit composting	Kitchen waste, Food waste from student's cafeteria, grass and urine

4.6.2 Operation and maintenance

The composting units can be managed and operated by the users and the compost can be used in the users' compound. In case of large production of compost like that of 'Egnan New Mayet' compost association and AMU, the compost can be sold directly to persons who need compost. Some of the compost produced by AMU was used by the nursery site in the university. The composting association has also sold 10 quintals of compost to the municipality at a rate of 100 Birr per

quintal. The compost association is involved in the compost preparation at AMU. The compost produced was used for nursery site in AMU and was also used by fruit and vegetable producing MSEs.

There are more than 12 MSEs who are organized and got land from the municipality to grow fruits and vegetables. The 12 MSEs, the municipality, hotels, institutions and the state farm can purchase the compost which is produced by the compost association.

4.6.3 Challenges

There is no potential challenge as far as composting activity up scaling is concerned. The only problem may be the existence of pathogens and persistence of eggs of nematodes, schistosomes and ascaris due to improper composting.

5 Summary of research results

5.1 A preliminary survey of the microbiological and parasitological quality of some locally produced and marketed vegetables in Arba Minch, Ethiopia.

As part of ROSA research activity on Research topic 1 i.e. WHO guideline implementation study preliminary surveys on the microbiological and parasitological quality of some locally produced and marketed vegetables in Arba Minch were carried out for three seasons between September 2007 and January 2009. Samples of tomato and lettuce were collected from Arba Minch town (Sikela and Shecha) and Arba Minch University. Then, the samples were analyzed for *E. coli* (fecal coliform) and helminthes eggs contaminants. By using membrane filtration method, washout samples of tomato and lettuce were filtered, inoculated on Lauryl sulphate broth and incubated for *E. coli* analysis and yellow colonies were detected in all the samples. The highest numbers of *E. coli* were observed on the

tomato samples collected from the town. Helminthes eggs were detected following Bailenger method which allows sedimentation of the sample washout. Upon microscopic examination of helminthes egg, higher values were detected on the lettuce sample collected from town. *Ascaris lumbricoides*, *Hymenolepis nana*, *Fasciola hepatica, Enterobius vermicularies* and Hook worm eggs were detected of which *Ascaris lumbricoides* were dominant. The result could indicate that the tomato and lettuce vegetables are contaminated with fecal matter (*E. coli* and helminthes eggs). Even though, further work is needed to include other vegetables; consumers should treat the vegetables before consumption.

5.2 Perception, attitude and practices with regard to ecological toilets and recycling of excreta.

Ecological sanitation (ecosan) is an alternative sanitation system with the aim to protect human health and the environment while reducing the use of water in sanitation systems and recycling nutrients to help reduce the need for artificial fertilisers in agriculture. Since 2007, ROSA project start implementing of ecosan toilets (Arbloo, Fossa alterna and UDDT) in pilot households and public places in Arba Minch. As in most parts of the world, in Ethiopia any practices with fresh excreta is regarded with disaffection, but the socio-cultural attitudes are less articulated in relation to excreta derived compost use as fertilizer or land reclamation. The objectives of this research are assessment of users perception, attitude and practices with regard to ecological toilets, the recycling of resources and to find the nature of project harmonization and community participation towards the new technological option. The research is a descriptive and quantitative method that makes use of multiple participatory data gathering. Every answer from respondents are triangulated and adjusted to fit to structured perception-attitude question format for convenience of data analysis. Informations were gathered from house hold heads and most of them are adults with some level of schooling.

Preliminary results reveal that 24% pilot project sites are living in confined compound of less than hundred square meters and only few HH that practice urban agriculture. Large number of users (91%) have average to high level of understand to the design objective of ecosan toilets, while only 41 % are aware of design options available and on average they scored five from ten operational and management related questions. Almost all respondents have very good attitude towards design objective and the operation of ecosan toilets. This could be related to the similarity to the traditional cultural practices employed in users and that of ecosan technology. Inspite of the fact that a high acceptances as sanitation technology achieved, a significant amount of users fell to adopt hand washing tip-tap and practices on house hold level urban agriculture.

At last a continuation to this study on the investigation on knowledge, attitude and practices (KAP) on ecosan toilets and excreta reuse targeted on non users of ecosan is being carried out.

5.3 Crop trial experiment in Arba Minch town

Crop trial experiments were done in Arba Minch town since the start of ROSA in the town. Two important results have been achieved from the experiment: attitude change of the different community members is made and the effect of urine on the soil and plant physical structure was identified.

Different community members were demonstrated with the Pot and field experiment. Refer Photographs 22, 23 and 24. We assume attitude change towards the use of excreta as fertilizer created. The crop trial was performed in different parts of the town. With urine in ROSA office secha, Arba Minch University farm, Genta Meche elementary school, Arba Minch state farm, and the organized farmers are testing with compost produced with urine. From the trial experiments, many students and community members have visited and their negative attitude

towards urine and faeces are somewhat changed to use it as a fertilizer.

The second output of the crop trial was the study done on the effect of urine on the soil, physical characteristics of plant and urine dose determination.

Photograph 22 pot trial January 2009

Photograph 23 Pot trial with 800 ml of urine and with out urine

Photograph 24 Mixing urine with water for watering

5.4 Operation and maintenance research

Operation and maintenance (O&M) is very important towards sustainable achievement of ROSA objectives. Two important activities that are taking place in Arba Minch in O & M and the practical and the research aspects. In order to achieve resource reuse cyclic loop toilet operation, excreta storage, excreta treatment, excreta transport and excreta agricultural use, it is tried to make people be involved in transport, prepare co-compost. Experience sharing among the UDDT users was done. With respect of transport, solid waste collectors are oriented and supported with donkey cart as incentive. Compost shade was constructed for co-compost producing MSE and technical assistance was also given to add value to excreta. Market search is being done by ROSA by giving Co-compost for free for the farmers. Refer photograph 25. In some UDDT users like Chamo School, co-compost production is started and orientation is given. Refer photograph 26.

Research activities have been started to monitor the attitude changes of the toilet owners, transporters and farmers which are involved in the above activities.

Photograph 25 Compost application by the farmers

Photograph 26 Co-compost preparation at Chamo Primary School

5.5 Financing sanitation research Progress Report

The original title of the theme as earthed in five ROSA thematic topics is “Development of Local Structures for Financing Sanitation”. Various significant data have been collected from the banks, micro financing institutions and other organizations as well as MSEs engaged in sanitation activities of the town. Some of these data are used in the development of the business plan of Arba Minch town SPA project. The following methods and objectives have been set as fundamentals of this research.

General Objectives

To enhance the local institutional structures of the town for sustainable sanitation financing and there by link the structures in the city wide strategic sanitation and waste plan financing systems.

Specific Objectives

- contribute for the promotion of ROSA concepts by actualizing access to several ten thousand people in the town to sanitation through development of sustainable sanitation financing structures, toilets hardware services and household self – help financing system on sanitation facilities at reasonable distance of the town's quarters as well as neighborhoods
- Solve the social vulnerabilities and economic problems of the town population, which have been hedges against improved sanitation facilities and hygienic conditions, by creating opportunities to the poor and women headed families to access sustainable sanitation finances.
- identify and assess the potential local banks and micro financing institutions to involve in rendering of sanitation financing services on loan, credit, facilitates provision as well as mortgage
- Precisely indicate the bench marks of meso- financing and help in setting guidelines of capital development strategies for the operation of the Arba Minch town business plan of the SPA project owned by the municipality.
- Uncover the financing modalities, money transaction policies, credit disbursement and recollection regulation, interest rates and grace period/maturation period.

Proposed methodology of Data collection

Under these techniques of data collection, the mix of semi structured and unstructured interview questionnaires are designed and implemented in the survey of households, MSEs and micro financing institutions and banks

Proposed methods for analysis

The study findings are analyzed using statistical/quantitative and qualitative techniques of data analysis. The data from FGD are analyzed through the qualitative methods and data assessed on the possibilities and potentials of local financing institutions to finance sanitation will be analyzed in line with resource oriented sanitation SSWP developed in ROSA project.

5.6 Grey water research

The grey water research in Arba Minch town under the ROSA project tried to look at the quantity, quality of grey water generated from the various premises as well as the manner of disposal, existing reuse practices and possibilities of expanding reuse in to the future.

The research study revealed that the water fetched by a single household vary between 10 liters per day and 200 liters per day, the most frequent daily volumes being 20 liters, 40 liters and 100 liters per day, depending on the family size and the type of connection. Water supply shortage is being experienced in many parts of the town as the supply is inadequate to meet the demand of the fast growing population. There is a general awareness about the need to conserve water. The amount of grey water produced is also variable. A volumetric measurement study revealed that mostly between 20-40 liter grey water was collected from a single household per day. There is a general decline in the percentage of grey water collected as the level of consumption increases (some of the grey water was not directed to the collection tanks. This calls for efficient way of collecting grey water for high water consumption households. The volumetric study revealed that the water use habits among households are similar and the collected volume of grey water is significant. The fact that the area has a warm weather and the soil is sandy conceals the presence of grey water as it is lost in to the ground. The

generation of grey water among hotels and restaurants is also high.

Reuse of grey water is limited. Only 18% of those households surveyed said they practice reusing grey water. Grey water by many is viewed as dirty, contaminated and useless; and many fear the soap mostly present in grey water will harm plants. There is some resistance towards reusing grey water even after treatment and the greatest percentage of households surveyed suggested the best use of grey water after treatment is for growing plants. However, there is a general openness about the willingness to reuse grey water after treatment.

The quality analysis of grey water revealed presence of feacal coliforms, high COD (up to 8000 mg/L) and very high BOD (up to about 5000 mg/L). Tutrbidity is very high in many cases (up to 3000 NTU). Total dissolved solids and sodium content concentrations were high in some samples. Generally the quality analysis revealed that the grey water quality is not the same as those suggested in the literature from other countries. The waste is generally concentrated and the pollution load is high. Treatment design should take this information in to consideration.

5.7 Integration of resource oriented sanitation into 01 kebele of Arba Minch town

Kebele 01 which is presently called Chamo kebele, having a 1.5 square km area, is one of the eleven kebeles in Arba Minch town. In this study an attempt was made to assess the settlement/neighborhoods in the kebele and explore and recommend suitable resource-oriented sanitations systems which will upgrade the existing local sanitation situation or even solve the most urgent sanitation problems.

In the study the settlement in the Kebele was divided into seven types as listed below

1. Informal settlement/Tukul Houses
2. Formal residential settlement

3. Low-cost houses
4. Condominium apartments
5. Schools and colleges
6. Hotels
7. Institutions/Offices

Therefore the settlements in the Kebele were studied in-depth making use of various parameters and indicators and based on this study resource-oriented sanitation systems to be integrated in the settlements were recommended. A method developed by NETSSAF was used for organizing and defining sanitation systems to assist in the decision making process to avoid fixed mind sets towards conventional solutions which to-date have not always shown to be the best choice in a site specific context.

The sanitation solutions selected for the settlements of the Kebele include Urine-Diversion Dry Toilets, Fossa alternas, Arborloos and Cistern-flush toilet. In the study the possible and recommended on-site treatment & storage technologies, transportation technologies, off-site treatment & storage technologies, reuse technologies and disposal technologies were pointed out. The solutions identified would help in the development of the strategic sanitation and waste plan (SSWP) of the town.

Furthermore, this study can be a base for future implementations in other kebeles of Arba Minch town as it provides adaptable findings/solutions for different situations in the kebele.

6 Prospects of Urban Agriculture and Reuse Value Chain

Situation Analysis: - Although there are agricultural activities in Arba minch, it is not common and significant in general. Most of the employment sector that absorbs the population is service sectors where petty traders dominate. A few farmers whose

farmlands are situated in rural areas nearby (7-20kms) are living in the town.

Households with subsistence farming in the town are living along the course of the **Kulfo River**. The total land available for this purpose is not much in general except for one Kebele where more than 150 households mainly lead their subsistence from the income generated from agriculture. Crops grown are Maize, Sweet potato, Sugar cane, Banana, Mango, Allium, Carrot, Pepper, Radish, Avocado, and cabbage. More than 500 ha of land are used for this purpose. No practice of using organic waste, Waste water; no application of chemical fertilizers, Purpose: commercial and subsistence.

Arba Minch State farm is the major institute where there is UA in the town. About 973 ha of land are available. It is irrigated by Kulfo River. The main crops grown are Cotton, Maize and Banana. The farm yields 2600kg of Cotton, 3000kg of Maize and 7000kg of Banana per hectare. The soil has a problem of nitrogen deficiency which is compensated by application of chemical fertilizer (100kg Urea/ha). Previous study also stated that the determinant problem of plant growth is nitrogen deficiency in the area. The same source recommended that the problem can be alleviated by addition of organic matter and commercial fertilizer. Employees: > 1000; No practice of using organic waste, Waste water; applies chemical fertilizers (Urea and DAP), Purpose: commercial.

Arba Minch University farm: About 100 hectares of land is available. It serves the university as a means of income generation. There are also experimental plots. The main products of this farm includes: Maize (60 ha), Banana (4 ha), Tomatoes, Radish, Lettuce, Pepper, Mango, Avocado, and Cabbage. Consumers of these products are University communities. The soil demands nitrogen fertilizer. Employees: >50, No practice of using organic waste, Wastewater; applies chemical fertilizers (Urea and DAP), Purpose: commercial, ready to apply compost prepared by the ROSA project.

Arba Minch Hospital irrigates crops which it grows in small area by treated waste water. They have a plan to enlarge the size. Crops encountered during the visit were Banana, Mango and Pepper. **Zonal prison** is also potential area to look for intervention.

Micro and Small Enterprise packages: - There are six packages through which the nation is contributing to poverty alleviation effort. Urban agriculture is one of these packages. It seems that attention was given to the sector at national level. Despite this in terms of the actual implementation, attention has not been given to the sector. This can be explained in terms of lack of space and budget. If the need arise for space or if the question comes from group of youngsters whom the government itself organizes into cooperatives, then the only free land to be encroached is either the forest land in the periphery of the town or the edges of the Kulfo River, which from environmental point of view all are unsustainable and not recommendable. A good point to mention here is that if the cooperatives prepare project document and made request, there is possibility of getting money from micro finance on loan base.

Sub sectors of urban agriculture in the town: - Small scale fruit and vegetable production, Wool development, small scale Sheep fattening, Poultry, Cattle fattening, Fodder development, and Apiculture.

Among these only fruit and vegetable production is active and functional in the town. There are about 15 cooperatives involved in small scale fruit and vegetable production in the town. Cooperate has 10 members each. More than 10 ha, outside Kulfo edge and significant portion along the catchment (more than 500 ha) are provided for this purpose.

Home garden or yard agriculture: - is not a common phenomenon in the town. If yes it is mainly for the decorative purpose. It is common to see ornamental plants grown in yard. Farm activities (home garden) in Arba Minch may play an

important role in providing recreational (ornamental) function. It has nothing to do with resource management or as income generation. Mainly women especially girls are responsible to take care after the ornamental flowers management but may not be necessarily exclusive. Men can also participate.

Urban forestry: - In few cases it was observed that an attempt has been made to cover a yard by indigenous tree species called *Terminalia brownii*. It is a drought resistance native tree species. This may be a concept of urban forestry which can be considered as part of UA. But there is no any waste water irrigation and organic waste application to this field. One can presume that it would be more fruitful if it would have been supplemented by these applications. In general this practice can have positive contribution to maximize resource reuse (waste sink & resource release) and stabilize local climate. In addition to these, urban forestry can also contribute in controlling wind speeds (as a wind break), dust reduction and provision of shade. These will have positive impact on environment and greenery around homes has a positive effect on people's health.

The most common indigenous tree species encountered during the city assessment is the African cabbage tree (*Moringa stenopetala*). This species is very useful for water treatment even for drinking purpose. The seed has a coagulant property. It can serve as simple and chief technology in waste water treatment. Leaves of this multipurpose tree species are edible, used as fodder and sold at the local market assisting household in their income generation.

Public Park: - Arba Minch has no public park. But wild edible fruit tree species such as *Ximenia americana, Tamarindus indica* and *Balanites aegyptiaca* were deliberately left uncut and/or cultivated in some households.

Common Crops (fruits, vegetables, cereals, wild plants) grown in the town: -Maize, Cotton, Banana, Mango, Papaya, Avocado, Cabbage, Tomatoes, Lettuce, Egg plant, Moringa,

Onion, Lemon, Kazmir, Gishta, Orange, *Coffee,* Beet, Radish, Sugar cane, Cactus, Pepper, Mitimita, Grawa, Sweet Potato, ornamental flowers, Cordia, Terminalia, Phoenix, Boye, Ensete, Recinus, Kore, Inkoy, Neem tree, Woyn, Eucalyptus, Sasbania, Qurqura, Jatropha, Dovyalis, Euphorbia, Sun flower, Bedena, Bean, Birbira, and Weyra.

Waste reuse for UA:- Use of organic waste is not a common practice in the town or waste reuse is not capitalized at all and as such deserves for awareness creation campaign. But people may use wastewater for irrigation unintentionally. For example the Maize and Banana farm close to the old waste stabilization pond of the University is irrigated from the overflows of the pond. Similarly large proportion of the farmlands along the edges of Kulfo River is irrigated by the river. The river is one of the sites where people can defecate or dispose any domestic waste.

Prospects of UA: - Had it not been for its constraints, Arba Minch would have been potential area for urban agriculture. Many different plant species are growing in the town. The environmental and ecological contribution of these species to the town should be valued in addition to their economic importance to the households. Besides, UA provide employment opportunity for different group of peoples living in the town. Immigrants, HIV-AIDS affected households, disabled people, female headed households with children, elderly people without pension and youngsters without job can and are working in UA.

However, one of the major threats to implement resource oriented sanitation in Arba Minch is that agriculture plays insignificant role as livelihood for the community. With the existing situation this sector could not play a role as an important sink/recipient to/for the wastes generated in the town. The following factors contribute to the problems: - No attention has been given to promote UA in the town by the authorities; The number of activities to promote UA in the town is minimal;

Urban Agriculture is not integrated into the town planning, Dry climate; and no reliable water supply in terms of distribution.

To bridge this gap and to capitalize the existing opportunities for resource oriented sanitation, efforts have to be exerted to mobilize the community towards promoting different agricultural activities even within limited spaces within the town giving primary attention to households and cooperatives organized under micro and small enterprises, and peasant associations closer to the town where there is demand for the ecosan products. Besides, awareness raising campaign and regular sensitizations of the households, private entrepreneurs, cooperatives and farmers shall be part of the strategic approach to achieve its objective. For sustainability UA must take part in the SSWP of the town. This is to value its potential contribution for local economic development, food supply, social welfare, means of income generation, recycling of wastes, urban greening, ecological and environmental systems, maintaining open buffer zones, provision of recreational service/ aesthetic value, provision of educational service, mitigation of HIV-AIDS, and social inclusion of disadvantaged groups.

7 An overview of Strategic Sanitation and Waste Plan for Arba Minch Town (SSWP)

7.1 The Project area

Arba Minch, with a population of 75,000 and annual growth rate of 4.5% is one of the fast growing towns in Ethiopia. It is located in Gamo Gofa zone, the Southern Nations, Nationalities and Peoples Region at about 500 km south of Addis Ababa. The town is divided into four sub-cities which are restructured into eleven administrative kebeles. The steep and undulating topography exposed the town for flooding. This has resulted in formation of several gullies and gorges which aggravates the sanitation problems. The area administered by the municipality extends up to 20.8km^2 and the expansion is fast particularly

after 1980's due to the establishment of different institutions and rapid flow of rural migrants.

7.2 Driving forces

There are wide ranges of sanitation problems in the town. It is expected to grow even worse with population growth. The town does not have pit desludging services forcing the residents to dig another pit, or manually desludge the pit, which is unacceptable practice from health and hygienic point of view. The dwellers in peripheries practice open defecation on water courses and gorges. There are portions of the towns that are congested settlements with rented houses in which land is not available for digging pits & people either share a single latrine, defecate open or use flying toilet. 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.

7.3 Strategic approach of SSWP

This SSWP, which is intended to the entire town focuses on resource oriented strategic sanitation approach combining several techniques which help in better management and reuse of excreta (faeces & urine), grey water and solid wastes. It will also help the implementers to identify areas and options for implementation. The approach seeks to integrate Health, Environmental, Economic, Social and Technical factors that have an impact on the sustainability of service provision. It builds on the assumption that the provision of sustainable sanitation is only possible by a demand oriented service delivery system.

7.4 The process of the development of the SSWP

As part of SSWP document development process, different activities were accomplished so that inputs and information obtained will contribute in the preparation of the strategic plan.

A baseline study has been carried out in February and March 2007. The major objective of the study was to get a better understanding of the existing sanitation situation of the town. While conducting the baseline study, relevant data and documents from various administrative offices were referred and a transect walk survey was carried out. Besides, group discussions were held with relevant stakeholders in all administrative levels including the sub city and the sub-kebeles administrations. In addition, demand assessment has been carried out to grasp the actual sanitary demand of the community in the town using focus group discussions and household questionnaire survey. The participation and involvement of the stakeholders was effected in problem and objective analysis during the planning workshop which was held in December 2007. Consultative and community meetings will also be held in the future targeting in maximizing the efficiency of the strategy.

7.5 The goal of developing SSWP

The goal to develop SSWP for Arba Minch is to have technically, financially, institutionally, socially and environmentally sustainable, excreta, wastewater and solid waste resource oriented management in the town. Its objective is to promote resources oriented sanitation as a route to achieve the MDG and to provide guideline for improving the existing sanitation facilities and services as chosen by the people, and ensure improved livelihood of the community.

8 Monitoring and Evaluation of ROSA project activities

The monitoring of different ROSA pilot and implementation units, such as new ecological sanitation toiles, biogas, compost, crop trials and grey water treatment towers, is the vital component of the project and have been followed up once in every week. The activity is carried out by two social workers employed to this effect (one in the lower town and other in the

upper town division) of the project sites, user households as well as institutions. The purpose of monitoring is mainly to actualize the adoption of resource oriented sanitation, enable the users to hygienic practices of sanitation by raising awareness and thereby research the operational pros and cons of the implemented technical options in the town. The feedback is continuously shared with all project staff and necessary measures have been made by the design and construction engineer and construction mason (MSEs). The overall project issues and progresses have been discussed by the presence of all project staff and valuable decisions have been made in the regular meeting conducted every Monday of a week. Site visit has been also undertaken by the project staff every Friday of a week and notes of the visit have been shared to local and European partners for sound feedbacks as well as advices have regularly provided. The data is collected by filling the participatory monitoring format developed by the project team. These data from monitoring ROSA project implemented units and users have been documented and the general results are being compiled for further lessons and improvements of the project monitoring.

By and large, the evaluation of the project out puts/impacts has been conducted in the workshops and project consortium meetings. Project-Specific evaluation have been undertaken in the experience sharing forum of the collectives of same project using households and school representatives which is organized by the project office.

The evaluation indicators and parameters have been identified by the local project team and shared to the European partners to analyze the contents and reach on working format of evaluation. The final evaluation will be made in the general stakeholders' workshop at the end of implementation phase and shall be compiled to be used as ROSA document outputs.

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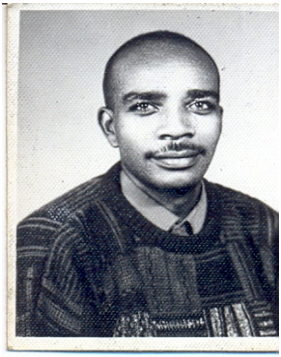
10 List of ROSA project staff and expatriates

1	**Wudneh Ayele Shewa** is an Environmental engineer by profession and has got a bachelor degree in Sanitary Engineering and a master degree in Environmental Engineering. He has a total of 13 years work experience in water supply, sanitation and housing development sector. More over, he has been teaching water supply and waste water engineering courses in Arba Minch University and HHawassa University on part time basis. He has been working for ROSA project in Arba Minch Water Supply and Sewerage Enterprise as a local project coordinator since December 2006. He is also the team leader of the research theme entitled integration of resource oriented sanitation systems in to settlements.	 E-mail wudexa@yahoo.com Office ph: +251-46-8815115 Mobile ph: +251-916-825611
2	**Dr. Ababu Teklemariam** is an environmental engineer by profession and received Ph.D. degree in Environmental engineering from the university of Siegen, Germany in 2004. Currently he is assistant professor at the department of water supply and environmental engineering of Arba Minch University and has had a teaching and research experience of over 20 years. He has been involved in the grey water research and worked for Arba Minch University ROSA project as a work package leader from January 2007 up to March 2009.	 E-mail: ababute@yahoo.com Office ph: +251-46-8812939 Mobile ph: +251-911-708608

3	**Kinfe Kassa Ayano** has graduated from Addis Ababa University (Ethiopia) with B.Sc, & M.Sc. degree in Chemistry and M.Sc degree in Environmental sanitation (Eng'g) from Gent University (Belgium). His duties in Arba Minch University are teaching, research and consultancy in Water Quality, waste water, solid waste and resource oriented sanitation. In ROSA project, He is working as operation and maintenance research leader and crop trial experiment. Currently he is the acting work package leader of ROSA project in Arba Minch University.	 E-mail: kinfe_k@yahoo.com Office ph: +251-46-8812939 Mobile ph: +251-911-745172
4	**Simon Shibru Cheche** is a biologist by profession holding a bachelor degree in Biology and Master degree in Botanical sciences. He has a total of 15 years work experience in teaching, biodiversity conservesionist and lecturing at various GOs and NGOs. In addition to serving as a lecturer at Arba Minch University, he has also been currently working for ROSA project as research staff since January 2006. He is also local team leader for the ROSA research topic 1 which is entitled as "An implementation study of the WHO-guidelines for use of waste and excreta in agriculture and aquaculture in peri-urban areas and the integration of resource-oriented solutions in regulatory Frameworks".	 E-mail: simonshibru@yahoo.com Office ph: +251-46-8810453 Mobile ph: +251-911-637784

5	**Muluken Hailu** He has Bachlor Degree in Biology and Master of Public Health from Addis Ababa University. He has twenty years of teaching various courses and research experiences in Arba Minch University and research staff in ROSA project.	 E-mail: mulukenhail@yahoo.com Res ph: +251-46-8813448 Mobile ph: +251-911-836283
6	**Eyob Esatu Bura** has a B.A Degree in Sociology and Social Anthropology from Addis Ababa University. He had been teaching sociology in Health Science collage for a year. Later he was employed in Catholic Church Integrated Community Development Program as Technical Facilitator for Social Works. He has been working for ROSA project in Arba Minch Water Supply and Sewerage Enterprise as a sociologist since January 2007. He is also the topic leader of Financing Sanitation research.	 E-mail eyobb2007@yahoo.com Office ph: +251-46-8815115
7	**Bogale Gelaye Geleta** is a sanitary engineer by proffession and has got a Bsc degree in Water resources and irrigation engineering. He has atotal of 5 years experience in water supply, sanitation and irrigation. He has also been working consultancy works on sanitary instalation works on part time basis. He has been working for ROSA project in Arba Minch Water Supply and Sewerage Enterprise as a sanitary engineer since March 2009.	 E-mail bogalegelaye@yahoo.com Office ph: +251-46-8815115 Mobile ph: +251-911-798018

8	**Mesele Mekonen Tibebu** was trained as an elemenntry school teacher in Kotebe Teachers' training institute and continued his diploma education on school administration and supervision in Addis Ababa University. He has worked as a social worker for 8 years. He has been working for ROSA project in Arba Minch Water Supply and Sewerage Enterprise as a social worker since september 2008.	 Residence ph: +251-46-8810736 Mobile ph: +251-916-883266
9	**Amelework Wolde Delbeto** was trained as a kndigarten teacher in Sodo Biruh Tesfa KG teachers training center. She took training on community development in Fura Development Center. She has worked as technical facilitator for more than 13 years in Catholic Integtrated Community Development Program. She has been working for ROSA project in Arba Minch Water Supply and Sewerage Enterprise as a social worker since March 2009.	 Residence ph: +251-46-8813965 Mobile ph: +251-913-216758
10	**Zewetir Tamiru Belachew** has a diploma on personal computer training. She has also took training on typing. She has been working for ROSA project in Arba Minch Water Supply and Sewerage Enterprise as a secretary since December 2006	 Residence ph: +251-46-8810232 Mobile ph: +251-913-310198

11	**Wubishet Zewde W/meskel** is a soil chemist by proffesion and has Msc in soil science. He has worked for 24 years as plant and production expert, as agricultural extention and management coordineter and related postions in zonal agricultural bureau. He has been working as an advisor on crop trial experments and related research activities on part time basis.	 E-mail wubtad43@yahoo.com Office ph: +251-46-8810043 Residence ph: +251-46-811967
12	**Franziska Meinzinger** has been working as a research assistant and lecturer at the Institute of Wastewater Management and Water Protection at Hamburg University of Technology (TUHH) in Germany for six years . She is a civil engineer by profession and has an additional master's degree in International Rural Development. Her main interests are planning processes and evaluation methods for increased resource efficiency in wastewater management. She has been working for ROSA since October 2006. Her tasks include the support of the local team in Arba Minch.	 E-mail: f.meinzinger@tuhh.com Office ph: +49 – 40 – 42878 2416 Office fax: +49 - 40 - 42878 2684
13	**Sarah C. Schreiner**, Dipl.-Ing. (Urban Planning), works as a research assistant at Hamburg University of Technology and as a freelance consultant in urban planning throughout Germany. Co-ordinator of the research topic of "integration of resource-oriented sanitation systems into settlements" within the ROSA project.	Email: sarah.schreiner@tu-harburg.de Office ph: +49-40-42878-2767

14	**Krishan Gairola** has studied Environmental and Energy engineering and is currently working as PHD student at the university of technology, Hamburg. He did research for the ROSA project on biogas and composting techniques during an internship within the European GLEN program	 E-mail krishga@googlemail.com Mobile ph: +49-178-1658561
15	**CABANES David** was a french volunteer who participated for ROSA project in Arba-Minch with the GeCO-GLEN program during 3 months in 2007. He's now an engineer in agronomy and has got a bachelor degree in water treatment plant and a master degree in water management for agriculture. He's working in France at the moment for the firm Veolia Water in the field of waste water plant.	 E-mail cabanesdavid@yahoo.fr
16	**Aleksandra Drewko** is a PhD candidate at the Hamburg University of Technology in Germany. She holds a MSc degree in Environmental Engineering and a MBA degree in Global Technology Management. Her MSc and PhD deals with resource-oriented sanitation in Ethiopia and as such her research is connected to the ROSA project. She travelled to Ethiopia in September 2009 and conducted numerous interviews in Addis Ababa and Arba Minch in order to analyze stakeholder's relationships in the sanitation sector.	 E-mail drewko@tuhh.de Office ph: +49-40-428782767

17	**Susanne Schubert** is a student of urban planning at the HafenCity University in Hamburg, Germany. In July 2008 she finished her Bachelor in urban planning and is actually studying in the master classes of urban planning with the focus on infrastructure. She has collected some work experience in several internships during her bachelor studies and from July to September 2008, she has participated in the ROSA-Project in Arba Minch by working on a small research project about CBOs.	 Email: susanne_cleo@yahoo.de

List of ex-ROSA project staff

1. Abdisa Hirpo (Social worker)
2. Betamiruk Tesfaye (Civil Engineer)
3. Demelash Abate (Civil Engineer)
4. Ephrem Israel (Economics)
5. Fikre Assefa (Environmental Engineer)
6. Muluken Bekele(Civil Engineer)

ROSA project consortium

1. BOKU - University of Natural Resources and Applied Life Sciences Vienna, Austria (Co-ordinator)
2. Hamburg University of Technology, Germany
3. EcoSan Club, Austria
4. WASTE - Advisors on Urban Environment and Development, The Netherlands
5. London School of Hygiene and Tropical Medicine, United Kingdom
6. Makerere University, Department of Civil Engineering, Uganda
7. University of Dar es Salaam, Department of Water Resources Engineering, Tanzania
8. Egerton University, Department of Water and Environmental Engineering, Kenya
9. **Arbaminch University, Ethiopia**
10. Kitgum Town Council, Uganda
11. Arusha City Council, Tanzania
12. Municipal Council of Nakuru, Kenya
13. **Arba Minch Town Water Supply Enterprise, Ethiopia**

Local ROSA project consortium members

1. 4 Sub-city Administrators
2. 2 Selected kebele chairmen
3. President of Arbaminch University
4. General manager of Water Supply and Sewerage Enterprise
5. Head of Zonal Health Department
6. Arba Minch district health Center
7. Meyor from Arba Minch town administration
8. General manager from Arba Minch town municipality
9. Head of Zonal Agriculture and rural development department
10. General manager of Housing Development Project office
11. Representative from Catholic church
12. Representative from Refugee trust international

ROSA project

Resource-**O**riented **S**anitation concepts for peri-urban areas in **A**frica

a Specific Target REsearch Project
funded by European Union

October 2006-March 2010

Website http://rosa.boku.ac.at