sustainable sanitation alliance

Case study of sustainable sanitation projects

UDDTs for peri-urban households
Arusha, Tanzania

Fig. 1: Project location

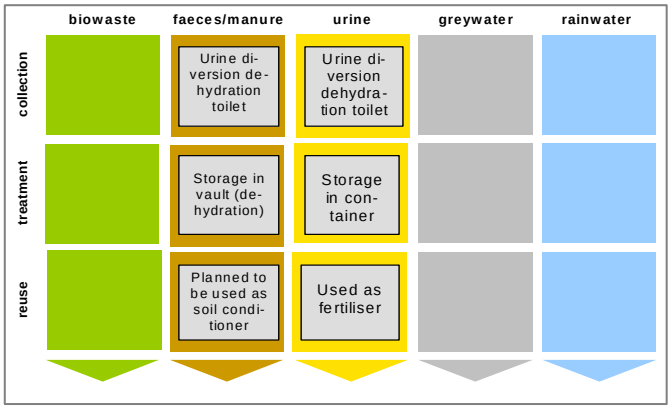

Fig. 2: Applied sanitation components in this project

1 General Data

Type of project:
Pilot scale urine diversion dehydration toilets (UDDTs) for peri- urban households

Project period:
Start of construction: February 2008
End of construction: May 2009
Start of operation: February 2008
Ongoing monitoring period planned for: 24 months
Project end: March 2010

Project scale:
Number of UDD toilets: 8
Number of inhabitants covered: approximately 36
Total investment: EUR 3,300

Address of project location:
Arusha Municpal, Central Bussines Area, Plot No 149, Block E-Building No 2 Sekei ward, Tanzania

Planning institution:
ROSA-Project, Arusha, Tanzania

Executing institution:
University of Dar es Salaam & Arusha Municipal Council, Tanzania

Supporting agency:
European Union and ISSUE-2 programme

rosa
Resource-Oriented Sanitation concepts for peri-urban areas in Africa

SIXTH FRAMEWORK PROGRAMME

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 general objective of the ROSA project is to promote resource oriented sanitation concepts in high density areas. The specific objectives of this project are to:

- Support capacity building in constructing, operating and maintaining UDDTs.
- Create awareness and demand of UDDTs as a viable solution for excreta management problems in the case study area and other wards of Arusha municipality.

The main expected impact of the project is an increased number of people owning UDDTs and wide knowledge on resource oriented sanitation concepts.

3 Location and conditions

The project area is located in Arusha, Tanzania. Three wards have been selected, namely: Daraja II, Lemara and Sokon I. These wards account for 26% of the municipal population. Most people are economically depending on the informal sector in the project area.

Fig. 3. Stakeholders meeting during planning phase (source: ROSA (Faraja Naiman), 2008).

It is estimated that the monthly average income per household in the project area is between 4 to 63 EUR. The area is characterised by high population density (2,600-

UDDTs for peri-urban households
Arusha, Tanzania

30,500 persons/km^2) and unplanned settlements with pit latrines being the major means of excreta management (75%). The emptying service is very difficult - especially in Daraja II - and sewerage system connection has not been established in the entire area with exception of a small portion.

The estimated population of Arusha is 516,000 with 4% growth per annum and the distance to the capital is 647 km. The average household size is 4.5 people.

Arusha municipality consists of people with multicultural religious backgrounds. About 95% of households are washers (meaning they use water for anal cleansing). This is so because apart from Muslims that do anal cleansing, non-Muslims also use water for anal cleansing due to limited funds to buy toilet paper.

In Tanzania, the under-five child mortality rate is currently[1] 108 children per 1000 (compared to 163 per 1000 in 1990).

4 Project history

The project came into existence since Arusha is one pilot city of the EU funded project "Resource-Oriented Sanitation concepts for peri-urban areas in Africa (ROSA) which took place in four countries in East Africa The design and construction of UDDTs started in February 2008 after the first draft of the Strategic Sanitation and Waste Plan (SSWP) for Arusha Municipality had been prepared.

The selection of the implementation and case study areas was based on a baseline survey and a series of stakeholder meetings, where households for demonstration were selected by a participatory approach (Figure 4). The ROSA project finished in March 2010.

5 Technologies applied

Urine diversion dehydration toilet technology (UDDT) was chosen by the project team due to the fact that the structure is permanent and there is the possibility of using the products from the toilet for local agriculture. Lack of smell and flies as a result of keeping faeces dry is a further main advantage of this technology. Due to the easy set up of these systems, household users are able to spread the information to others who do not have this type of toilet.

6 Design information

The design was adopted from EEPCO (Environmental Engineering and Pollution Control Organization), an NGO based in Dar es Salaam, which is dealing with environmental engineering and pollution control in Tanzania (http://www.eepco-tz.org/). This organisation has experience with design and constructing UDDTs in different locations in Tanzania including Pemba and Zanzibar. The EcoSan Club Manual from Austria was also consulted for designing the toilets (see Section 13 for the link).

The units constructed were double vault types (Figure 5) for five households and single vault types for three households. The size of each vault is 1 m^3. It is estimated that with 4-6 people per household, it will take 3-5 years for one vault to get full. In all UDDTs concrete blocks of 12.7cm thickness were used as substructure. The superstructure was also built using concrete blocks (Figure 6). In one case timbers (mabanzi) were used for walling. In the other cases 3-inch (7.5cm) blocks were used instead of the 5-inch (12.7 cm) blocks of the substructure[2].

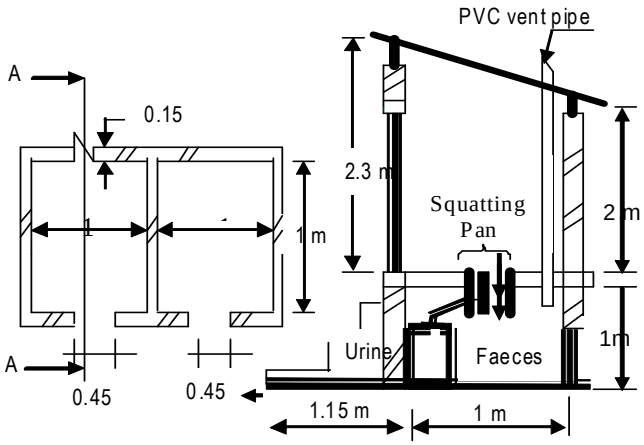

Fig. 4: Floor plan and cross section of double vault UDDT (Source: EEPCO, 2008).

Fig. 5 Single vault UDDTs in Daraja II built with concrete blocks (source: ROSA, 2008).

Some toilets were provided with plastic urine diversion squatting pans from Kenya (company Kentainer, see Section 14), but the majority was constructed using concrete urine diversion squatting pans that have been made locally in the project area (no paint is added to the concrete just ordinary Potland cement finishes). Access to the faeces vaults is provided by black timber panels.

[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/)

[2] This is usually long (3-5 years) more common will be one year.

UDDTs for peri-urban households
Arusha, Tanzania

Urine is collected in 20 litres plastic jerrycans located adjacent to the main door (inside the vault). All UDDTs have a place for discharge of anal wash water since 95% of the people in the area are washers.

7 Type and level of reuse

The large area of Sokon I and Lemara and a small portion of Daraja II are practicing urban agriculture whereby maize, beans, banana and vegetables are the main crops in the area. The soil fertility in this area is low and the demand of fertiliser per household ranges between 0.05 to 10 tons per growing season. The cost of 50 kg urea is sold at about 30 EUR.

Due to the small size of containers used for urine collection (20 litres), urine is emptied almost after every two weeks and is then used at the farms around the households as fertiliser. Crops grown are predominantly banana and maize. Dried faeces have never been used to date since the vaults are not yet full even at those UDDTs built more than a year ago. Once the vaults are full the faeces will be dried and composted for improving soil condition or disposed to the municipal dumping area together with solid waste. The faeces from the single vault UDDTs will be dried outside the vault in a 60-liter container before composting.

The application of urine is done directly to the plant followed by an equal amount of water. The difference between those fertilised by urine and those left without urine is seen clearly in the growth rate and even the colour of leaves.

Fig. 6: Maize fertilised with urine (source: ROSA project O&M research, Arusha).

8 Further project components

- Promotion campaign on up-scaling and reuse with posters and exhibitions. The exhibitions were done every farmers day which took place on 8 August every year. In fact the ROSA project also built a UDDT at the exhibition ground.
- Research on factors affecting integration of UDDTs in informal settlements and their O&M costs.
- Research on greywater quality and quantity as well as a treatment.

9 Costs and economics

In this project most of the toilets built had their investment cost fully covered through ROSA/ISSUE-2 demonstration funds[3]. Cost sharing with households of up to 30% was seen in some cases. The cost of toilets for double vault UDDTs ranged from EUR 280 to 410 (Table 1). In Table 1, the costs vary depending on the user need. For example, if one decides to use a concrete squatting pan instead of the plastic pan, the cost will decrease by 5%.

Table 1: Cost break down for double vault UDDT in household (EUR).

COST ESTIMATION FOR SUBSTRUCTURE				
Requirements	Quantity	Unit	Unit cost	Total
Blocks	80	Number	0.29	23.1
Cement	4	Bags	6.74	26.9
Sand	13	Tins	0.24	3.1
Aggregate (0.5")	25	Tins	0.48	12.0
Basket	2	Number	1.44	2.9
Wire mesh	2	Pcs	6.74	13.5
Pipe (pvc 1")	5	Meter	1.20	6.0
Vent pipe (pvc 4") 6m	1	Number	1.20	1.2
Timber (1 x 8)	10	Number	3.37	33.7
Nails	0.5	Kg	0.77	0.4
Elbow (pvc 1")	2	Number	0.96	1.9
Wire net	1	m^2	0.29	0.3
Cap (pvc 4")	2	Number	0.96	1.9
Squatting pan (plastic)	1	Number	19.26	19.3
Labour Charge	1	Days	7.22	7.2
Total-1 (EUR)				**153.6**
COST ESTIMATION FOR SUPERSTRUCTURE				
Requirements	Quantity	Unit	Unit cost	Total
Walling blocks	120	Number	0.29	34.7
Sand	4	Tins	0.24	0.9
Nails	2	Kg	0.77	1.5
Cement	4	Bags	6.74	26.9
Corrugated Iron sheets (gauge 32)	4	Pcs	4.14	16.6
Doors	1	Number	38.52	38.5
Timber (2"×4")	3	Pcs	2.41	5.8
Timber (2"×2")	2	Pcs	1.44	1.9
Total-2 (EUR)				**126.9**
Labour	5	Days	7.22	36.1
Costs Total (EUR)				**316.6**

Note: 1.00 EUR= 2076.83Tshs (23-02-2011)

For single vault UDDTs the cost ranged from EUR 140 to 150. The operation costs are estimated to be EUR 1 to 2 a month. This involves labour costs for a person to empty the urine and to apply it at the farm near the household's compound.

The transportation costs for urine range from EUR 25 to 50 per truck which has the capacity of 6,000 to 14,000 litres. This means 300-700 households can have their urine collected every two weeks at an average of 0.07 to 0.08 EUR per

[3] ISSUE -2 was an EU funded project (Integrated Support for Sustainable Sanitation in Urban Environment). The project was not limited to Resource oriented sanitation only. The project was managed by EEPCO and supervised by WASTE in the Netherlands. It happens that WASTE was a partner organisation to ROSA project in Arusha.

UDDTs for peri-urban households
Arusha, Tanzania

household or 0.14 to 0.17 EUR per month per household, respectively. These transportation costs are valid for a maximum of 8 km distance[4]. By using the pushcart, which can carry about 20 containers of 20 litres, these costs are estimated to be higher ranging from 0.25 to 0.31 EUR.

10 Operation and maintenance

To date, the operation and maintenance of the UDDTs within the project area is left to the households who have previously received minimum training on how to use the toilet and reuse the UDDT products. Pilot households are using their urine in their small banana, maize, flower and grass farms around their compounds.

The squatting pan is frequently cleaned with water to avoid clogging of the urine pipe and the application of ash in the vaults for stabilisation and odour prevention has been perceived well. In few incidences children discharged water for anal cleansing directly into the faeces vault and this sometimes created problems. Intervention is taken from time to time by ROSA project staff to make sure that the toilets are operated properly[5].

11 Practical experience and lessons learnt

People are very happy with their UDDTs and spread information of this new option to other areas. The pilot has made a head teacher from Ashira Primary School in Moshi to visit the area and now the school has six UDDTs for 500 students built by artisans trained by ROSA/ISSUE-2 (the distance from Moshi to Arusha is 73 km). The school paid from internal generated funds. The school was under pressure on excreta management.

Two more households in the study area have built their own single vault UDDTs without any financial support from ROSA.

Private operators who transport UDDTs' products and users of UDDTs' products are crucial key players to the success of the system. How is it working out? Were there any problems?

12 Sustainability assessment and long-term impacts

A basic assessment (Table 1) 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).

Table 2: Qualitative indication of sustainability of the 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).

Note: Long-term impacts since April 2010 are not known as monitoring of the project has stopped at that time.

13 Available documents and references

Additional **photos** from this project are available at: http://www.flickr.com/photos/gtzecosan/sets/72157626523775274/

Information on Arusha, Tanzania can be found at the ROSA website: http://rosa.boku.ac.at/index.php?option=com_content&task=view&id=11&Itemid=11

Further publications:
Lechner, M. (2007). Dry Toilets - EcoSan Club Manuals - Volume 2. EcoSan Club, Austria. http://www.susana.org/lang-en/library?view=ccbktypeitem&type=2&id=1175

[4] These are like petrol tankers with 6 m3 or 14 m3. The bigger it becomes the cheaper it is. The price was quoted from private operators.

[5] The intervention took place before the end of ROSA project. Municipal council has established ROSA unit within sanitation department to continue with monitoring of UDDTs you can write to pattkiny@yahoo.com for any question regarding monitoring program.

ROSA (2006). Resource-oriented sanitation concepts for peri-urban areas in Africa - a specific target research project funded within the EU 6th framework programme sub-priority, Annex I - "Description of Work". http://www.susana.org/lang-en/library?view=ccbktypeitem&type=2&id=1095

ROSA (2007). Assessment and baseline study for sanitation development of strategic and sanitation waste - Work package 6 team Arusha, Tanzania. ROSA Project Report. http://www.susana.org/lang-en/library?view=ccbktypeitem&type=2&id=1096

Senzia, M.A., Markus, L., Elke, M., Kimwaga, R. (2009). Local requirements and constraints of O&M of urine diverting dry toilets - Final report on O&M research topic. ROSA project, Arusha, Tanzania. http://www.susana.org/lang-en/library?view=ccbktypeitem&type=2&id=1093

14 Institutions, organisations and contact persons

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