



Fig. 1: Project location

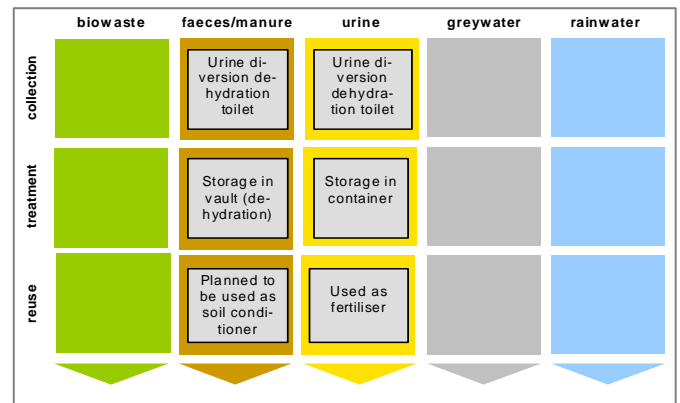


Fig. 2: Applied sanitation components in this project

1 General Data

Type of project:

Pilot scale urine diversion dehydration toilets (UDDTs) for 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: 2010

Project scale:

Number of UDD toilets: 8
Number of inhabitants covered: 32-48
Total investment: EUR 3,300

Address of project location:

P.O. Box 3013, Arusha
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



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 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. As shown in Figure 3, most people are economically depending on business activities in the project area.

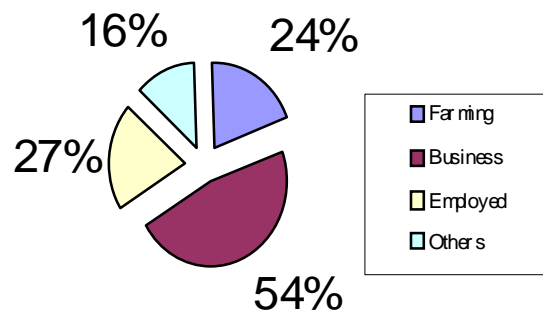


Fig. 3: Economics in the project area. (Source: ROSA project baseline study, Arusha)

It is estimated that the monthly average income per household in the project area is between 4 EUR and 63 EUR. The area is characterised by high population density (2,600-30,500 persons/km²) 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

of Daraja II. 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 fertilizer per household ranges between 0.05 to 10 tons per growing season. The cost of 50 kg urea is sold at about 30 EUR and for animal manure the cost is about 18 EUR per 7 tons.

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 takes place in four countries in East Africa. It is the first self-standing project in this respect in Arusha. The design and construction of UDDTs was in place after the first draft of the Strategic Sanitation and Waste Plan (SSWP) for Arusha Municipality was 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 obtained by a participatory approach (Figure 4).



Fig. 4: Stakeholders meeting during planning phase (Source: ROSA, year?).

5 Technologies Applied

Urine diverting dehydration toilet technology (UDDT) was chosen 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 separating urine and faeces 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. The investment and operation cost are also low compared to the conventional systems (cf. chapter 9).

6 Design Information

The design was adopted from EEPKO (Environmental Engineering and Pollution Control Organization), an NGO based in Dar es Salaam, which is dealing with environmental engineering and pollution control in Tanzania. The organisation has experience in designing and constructing UDDTs in different locations in Tanzania including Pemba and

Zanzibar. The EcoSan Club Manual (www.ecosan.eu) was also consulted for designing. 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 m³. 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 5 inches thickness were used as substructure. The superstructure was also built using concrete blocks (Figure 6). In one case waste saw mills timbers (mabanzi) were used for walling. In the other cases 3-inch blocks were used instead of the 5 inches blocks of the substructure.

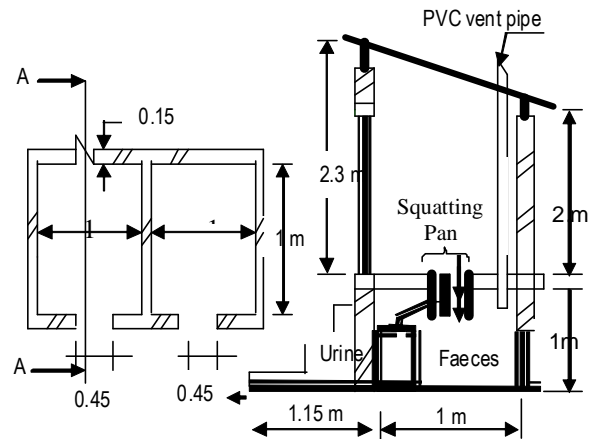


Fig. 5: Floor Plan and cross section of double vault UDDT (Source: EEPKO, 2008).

Some toilets were provided with plastic squatting pans from Kenya but the majority was constructed using concrete squatting pans that have been made locally in the project area. Access to the vaults is provided by black timber panels. Urine is collected in 20 litres plastic tanks located adjacent to the main door at one of the sidewalls. All UDDTs have a place for ablution for washers since 95% of the people in the area are washers.



Fig. 6: Concrete block single vault UDDT in Daraja II (Source: ROSA).

7 Type and Level of Reuse

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 fertilizer. Crops grown are predominantly banana and maize (Figure 7). Faeces have never been used to date since the vaults are not

yet full even at those UDDTs built more than a year ago. However, once the double vault types 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 solid single vault type products will be dried outside the vault in a 60-liter container before composting.



Fig. 7: Maize fertilised with urine (Source: ROSA project O&M research, Arusha).

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

8 Further project Components

- Promotion campaign on up-scaling and reuse.
- 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. Cost sharing with households of up to 30% was seen in some cases. The cost of toilets for double vault systems ranged from 280 to 410 EUR (Table 1). In Table 1, the costs vary depending on the user need. If one decides to use e.g. a concrete squatting pan instead of the plastic pan, the cost will decrease by 5%.

For single vault systems the cost ranged from 140 to 150 EUR. The operation costs are estimated to an amount from 1 to 2 EUR 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.

Table 1: BOQ for double vault UDDT in household.

COST ESTIMATION FOR SUBSTRUCTURE				
Requirements	Quantity	Unit	Unit cost	Total
Blocks	80	Number	600	48,000
Cement	4	Bags	14,000	56,000
Sand	13	Tins	500	6,500
Aggregate (0.5")	25	Tins	1000	25,000
Basket	2	Number	3000	6000
Wire mesh	2	Pcs	14,000	28,000
Pipe (pvc 1")	5	Meter	2500	12,500
Vent pipe (pvc 4") 6m	1	Number	2500	2500
Timber (1 x 8)	10	Number	7000	70,000
Nails	0.5	Kg	1600	800
Elbow (pvc 1")	2	Number	2000	4000
Wire net	1	m ²	600	600
Cap (pvc 4")	2	Number	2000	4000
Squatting pan	1	Number	40,000	40,000
Labour Charge	1	Days	15,000	15,000
Total-1 (Tshs)				318,900
COST ESTIMATION FOR SUPERSTRUCTURE				
Requirements	Quantity	Unit	Unit cost	Total
Walling blocks	120	Number	600	72,000
Sand	4	Tins	500	2,000
Nails	2	Kg	1600	3200
Cement	4	Bags	14,000	56,000
Corrugated Iron sheets (gauge 32)	4	Pcs	8,600	34,400
Doors	1	Number	80,000	80,000
Timber (2" x 4")	3	Pcs	5000	12,000
Timber (2" x 2")	2	Pcs	3000	4000
Total-2 (Tshs)				263,600
Labour	5	Days	15,000	75,000
Costs Total (Tshs)				657,500

1.00 EUR= 1,998.66 Tshs (24-11-2009)

The transportation costs for urine range from 25 to 50 EUR 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 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, indicating that the transportation costs are in the range of 0.0175 to 0.0215 EUR per km/household every month. By using the pushcart, on which the majority can carry about 20 containers of 20 litres, these costs are estimated to be higher ranging from 0.25 to 0.3125 EUR. The cost comparison of UDDTs and other options of excreta management are shown in Table 2.

Table 2: Cost comparison of various excreta management options (Source: ROSA project O&M research, Arusha).

Option	Investment cost (€)	Life span (yrs)	Annual (O&M) (€)	Annual Gain (€)
UDDT	140-410	15	15-26	>100*
Pit latrine	375-750	8	18-110	-
Septic tank	90-1250	15-19	10-15	
Sewerage system	50-315	30-40	15-50	

*Experiences elsewhere have shown that urine of a household (4-6 people) can produce 1000kg of grain annually.

This is sold at 10 EUR per/100kg. From the Table 2 it is clear that pit latrines and septic tanks have higher investment costs as compared to UDDTs and sewerage systems. Sewerage systems have the lowest investment costs compared to all other options (reasons?). UDDTs and septic tanks have the lowest annual O&M costs. However, UDDTs have long term benefits since the products can be reused at household level or sold to other users who might need these for their use. When pit latrine costs (Table 2) are compared with that of UDDT in Table 1, it can be clearly seen that a UDDT has lower investment and O&M costs and is therefore suitable for the study area despite of other benefits.

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 by water to avoid clogging and the application of ash in the vaults for stabilisation and odour prevention has been perceived well. In few incidences children used water for anal cleansing directly in connection to the vault and this sometimes created nuisances. Intervention is taken from time to time by ROSA project staff to make sure that the toilets are operated properly.

11 Practical experience and lessons learnt

People are very happy with their UDDT 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. 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.

12 Sustainability assessment and long-term impacts

A basic assessment (Table 3) 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 3: 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; 0 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		
	+	0	-	+	0	-	+	0	-
• 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, e.g. from fertilizer 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).

13 Available documents and references

General project information:
<http://rosa.boku.ac.at>

14 Institutions, organisations and contact
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Case study of SuSanA projects

*Urine diversion dehydration toilets for households, Arusha,
Tanzania*

SuSanA 2009

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