sustainable sanitation alliance

Case study of sustainable sanitation projects

UDDTs and greywater treatment at Secondary School, Nakuru, Kenya

Figure 1 Project location

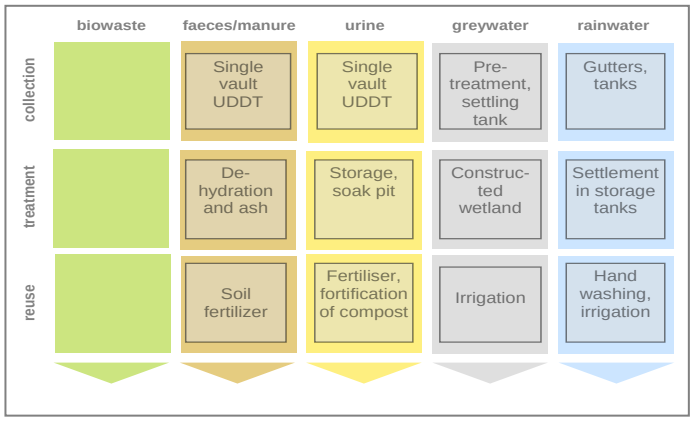

Figure 2 Applied sanitation components (UDDT stands for urine diversion dehydration toilet)

1 General data

Type of project:
Full-scale pilot project for a school in Nakuru, Kenya

Project period:
Start of construction: June, 2008
End of construction: May, 2009
Start of operation: September, 2009
Monitoring period planned for: one year
Project end: 31 March 2010

Project scale:

Total investment: EUR 8, 473

Total number of users: 223

1. Design and construction of a school UDDT with 3 toilets and 9 urinals for boys, 5 toilets and 4 urinals for girls, urine storage tank, roof water harvesting for a population of 200 students at a cost of EUR 5,135
2. Design and construction of a greywater treatment system for kitchen and dish washing effluents at a cost of EUR 1,500
3. Design and construction of a faeces drying shed at a cost of EUR 857
4. Workshops and training at a cost of EUR 981

Address of project location:
Crater View Secondary School,
Prisons road, off Eldama Ravine Highway
Nakuru, Kenya

Planning institution:
Egerton University/Rosa Project, Egerton-Kenya

Executing institution:
Nakuru Municipal Council/ ROSA project, Nakuru-Kenya

Supporting agency:
European Union

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 ad motivation of the project

The objectives of this project which was part of the much larger ROSA project were mainly to:

- Introduce concepts of resource oriented sanitation and present a change of paradigm from the conventional waste oriented to beneficial reuse oriented sanitation.
- To improve on sanitation by establishing a urine diversion dehydration toilet system that is free of flies and odour.
- To reduce groundwater pollution and health risks associated with pit latrines.
- To demonstrate that faeces and urine collected from the UDDTs can be safely sanitised and utilised as soil conditioner and as fertiliser respectively.
- To demonstrate that greywater can be effectively treated and used as for irrigating crops.

The motivation was to contribute towards achieving the MDGs by promoting productive sanitation.

3 Location and conditions

Figure 3 The UDDT facility at Crater View Secondary School two years after construction (Source: L.Kraft, May 2011)

UDDTs and greywater treatment at Secondary School, Nakuru, Kenya

Crater View Secondary School is a government school located in the north-western part of Nakuru municipality.
Nakuru Municipality is a mid-sized town, the fourth largest town in Kenya after Nairobi, Mombasa and Kisumu. The current population is estimated at 500,000 people with a growth rate of 4.5% per year (MCN, 1999). The soils are mainly volcanic loose soils ranging from moderate occurrence of surface rock to very shallow soils with surface rocks rendering the area unsuitable for digging pit latrines. In Kenya, the under-five child mortality rate is currently[1] 84 children per 1,000 (compared to 99 per 1000 in 1990)

The piloting area is London estate in Nakuru and has little or no connection to the main sewer line. It is an area inhabited by low income earners and thus, poverty levels are very high. Furthermore, it is densely populated (2000-4500 persons/km^2). Crater View secondary school in London area is strategically located to serve children from the poor neighbourhood. It is a day school, but lunch is served to the entire school population.

The school population is made up of 200 students (120 girls and 80 boys), 16 teachers and 7 workers. Previously, the students were served by 3 pit latrines for the girls and 2 for the boys. The condition of the latrines was poor and characterized by pungent smell and flies. The new UDDT's has improved the students/toilets ratio to 24 for the girls and 26 for the boys and hence conforms to the recommended ratio of one toilet to 25 girls and one toilet to 35 boys (GOK, 2007). Furthermore the four urinals installed for the girls have reduced the demand for the toilets to approximately one half while the ratio for the boys urinals is 9 boys per urinal. The project did not make any provision for anal cleansing since majority of the students (95%) who are between 14 to 18 years old are Christians and use toilet paper for anal cleansing.

Greywater from kitchen and dish washing was disposed into the open resulting in ponds of wastewater that caused a major public health threat since the site acted as breeding grounds for flies.

Figure 4 Left: The old pit latrines at Crater view secondary school (Source: Muchiri, 2008) Right: Greywater from kitchen and dish washing was disposed in open drains prior to the project (Source: Raude, 2009)

4 Pilot project history

In 2007, the ROSA project (Resource-Oriented Sanitation concepts for peri-urban areas in Africa) carried out a survey to investigate the status of sanitation in Nakuru. The results showed that only 19% of the built-up area was sewered and in the high-density areas, sanitary facilities were poor and inadequate. The study identified the following as some of the main problems of onsite sanitation in Nakuru: collapse of pit latrines due to weak soils, flooding of pit latrines during heavy rainfall, smell and flies in pit latrines, contamination of groundwater, and inadequate water supply for basic hygiene. In some areas shallow soils and rocky grounds made it difficult to dig pit latrines and poor handling and disposal of greywater.

The school was selected due to: the poor condition of the existing pit latrine that was inadequate, smelly and with a lot of flies, the school lacked adequate and reliable water supply, there was no municipal sewerage system in the vicinity, and the school had a garden on which the urine and treated feacal matter could be used and lastly the principal and the school management were ready to take up the new system and were willing to collaborate accordingly.

Intensive awareness creation and demonstration workshops were later carried out to educate the students and teachers on the ROSA systems and particularly on the UDDT technology and greywater management. Five awareness creation and demonstration workshops were conducted in the school, the first one was before the construction commenced in April 2008, the second was during the ground breaking and foundation stage and the other two were demonstration on how to use the facility in June and September 2009. In January 2010, another demonstration was conducted for the new students.

The design and costs of the pilot units were developed and discussed with the users. A memorandum of agreement between the school management and ROSA was signed by both parties. The school is responsible for the management of the facilities. The pilot project construction phase started in May 2008 to June, 2009 and the ROSA project ended in March (2010).

Monitoring in May 2011:

A monitoring of the ROSA projects in and around Nakuru was done in May 2011 by the consultant Laura Kraft (e-mail address: kraft_laura@yahoo.de) on behalf of GIZ sustainable sanitation program (Kraft, L. 2011). The overall objective of the monitoring was to update the SuSanA case study in regard to present status and lessons learned from the project.

For monitoring and evaluation three methods were used to gather information:

- Desk review, field observations and interviews

During the desk study different online documents were reviewed to understand the project approach and to access the latest information on the project status. This knowledge was used to prepare monitoring sheets and questionnaires for interviews with UDDT users, related service providers for excreta management and other relevant stakeholders.

The ROSA project sites described by SuSanA case studies were visited to assess the status of the UDDTs and other related facilities within the ROSA project. Interviews were conducted with teachers, students, landlords, CBO/ NGO leaders and the Municipal Council. For documentation purpose digital pictures were taken during the monitoring and uploaded on flickr (see link in Section 13).

[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/)

UDDTs and greywater treatment at Secondary School, Nakuru, Kenya

During the visit of Crater View Secondary School interviews were conducted with students and the teacher who is in charge of the environment. The state of the toilet facility and the greywater system were assessed using the monitoring sheet.

Based on the resultant information, the case study was updated. The original text referring to the project state in 2009 was maintained with minimal alterations in addition to the new observations added under the headings “Project update May 2011”.

5 Technologies applied

After consideration of options, the urine diversion dehydration toilet (UDDT) was chosen due to its advantage of not requiring water for use as flush toilets do and for not having to dig pits in the hard rock as the pit latrines require. The greywater treatment method used was the sub-surface flow constructed wetland system. The project consisted of the following components:

Urine diversion dehydration toilets (UDDTs)

Figure 5 New school toilet implemented by ROSA project (Source: Muchiri, 2009)

A masonry block consisting of eight cubicles of single vault UDDTs was constructed. The girls section was provided with 5 cubicles (25 students per toilet), 4 urinals and a space for changing menstrual pads and school uniform into sportswear. On the other side the boys were provided with 3 cubicles and 9 waterless urinals.

Figure 6 New waterless girls’ urinals (squatting) inside the girls’ toilet block (Source: Muchiri,2009)

Each side has two hand washing basins located strategically at the entrance of the facility.

Figure 7 Inside of the UDDT, showing urine diversion squatting pan and bucket of ash (Source: Muchiri, 2009)

Figure 8 Inside the boys’ toilet - 3 cubicles (left) and 6 waterless urinals (right) made of plastic buckets (Source: Muchiri, 2009)

Greywater treatment

The greywater treatment system consists of a collection trough (dish washing facility), a settlement tank of 250 litres and greywater collection tank of 750 litres. The development of a greywater treatment system involved consideration of institutional and social issues in addition to technical factors.

A horizontal subsurface flow constructed wetland (HSSF CW) system was chosen with a water surface maintained at 15-30 cm below the ground level.

Drying shed for faeces

To ensure a closed loop sanitation system in the school, a drying shed was constructed where faeces from the UDDTs will be stored for further drying and treatment.

6 Design information

UDD toilets

The overall dimensions of the UDD toilet block are 13 m length by 3.6 m width, housing eight UDDT cubicles, space for urinals and an area for changing uniform into games kits is provided adjacent to the urinals.

The superstructure is constructed of masonry stone which is locally available and the roofing is made of timber trusses (75

UDDTs and greywater treatment at Secondary School, Nakuru, Kenya

mm by 50 mm) and gauge 30 corrugated iron sheets. Standard size doors and frames (1.98 m by 0.9 m) made of Cyprus timber was used for each toilet cubicle. To save on cost, each toilet area (1.1 m x 0.9 m) was designed to meet the minimum toilet floor area requirement of approximately 1 m^2 (Harvey et al., 2002).

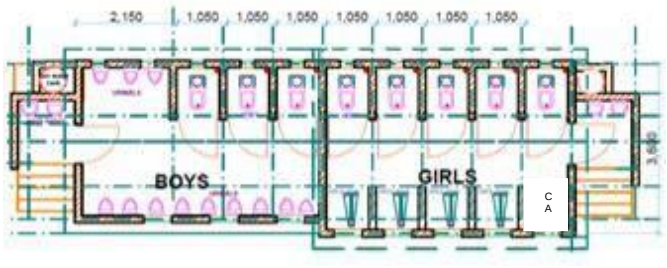

Figure 9 Floor plan for the toilet block at Crater View School (Source Muchiri. 2009)

The faeces are collected in single vaults below a 75 mm thick reinforce concrete floor slab fixed with a plastic urine diversion squatting pan called ``eko plate´´ (Product of Kentainer Ltd.). The faeces vaults are 1.1 m x 0.9 m x 0.75 m (LxWxH), with enough space to hold three 50 litre containers for the faeces and adequate room for the attendant to remove and replace the containers. This reduces the need to frequently empty the buckets and allows pathogen die off for at least six months (WHO, 2006). Once a container fills after approximately 30 to 45 days, it is pushed aside to allow an empty bucket to be placed below the hole.

Vault doors (0.9 m x 0.75 m) are large enough to allow removal and replacement of the containers at ease. They are made of galvanised steel for durability, painted to prevent rusting and tightly fixed to prevent entry of flies.

In each cubicle a bucket of ash and a scooping cup is provided for use after defecation.

Figure 10 Interior of a faeces collection vault with a 50 litre container to collect the faeces (Source: Muchiri, 2009)

Other toilet components

To supplement the inadequate water supply in the school, rainwater is harvested from the roof into two 250 litre plastic water tanks and the water is connected to hand washing basins.

To overcome the problem of foul smell, vent pipes are installed in each vault and rise 1.00 m above the highest point of the roof to enable draft action to suck the foul air from the chamber. Flies are prevented from getting into the faeces vault by gauze mesh wire fixed at the top of the vent pipe. The interior of the toilet is well ventilated and lighted by glazed windows both in the front and in the rear as shown in figure 12 below.

Figure 11 Ventilation pipes and windows for each UDDT collection vault and cubicle respectively (Source: Muchiri, 2009)

Underground urine tank

Urine from the waterless urinals (4 for girls, 9 for boys) and from the UDD toilets is collected and stored in a 2000 litre masonry underground tank. The tank is large enough to hold urine for approximately 2 months assuming a generation rate of 0.20 l/student /day (a day is from 8.00 am to 5.00 pm since it is a day school). The total amount generated by 200 students will be 40 litres per day amounting to 2000 litres in 50 working days (2 months). To minimise odour, the urine drain pipe is submerged into the collection tank to provide a basic water seal. An overflow connected to a perforated 50mm drain pipe is buried along a plantation of trees in the garden. Provision for installation of a hand pump is fitted, however the school is yet to install the pump.

Figure 12 Urine collection tank (2000 L) at Crater View secondary school (Source: Muchiri, 2009)

Drying shed

The area of the drying shed is 22 m^2 and the dimensions are 6 m x 3.6 m. The shed is constructed of cedar poles and wire mesh on the sides and the roof is covered with corrugated iron sheets.

The amount of faeces generated by the students was calculated based on an annual generation rate of 50 litres per person. However, since the school is closed for 3 months per year for holidays, the toilets are only in use for 9 months of the year. The amount generated per student during school sessions was estimated to be 37 litres in 9 months.

Furthermore the school is a day school and it is reasonable to assume a half rate generation at the school and half at home reducing the amount to 19 litres/student and this works out to approximately 4000 litres (4 m^3) per year. If faecal matter is spread over ¾ of the shed area (to allow working space) at a minimum depth of 0.5 m, it can hold 8.25 m^3 of material from the UDDT (the volume of ash and toilet paper is not included in these calculations). The drying shed is therefore designed

to accommodate faecal matter generated in the UDDT for at least 2 years.

The floor is made of concrete and a 500 mm stone wall is constructed along the four sides of the floor slab to prevent surface runoff from entering the shed. The roof slopes from 2.4 m at the ridge to 1.5 m at the sides. Gutters for rainwater harvesting are fitted.

Figure 13 Drying shed for processing faecal matter from the UDD toilets (area 6 m x 3.6 m) (Source: Muchiri, 2009)

Rainwater harvesting for hand washing

Rainwater from the roof is collected in gutters and harvested in two 250 litre capacity plastic tanks. The water is then piped to two hand washing basins inside the toilet both on the girls' and the boys side. When there is no rain or when the tanks run dry, they are refilled by the students on a weekly basis. The water was drawn from a tap within the school (50 m from the toilet) in 20 litre containers. It takes 20 trips (20 minutes) to fill the two 250 litre tanks.

Figure 14 Roof water harvesting system and students washing their hands after visiting toilet (Source: Muchiri, 2009)

Greywater treatment system

The greywater treatment system was designed for the treatment of greywater generated from preparing food and washing dishes at Crater View secondary school. The system also receives water from hand washing basins in the kitchen area. The project aimed at treating greywater generated for reuse or safe disposal. This was achieved by gravity flow, single pass treatment of greywater through a pre-treatment followed by a horizontal sub-surface flow constructed wetland (HSSF CW) with vetiver grass (*Chrysopogon zizanioides L*) as aquatic plants. The pre-treatment chamber was connected to the wetland through a 610mm long, 50mm diameter pipe.

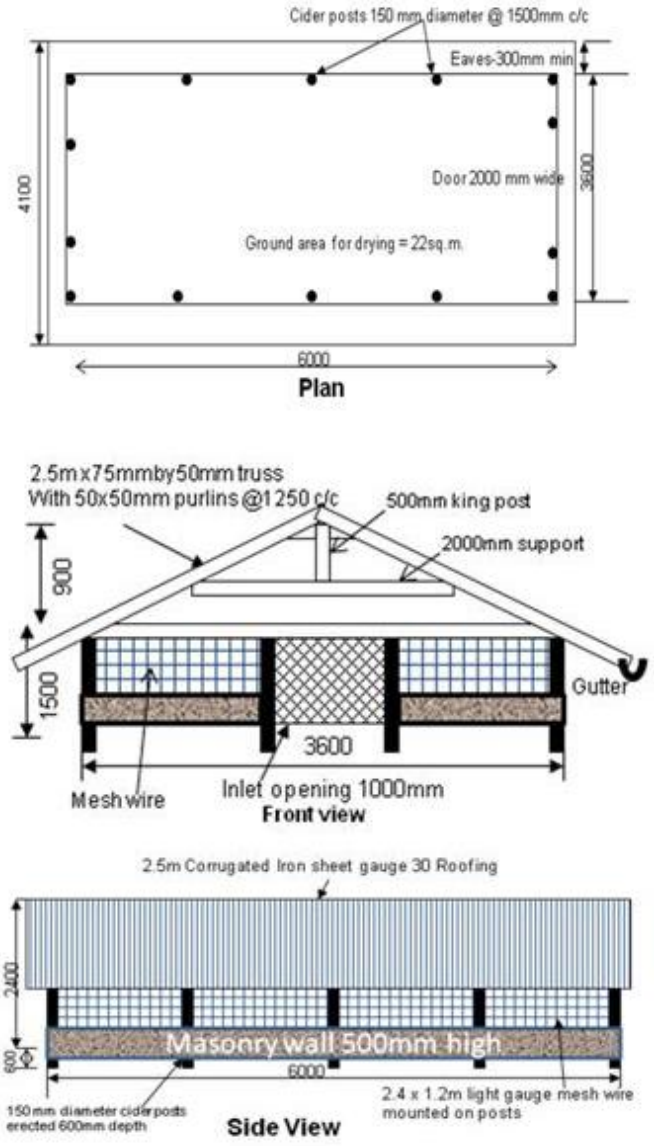

Figure 15 Plan, front section and side view of drying shed for faeces from UDDTs at Crater View Secondary school (Source: Muchiri, 2009)

Figure 16 Greywater treatment system at Crater View Secondary School (Source: Laura Kraft, 2009)

UDDTs and greywater treatment at Secondary School, Nakuru, Kenya

Table 1: Grey water treatment system design details

No	Name	Description
1	Pre-treatment	Two chamber (0.25 & 0.75 m³) litter trap for settling of coarse organic matter and grease trap; cleaning interval not more than 4 times/yr
2	Constructed wetland surface area	Horizontal sub-surface flow constructed wetland (HSSF CW); length = 2 m, width = 1 m (area 2 m^2)[2]
3	Inlet to constructed wetland	Stone distributor; slotted pipe for greywater distribution, inlet depth = 0.86 m
4	Treatment volume	Fine gravel (D60 = 3.5 mm, Cu = 1.8); initial porosity = 40%; with an average wetted depth of 0.875 m; Hydraulic conductivity was 17 m/day
5	Outlet	Outlet depth = 0.8 m; variable effluent outlet height
6	Flow	Flow rate is set at 1 m^3/day; hydraulic loading rate (HLR) is 500 mm/day
7	Other design considerations	Bottom slope of 1-2%; gravel media; geo membrane liner of 1 mm thickness
8	Materials	Building sand is locally available (3-8 mm in size)
9	Retention period	2 days
10	Cost	Treatment system including hand-wash facility EUR 1.500

Monitoring outcomes from May 2011:

Urine diversion dehydration toilets (UDDTs)

The superstructure was generally in good condition without visible damage beside one broken glass-window at the boys' side. On the inside walls were some signs of vandalism mainly on the boys' side. The walls have foot- and handprints and there some writings on the wall.

All toilet cubicles and urinals were in use, but one urine pipe was blocked on the girls' side. According to the teacher, blockage of urine pipes was a common problem before. Therefore the school exchanged the old pipes with new pipes having a wider diameter and sieves.

Underground urine tank and drying shed

It was observed that the urine tank got filled up and urine might overflow and infiltrate in the soil. The drying shed is in good conditions without any visible damage. Gutters for rainwater harvesting are fitted but not connected to a rainwater harvesting tank. Faeces in the drying shed were very dry, not smelling and ready for reuse. Despite a container for sanitary pads the faeces at the drying shed still contain not degradable material like plastic bags, sanitary pads and degradable material like paper (Fig.17).

Figure 17 Dried faeces mixed with not degradable materials inside the drying shed (Source: L.Kraft, May 2011)

Rainwater harvesting for handwashing

The handwash facility was in place and functioning but water was only in the boys' section available. The gutter for rainwater collection was blocked which could be the cause of water shortage. If there is no water available, the rainwater tank cannot easily be refilled manually due to its high position. There is another handwash facility which is connected to pipe water but as it is far from the toilet it is usually not used by the students.

Greywater treatment system

As observed the amount of treated water discharged from the greywater treatment system was very little. The pre-treatment containers were filled up with water and most probably the problem was either a blockage with overflow within the system or leakage at the point of the filter or piping.

Figure 18 Greywater treatment system with settlement tank (Source: L.Kraft, May 2011)

[2] This equates to 0.009 m^2 per person (223 people at the school), which is very small. (question: why is it so small?)

7 Type and level of reuse

Urine and dried faeces

After several awareness and sensitisation workshops on the reuse of the products from the UDDTs, the school is willing to use the urine as a fertiliser and the dried faecal matter as a soil conditioner. The school has a small farm on which they plan to grow crops and Napier grass using the products. The student environmental club has embarked on growing trees and is willing to use the UDDT products to grow the trees.

Greywater reuse

Water is a scarce commodity in this area and any available extra drop is critical to the survival of the agro-forestry activities in the school. Crater View Secondary School is currently involved in a tree planting program in line with the Kenya Government policy on stimulus package and employment creation through “Kazi Kwa Vijana (KKV)”- “Jobs for the youth”**.**

KKV aims at employment creation by encouraging the Kenyan youth to deal with environmental issues with schools and public institutions being the main targets. The greywater is reused in the school for the agro-forestry activities. This pilot has a great potential for possible future up-scaling since Kenya is a water scarce country. Demand for greywater treatment system is high in the Municipality due to its ability to compliment on the scarce water. However, the systems require space, flowing water and are relatively capital intensive.

Monitoring outcomes from May 2011:

According to the teacher the urine was not reused and the urine tank has not been emptied yet. The faeces have been collected in the drying shed for one year but have not been reused, too. It is planned to reuse treated faeces for trees and crops planted in the school compound however there was a concern that the students react negatively when faeces are reused. Also greywater has not been used as the outlet is insufficient.

8 Further project components

The following activities are in progress at Crater View Secondary School in respect to the pilot project:

- Monitoring operation and maintenance of the facilities
- Research on urine and faecal matter treatment, management and utilization.

Initial results for the operation and maintenance can be found in http://www.ecosan.at/ssp/issue-2-operation-maintenance/article-4/view

9 Costs and economics

The bill of quantity and construction cost for the school UDDT, the drying shed and the greywater treatment systems are given below. ROSA project covered 90% of the total cost while the school contributed 10%.

Equivalent cost for single UDDT cubicle would be EUR 639. This is because it is built in a professional way for demonstration purpose. The price includes architectural set up and it is completely roofed toilet block for boys and girls.

Table 2: Cost for construction (labour inclusive) of UDDT block at Crater View Secondary School. Current exchange rate 1 EUR =104.32 KES (Kenyan Shillings)

Item	Description	Amount (EUR)
1	Excavation and earthworks	194.53
2	Concreting	812,44
3	Walling	1248,58
4	Roofing	640,54
5	Doors	825,12
6	Sanitary installations	634,09
7	Finishes	764,23
	Total	**5119,54**

Table 3: Cost for construction of drying shed at the school

Item	Description	Amount (EUR)
1	Cedar posts and poles	22,81
2	Timber	202,74
3	Iron sheets and nails	140,91
4	Gutters and holders	19,17
5	Cement	76,69
6	Sand	47,93
7	Aggregate	134,20
8	Building stones	50,61
9	Wire mesh	63,27
10	Labour	95,86
	Total	**854,19**

Table 4: Cost for construction of greywater treatment system at the school.

Item	Description	Amount (EUR)
1	Mobilization and sensitisation	195,55
2	Foundation footing	14,95
3	Slab	82,92
4	Support pillars	173,51
5	Trough	103,14
6	Plumbing works trough	38,10
7	Plumbing works - wetland	97,73
8	Liner	49,85
9	Wetlands construction	261,50
10	Transport	134,20
11	Labour	133,24
12	Vetiver grass	38,34
13	Fencing materials	110,24
	Total	1433,29
	School contribution	666,42
	ROSA Project contribution	766,87

Table 5: Total cost for construction and implementation of ROSA project at Crater View Secondary School

Item	Description	Amount (EUR)
1	Construction of UDDT block	5119,53
2	Construction of drying shed	854,19
3	Construction of greywater treatment system	1433,29
4	Workshops and training	450,54
5	O&M basic tools	95,86
6	Monitoring exercise for 26 wks	498,47
	Total	**8446,89**

10 Operation and maintenance

The entire project is managed by the school after being handed over on 24th September 2009. However, as long as the ROSA project was running (until March 2010) the ROSA team continued with back-stopping when needed. To ensure sustainability, after mobilisation and sensitisation, the school nominated a care-taker who was actively involved during and after construction. The day to day cleaning of the toilet is done by an employee of the school who is paid a monthly salary of EUR 45.

It is planned that collection, transportation and emptying of the faeces chambers will be done once every three months during the holidays. The urine tank may be emptied as soon as there is demand for fertiliser. These activities will require additional labour to assist the care taker. It will cost approximately EUR 2 to empty the containers once per month amounting to a total of EUR 24 per year.

Monitoring outcomes from May 2011:

There was ash available in 7 out of the 8 toilets however not one of the fresh faeces were covered with ash. There were no posters or explanations on the right use of the toilet therefore it might still be lack of knowledge.

Figure 19 Left: In the boys section piled up faeces are visible as containers are filled up, fresh faeces are not covered with ash, signs of cross-contamination in the front part. Right: Blocked urine pipe in the girls section (Source: L.Kraft, May 2011)

On the boys' side a strong urine smell emitted from the urinals, there were signs of faecal cross-contamination in the urine section of the toilet slab, the faeces containers were already filled up and flies were observed. The girls' side was generally cleaner and better maintained however one urine pipe was blocked and urine stagnated in the front part of the UDDT slab (Fig.18).

11 Practical experience and lessons learnt

Crater View Secondary School is normally used for other social activities over the weekends and during holidays when students are away. In one such meeting, the school allowed a Christian function to take place that saw the school host over two thousand people. It was during this time that the vetiver grass was up-rooted from the constructed wetland out of curiosity by the participants. It is interesting to note that the students requested the principal to close the UDDT facility fearing that the visitors would misuse the toilets.

For the greywater system, the actual influent flow rate is higher than what was assumed in the design. The school is close to Nakuru GK prisons and the prison authorities sunk a borehole that offers continuously supply of pumped groundwater to the school. Hence, the system now occasionally experiences an overload of greywater and clogging. However, the system is designed with an overflow pipe that takes care of shock loads. As a result, the effluent quality is not affected.

The UDDTs received acceptance by the students due to lack of smell and lack of flies. A majority of the students found the UDDTs attractive when interviewed. Since completion of the pilot, both local and international visitors have visited the school to see and learn about the sustainable sanitation system. The main repairs and overall management is the responsibility of the school principal assisted by two members of staff who are patrons of the student's environmental club.

The UDDT's are fully operational and are kept clean most times. Ash is always available, while water for hand washing is 90% available. Further, 100% of the boys interviewed were satisfied with the UDDT and particularly the urinals, no blockage or damage was reported, however the girl's urinals were reported blocked but were unblocked by the caretaker with technical assistance from the ROSA team. It was learnt that the blockage was due to sand deposits from the foot-steps into the urinal channel. The drying shed does not produce neither odour nor flies.

Monitoring outcomes from May 2011:

There is still a challenge with the operation and maintenance and mainly with the reuse of the UDDT products. So far neither urine nor faeces have been reused by the school. There is the need of creating more awareness on the reuse of faeces and urine for teachers and students.

Majority of students prefer the UDDT to the pit latrines. Main reasons are that they are clean, build in a nice/beautiful way and the UDDTs offer more space and are therefore less congested. Some students prefer the pit latrines because they are less complicated to use and the management of the UDDT is sometimes poor therefore the toilets are dirty and smelly. Girls also often use the pit latrine to dispose their menstrual pads despite the fact that there are also containers for pads in the UDDT.

The students know the importance of handwashing and are aware that diseases can be prevented by washing hands. They wash their hands if water is available but they do not use soap as it is not provided by the school. Not all students believe that urine or faeces are a valuable fertiliser and some

students believe there is a health risk especially if somebody is sick.

The teacher said the previous workshops were very useful and helped the staff and students to understand and use the UDDT toilets well. There is only a challenge when new students come as they did not participate in the workshop but they are usually guided by the older students. The project implementation team is still in touch with the school and comes for follow up visits. Generally the UDDT attracts many visitors who sometimes come from outside Nakuru district.

The monitoring showed clearly that another workshop needs to be undertaken that shall focus on the reuse of the UDDT products and proper O&M procedures and budgets e.g. provision of soap. Toilet facilities must be cleaned and emptied more regularly. This should ideally be integrated into the curriculum with materials provided to the teachers on the subject. Problems with proper use of the toilet could be supported by putting posters on how to use them in every toilet. To ensure that there is always water available for handwashing it would be preferable if the taps can be connected to the piped water.

12 Sustainability assessment and long-term impacts

A basic assessment (Table 6) 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 6: Qualitative indication of sustainability of system. A cross in the respective column shows assessment of the relative sustainability of project (+ means: strong point of project; o means: average strength for this aspect and – means: no emphasis on this aspect for this project).

	collection and transport			treatment			transport and reuse		
Sustainability criteria:	+	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	

The UDDTs have attracted a lot of interest among the neighboring residential areas and schools. About sixteen landlords have constructed similar UDDTs in Nakuru and some secondary schools outside Nakuru have requested for similar designs and coasting. Learning from experience, the following recommendations are suggested for the long term sustainability of UDDT's:

- Strengthen the ownership concept among the students, teachers and workers to ensure proper use and maintenance of the facilities by continues education and sensitization on UDDT's.
- Encourage students to spread the knowledge of the sustainable sanitation system to the communities they live in.
- Sensitise all the stakeholders on the additional economic benefits arising from the utilisation of the products.
- Encourage the school to utilise the urine and the sanitised faecal matter in their farm and consider this as a potential business opportunity.

As the outcome of the monitoring crucial factors for sustainability are the proper operation and maintenance of the UDDT. This also includes the reuse or safe disposal of faeces and urine to avoid a scenario whereby the storage facilities will one day be full and the faeces and urine might be dumped in an inadequate way (see Section 11).

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).

13 Available documents and references

The following documents are available:

Photos from this project are available on flickr:
http://www.flickr.com/photos/gtzecosan/sets/72157624069945409/with/4666056056/

Publications:

- Sustainable Sanitation Practice "Operation and Maintenance – Successful models for O&M of sanitation systems, Issue 2. (2010) http://www.ecosan.at/ssp/
- Manual how to use urine as natural fertilizer in Kiswahili http://rosa.boku.ac.at/images/stories/Public%20Docs/urine_use_kiswahili.pdf
- Manual how to use urine as natural fertilizer in English http://rosa.boku.ac.at/images/stories/Public%20Docs/urine_use_english.pdf
- ROSA IEC Posters Kenya http://rosa.boku.ac.at/images/stories/Public%20Docs/nakuru_iec_posters.pdf
- ROSA Brochure Kenya http://rosa.boku.ac.at/images/stories/Public%20Docs/nakuru_brochure.pdf

- Further information is available from ROSA homepage http://rosa.boku.ac.at/index.php?option=com_frontpage&Itemid=1

  http://rosa.boku.ac.at/index.php?option=com_content&task=view&id=10&Itemid=11
- Baseline study for Nakuru

  http://rosa.boku.ac.at/index.php?option=com_remository&Itemid=5&func=fileinfo&id=187
- Kraft, L. (2011) Monitoring and evaluation of ROSA projects in Nakuru. Results of field observations and questionnaires, GIZ http://www.susana.org/lang-en/library?view=ccbktypeitem&type=2&id=1196

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14 Institutions, organisations and contact persons

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Municipal council of Nakuru
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(Pilot city and end-user in which the strategic sanitation and waste plan will be developed and where the ROSA project is implemented)

Crater View Secondary School
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Tel: +254 210264

Kentainers Ltd,
Nairobi, Kenya
info@kentainers.co.ke
Suppliers of Urine diverting Eco-plates

Case study of SuSanA projects

UDD toilets and greywater treatment at Secondary School, Nakuru, Kenya

SuSanA 2010

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