implementing organization:

E.S.C. Consulting OEG

Operation and Maintenance of sanitation systems in two public institutions: Experiences from Uganda

The O&M of sanitation systems in two Ugandan institutions works sustainably because the stakeholders were involved in the planning and decision making and are benefitting from the introduction of the sanitation systems.

Author: E. Müllegger, E. Freiberger

Abstract

In this article two examples of resource-oriented sanitation systems in Ugandan institutions are presented. The implementation of these systems led to an improvement of the sanitation situation in these institutions; the human waste is now safely disposed of and reused. In the Kalungu Girls Secondary School pupils are responsible for operating the urine diverting dry toilets. In the Maracha Hospital three attendants are employed to operate the sanitation system. Both institutions are gaining an extra benefit by selling the compost (Maracha) or using it in the own gardens (Kalungu).

Introduction and Background

Good sanitation in schools is crucial for the well being and school performance of children. It directly benefits a vulnerable segment of the population, communicates public health concerns to the community and lay the foundation to sustain demand for improved sanitation (Rwamwanja, 2009).

In Uganda almost all schools do not meet the minimum school standards on sanitation and hygiene (Ministry of Education and Sports, 2006). Only 72% provide separate facilities for boys and girls, and over a quarter offered shared facilities. The lack of separated facilities is a big factor for the high drop out rate of female teenage students. On average, 69 students shares one toilet, which are often in defective condition (Ministry of Water and Environment, 2007).

The safe disposal and reuse of human waste is also essential in institutions like health centres and hospitals.

Materials and Methods

Kalungu Girls Secondary School

The boarding school of the "Sacred Heart Sisters" is located in the hilly areas of Masaka District, Southwest of Kampala near the town Masaka. The school is located near Kalungu, a small rural village, surrounded by farm land. Around 450 girls between 14 and 18 years are attending the school and about 50 teachers and sisters are employed while the latter are either in the school's administration and/or teachers. Further staffs are responsible for diverse house keeping duties, like O&M of the toilets, gardening, animal keeping, etc.

After preparing a feasibility study, various meetings with the school administration and a workshop with the teachers, the water and sanitation infrastructure was improved sustainably

Key factors for sustainable O&M systems:

- Responsibilities for O&M were clearly defined right from the beginning.
- Both institutions see the benefit of the systems and are gaining extra income.
- All stakeholders were involved in the planning from the beginning of the project; critical design decisions were made by the users.
- Before and during construction of the sanitation system, users were sensitized and trained.
- In Kalungu teachers and students use the same type of toilets and the teaching personnel is convinced of this new technology.

Figure 2. Urine diverting dry toilets in Kalungu Girls Secondary. School.

in 2003. The implemented system consists of: 45 single vault urine diverting dry toilets (UDDTs) for the pupils (Figure 1), a UDDT for teachers, which also serves as demonstration unit for visitors, a drying / composting area for further dehydration of faeces, a horizontal sub-surface flow constructed wetland for greywater and blackwater treatment as well as rehabilitation of the water supply system. A detailed description of the system is available on the SuSanA website (SuSanA, 2008).

Maracha Hospital

In Maracha, a small trading centre in the Northwest of Uganda, near the borders of Sudan and Congo, the Arua Catholic Diocese operates a small rural hospital. It has a bed capacity of 200 patients and about 150 employees.

The sanitation infrastructure was rehabilitated in 2001/2002 with single vault urine diverting dry toilets (Figure 2) for the hospital staff (two blocks with 8 toilets each), a drying / composting area for faeces and sludge, a vertical-flow constructed wetland system with filter baskets as pre-treatment for black- and greywater and a low cost incinerator for medical waste.

Figure 1: Urine diverting dry toilets in Maracha Hospital.

Results and Discussion

O&M strategy in Kalungu

Collection and storage / pre-treatment

Faeces, ash and toilet paper from the pupils´ as well as from the teachers´ toilet are collected in wooden containers (Figure 3) located in the dehydration chambers underneath the squatting pan. These containers are emptied after every school term (every three months).

Urine from the pupils´ toilets is either led to an underground tank, which is situated behind the toilets, or to soak pits for infiltration into the ground. The four soak pits are next to the toilets. Urine from the teachers' / demonstration toilet is collected in 20l jerry cans (Figure 3). This unit is additionally equipped with a waterless urinal.

Greywater and some blackwater from two flush toilets from the sisters´ house, is collected via

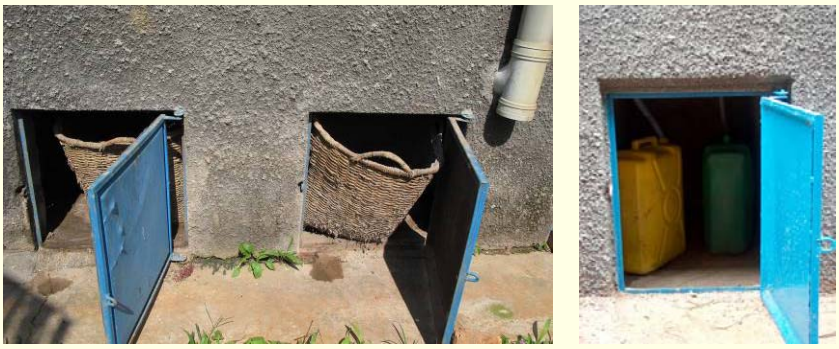

Figure 3: Wooden collection container for faeces and urine collection in 20l jerry cans.

gravity in a sewer system and pre-treated in a septic tank. The tank shall be cleaned at least once a year, but experiences showed irregular maintenance.

Transportation

The containers with the faecal matter are either carried by two pupils manually or transported in a wheelbarrow to the drying area. The baskets have handles on the side walls for easy movement. The transportation of the jerry cans with urine is identical to the containers. The urine from the underground tank is filled in small drums before the transport.

Centralised treatment

The centralised drying and storage area is situated behind the school, close to the emptying doors of the toilets, to avoid long transporting distances. It is a paved area, fenced with mesh wire and a simple roof.

After a drying period of at least six month the dried faecal material (Figure 4) is screened via a coarse-meshed sieve to remove toilet paper and sanitary pads. The sieved-out material is burnt and the remaining material used as a fertilizer and soil conditioner in the school garden. (Figure 4)

Figure 4: Drying and storage area for faecal material.

Urine is not stored for a certain time; it is used when there is need for.
The pre-treated wastewater is flowing via gravity to the constructed wetland system. The bed is planted with elephant grass, which is harvested two times a year and fed to cows.

Use

Mainly bananas and matoke are fertilised with dried faecal material. The urine is used as a liquid fertilizer in agriculture with a dilution of 1:5 (1 part urine to 5 parts water). Fertilized cultures are banana trees, pepper, cabbage, carrots and spinach. However, exact application of these fertilizers, if they are worked into the ground or under the top soil cover, is not quantified by the school. Agricultural products are not sold but entirely consumed at the school itself.

Table 1: Summary of O&M activities in Kalungu Girls Secondary. School.

Product	Treatment steps	Activity	Interval	Responsibility	Costs	Benefits
Faeces	45 UDDTs (pupils) 2 UDDTs (teachers)	Empty the dehydration chambers and transport to drying area	3 months	Students (supervision by teachers); O&M staff	Personnel costs; materials	-
	Drying area	Store dried feacal matter, sieve and burn sieved out materials	6 months	Students (supervision by teachers); O&M staff	Personnel costs; materials	-
	School garden	Apply the dried and sieved feacal matter to the school garden	on demand	Students (supervision by teachers); O&M staff	Personnel costs; materials	Improvement of agricultural production (self consumption)
Urine	45 UDDTs (pupils)	Decant from underground tank into small drums, transport to school garden	on demand	Students (supervision by teachers); O&M staff	Personnel costs; materials	-
	2 UDDTs (teachers) 1 Urinal (teachers)	Replace jerrycan and transport to school garden	when full	Students (supervision by teachers); O&M staff	Personnel costs; materials	-
	School garden	Apply the urine to school garden	on demand	Students (supervision by teachers); O&M staff	Personnel costs; materials	Improvement of agricultural production (self consumption)
Greywater (kitchen, laundry, showers) and **Wastewater** (two flush toilets)	Septic tank	Clean pre-treatment tank	once a year	O&M staff	Personnel costs; materials	-
	Constructed wetland	Check distribution pipes; Harvest elephant gras	2 times/ year	O&M staff	Personnel costs; materials	Fooder for cows

The treated greywater is infiltrated into the ground and is not reused as the amount of water is very little and the school never admitted demand for irrigation water.

Responsibilities for O&M

Teachers and students were trained in principles and proper operation of the sanitation system. The involvement of the teaching personnel responsible for health issues was particularly emphasized. The responsible personnel for operation and maintenance were trained both on-site and in a training course for sanitation personnel. However students are fully involved in operation and maintenance activities. They are organized in groups which have different tasks. Among other activities they are responsible for cleaning the toilets, removing containers, and fertilization of plants.

Income generation

Since the sanitation system has been implemented, the school became "famous" in Uganda and worldwide for the innovative sanitation concept. Delegations from all over the country and from abroad come to visit the school toilets regularly. The number of students increased to their maximum capacity from 350 to 450 over the last years. Furthermore the school administration even introduced an admission fee between 50.000 – 100.000 UGX (~18 and 37€ at a rate of 2700 UGX), depending on the type of visiting delegation. That fee is used to maintain the sanitation system, especially to keep the infrastructure in a good working condition.

O&M strategy in Maracha

Collection and storage / pre-treatment

Faeces, ash and toilet paper are collected in the dehydration chambers directly. Emptying takes place whenever there is need for, by an average of six months.

Wastewater, consisting of blackwater from flush toilets, urine from the UDDTs and greywater is collected via gravity in a sewer system and pre-treated in filter baskets. The pre-treatment allows dehydration and stabilisation of the retained organic solids. Wastewater is intermittently fed to two filter baskets (Figure 5**Fehler! Verweisquelle konnte nicht gefunden werden.**), constructed from welded mesh, lined with filter textile and elephant grass as filter material at the bottom. Every six months the baskets are emptied.

Figure 5: Filter baskets for pre-treatment of wastewater.

Transportation

The filter baskets are emptied by the O&M attendants of the sanitation system by using a spade and a wheelbarrow to transport the material to the centralised treatment area.

Centralised treatment

The centralised composting area is situated in the backyard of the hospital. It is paved, fenced and roofed. Dried sludge from the pre-treatment filter of the constructed wetland system is used for co-composting. The material (Figure 6) is stored at the composting area for 6 months and during this time turned frequently. The compost is then sold to local farmers.

The sludge from pit latrines is transported to a sludge drying bed next to the composting area, stored there for 6 months together with the faecal-ash mixture from the UDDTs and then applied to the hospital's fields (Figure 6)

Figure 6: Centralised co-composting area and maize fertilisation with co-compost.

Figure 7: Vertical-flow constructed wetland.

The pre-treated wastewater is collected in a distribution unit, equipped with pipe valves. This tank is designed according to the necessary discharge intervals (4-6 intervals/day). The wastewater is discharged to the beds (Figure 7) without energy in intervals depending on the inflow rate to the discharge tank. The tank is cleaned regularly, at least two times a year, to avoid blockages.

Use

The compost is sold to local farmers; material from the sludge drying bed is used in the hospital's garden. In the hospital it is used as fertiliser for various types of crops like bananas, pineapples, maize, cassava, sorghum, jackfruits and passion fruits, which are cultivated in the fenced area of the treatment system. The composted material is mixed with soil (one spade for one plant), between one and three months before sowing. The cultivated fruits and vegetables are consumed by the hospitals´ staff and workers.

The treated wastewater in Maracha Hospital is infiltrated outside the hospital's compound without any further use.

Responsibilities for O&M

Three attendants are employed by the hospital, who are among other duties responsible for operation and maintenance of the sanitation system. They have been trained on-site and in a training course for sanitation personal.

Table 2: Summary of O&M activities in Maracha Hospital

Product	Treatment steps	Activity	Interval	Responsibility	Costs	Benefits
Faeces	16 UDDTs (staff)	Empty the dehydration chambers and transport to sludge drying bed	6 months	Staff for their own ones	Personnel, Materials	-
	Pit latrines (patients and attendents)	Empty pits and transport to sludge drying bed	on demand	3 O&M attendants	Personnel, Materials	-
	Sludge drying bed	Store the dried faeces-ash mixture, remove plastics and turn frequently	6 months	3 O&M attendants	Personnel, Materials	-
	Hospital's fields	Apply dried feaces- ash mixture for agricultural production	6 months	3 O&M attendants	Personnel, Materials	Improvement of agricultural production (self consumption)
Sewage Sludge	Sewer line	Empty the pre-treatment chambers and transport to the co-composting area	6 months	3 O&M attendants	Personnel, Materials	-
Urine (UDDTs), **Greywater** (kitchen, laundry), **Wastewater** (flush toilets)	Filter baskets	Empty the pre-treatment chambers and transport to the co-composting area	6 months	3 O&M attendants	Personnel, Materials	-
	Distribution unit	Clean distribution unit	twice a year	3 O&M attendants	Personnel, Materials	-
	Constructed wetland	Check distribution pipes; Harvest elephant gras	6 months	3 O&M attendants	Personnel, Materials	Fodder for cows
	Co-composting area	Store the dried sludge, co-compost with kitchen wastes, turn frequently	6 months	3 O&M attendants	Personnel, Materials	-
	Hospital's fields, local farms	Sell compost to local farmers or use for the hospital's agricultural production	on demand	3 O&M attendants	Personnel, Materials	Improvement of agricultural production/ Income generation

The staff is responsible for the cleaning and emptying of their own UDDTs, sometimes they pay the O&M attendants for the emptying of the dehydration chambers.

Income generation

Since operation in 2002 the demand for compost is continuously rising. At the beginning, compost was only used within the hospital but the community around realised the impact. Currently 100kg bags of compost are sold at 40.000 UGX / bag (~15€ at a rate of 2700 UGX) to local farmers.

Conclusions

The success of these projects can be explained by two reasons:

- On the one hand all the important stakeholders were involved in the planning from the very beginning. In this manner the system was designed as wished by the institutions and a strong feeling of ownership and responsibility for the facilities was created.
- On the other hand the people are benefiting from the system. Income is generated by selling the compost in the case of Maracha hospital and by charging a fee for visitors of the school's toilets in Kalungu. The yield in the fields and gardens of the two institutions was increased by the application of compost, faecal matter and urine.

References

Ministry of Education and Sports (2006): *School Sanitation and Hygiene in Uganda.* Government of Uganda, Kampala, Uganda.

Ministry of Water and Environment (2007): *Water and Sanitation Sector Performance Report 2007.* Government of Uganda, Kampala, Uganda.

Rwamwanja, E. (2009): *School Sanitation Demand and Practice and Recommendation for Sustainable School Sanitation Support* – Uganda.

SuSanA (2008): UDD toilets at a Girls Secondary School, Kalungu Uganda. *Case study of sustainable sanitation projects*, Sustainable Sanitation Alliance, http://www.susana.org/images/documents/06-case-studies/en-susana-cs-uganda-kalungu.pdf (date of visit: 2. Nov. 2009).

Name: Elisabeth Freiberger
Organisation: EcoSan Club
Town, Country: Vienna, Austria
e-mail: elisabeth.freiberger@ecosan.at

Name: Elke Müllegger
Organisation: EcoSan Club
Town, Country: Vienna, Austria
e-mail: elke.muellegger@ecosan.at