

UDD toilets for a Girls Secondary School Kalungu, Uganda



Fig. 1: Project location

1 General data

Type of project:

School sanitation and water supply

Project period:

Start of planning: 2000

Start of construction: 2003

Start of operation: 2004

Project scale:

Renewal of water supply and sanitation facilities for 350 students and teachers

Address of project location:

Kalungu, Masaka District, Uganda

Planning institution:

EcoSan Club Austria (ECA)

Technisches Büro Lechner (TBL)

Executing institution:

Norman Construction and Engineering Services,
Kampala, Uganda (construction)

Technisches Büro Lechner (supervision)

Supporting agency:

Manos Unidas

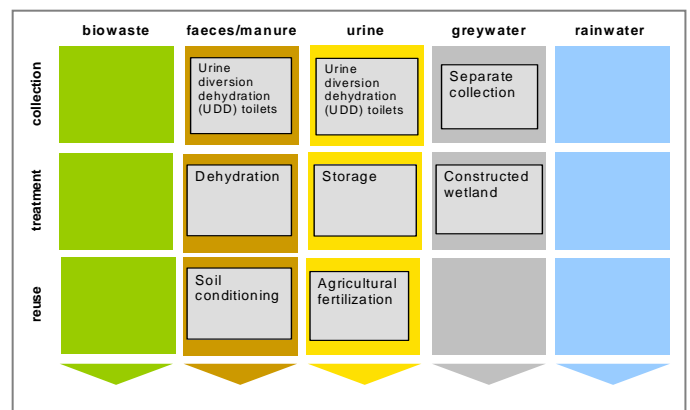


Fig. 2: Applied sanitation components in this project

2 Objective and motivation of the project

The objective at Kalungu Girls Secondary School was to:

- reduce groundwater and drinking water pollution caused by inadequate sanitary infrastructure.
- improve both quality and quantity of drinking water supply.

3 Location and conditions

The school is located in a hilly area with a high groundwater level and surrounded by small villages. The initial situation was as follows: Low quantities of wastewater from the teachers' quarters and sisters' house (flush toilets and greywater from kitchen and showers) were drained in soak pits. Human waste of the students was disposed in approx. 35 pit latrines. Greywater from showers and kitchen was discharged in a creek outside the school's compound. Wastewater was not treated at all. Due to the high ground water level and the soak pits and pit latrines located directly upstream of the school and the nearby villages' water spring, the situation was potentially dangerous for human health. In addition, the water sources were not properly built either so as to minimize the risk of cross-contamination.

In Uganda, the under-five mortality rate¹ is currently 130 children per 1000 (<http://www.childinfo.org/mortality.html>).



Fig. 3: School compound (source: EcoSan Club)

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 reaching the age of five if subject to current age-specific mortality rates.

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4 Project history

In the year 2000, the project started with a first site visit to gain an overview of the situation. After preparing a feasibility study, a first meeting with the school administration was organized to discuss the major issues of the required water supply and sanitation improvements. In 2003, detailed planning, construction and training were done.

Planning, technical design, control of the construction works and parts of the user training were done by TBL with support of the EcoSan Club. Realization of the project was carried out by Norman Construction and Engineering Services. Two site engineers, organizing and supervising the construction work of local contractors, were employed for the duration of the project implementation.

5 Technologies applied

The project consists of following 3 main components:

1. For the students, the existing pit latrines were replaced by 45 urine diverting dehydration (UDD) toilets. This action is in line with the National Strategy to promote ecological sanitation in Uganda. At the time of the project planning, experience about composting toilets in Uganda was low, so the decision has been taken to apply a UDD toilet system. An additional reason was that maintenance for these toilets is less complicated than for composting toilets, though secondary treatment of excreta has to be considered.



Fig. 4: Students' toilets (source: EcoSan Club)



Fig. 5: Interior of a students' UDD toilet (source: EcoSan Club)

2. For the teachers, a UDD toilet unit was built which also serves as a demonstration unit for visitors. It is located near the main entrance of the school and is attractively designed.



Fig. 6: Demonstration toilet for teachers and visitors (source: EcoSan Club)

3. The remaining wastewater (grey water with a small share of black water from the sisters' house) is treated in a horizontal subsurface flow constructed wetland. Main arguments for this decision were as follows:
 - Simplicity of construction
 - Low operation & maintenance efforts and costs
 - Enhanced nutrient removal is not required since the amount of nutrients is low due to the implementation of a UDD toilet system
 - Legal environmental standards in Uganda can be fulfilled
 - The subsurface flow constructed wetland has no free water surface (i.e. no fly breeding)

6 Design information

UDD toilets

The UDD toilets are built block wise, which allows the operator to empty them from the backside of the school. Each toilet consists of an elevated concrete floor including a sealed plastic squatting pan (produced by Cress tank, Uganda). The squatting pan leads faeces (together with anal cleansing material and ash) to a wooden basket located underneath in an overground dehydration chamber. These baskets are regularly emptied (after every school term, i.e. every 3 months) and brought to an outside drying area for further dehydration. The drying area is situated close to the school to avoid long transport distances.

Urine is led to an underground tank which is situated behind the toilets. In case of no or low urine use only, urine can alternatively be led to a soak pit for infiltration into the ground. The four soak pits are attached to the toilets.

Demonstration toilet

For the demonstration toilet, one of the main goals was a modern design. A designer made a first draft, before the school teachers contributed further ideas during a half day workshop. Urine from the demonstration toilet is collected in jerry cans while the collection of the faecal material is identical to the students' toilets. The demonstration unit is additionally equipped with a urinal to avoid incorrect use by male users.



Fig. 7: Faeces collection (source: EcoSan Club)

Constructed wetland

For the treatment of the remaining wastewater a horizontal subsurface flow constructed wetland system was built. Wastewater is pre-treated in a settling tank to remove solids (by sedimentation and flotation) before it flows by gravity to the inlet of the constructed wetland.

The settling tank is regularly emptied (at least once a year) and the material is dried together with faecal material from the UDD toilets at the drying area.

The inlet of the constructed wetland comprises coarse aggregate (diameter of 60-80 mm) in order to distribute the wastewater horizontally before it enters the actual treatment part consisting of sand (diameter of 4-8 mm). The bottom of the filter bed has a slope of 1%. At its lower end another area of coarse aggregate including a drain pipe (PVC DN 100) collects the purified greywater which is piped via an outlet manhole to an underground percolation ditch (10m of drain pipe DN 100 in a layer of coarse aggregate and covered with excavated material and soil).



Fig. 8: Constructed wetland and (in the background) drying area for faecal material (source: EcoSan Club)

7 Type and level of reuse

The possibility of reuse was one of the main motivations for the school administration to support the project since a farm producing food for the school is adjacent to the school compound.

- Faeces (incl. anal cleansing material and ash) is collected in locally produced wooden baskets which are regularly emptied (after every school term, i.e. every 3 months) and brought to a roofed drying area where it stays for at least 6 months. The dried material is then screened via a coarse-meshed sieve before being reused as a fertilizer in the surrounding banana/matoke plantation or as a soil conditioner in the school gardens. The sieved material like sanitary pads or toilet paper is burnt.

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Fig. 9: Drying area for collected faeces (source: EcoSan Club)

- The diverted urine is collected in an underground tank (students' toilets) or in jerry cans (teachers' toilet). After storage (for at least 1 month for application on fodder crops and more than 6 months for application on food crops), 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.
- In case of no or low urine use only, urine can alternatively be led to a soak pit for infiltration into the ground. But experience has shown that all urine is used.
- The treated greywater is infiltrated into the ground.

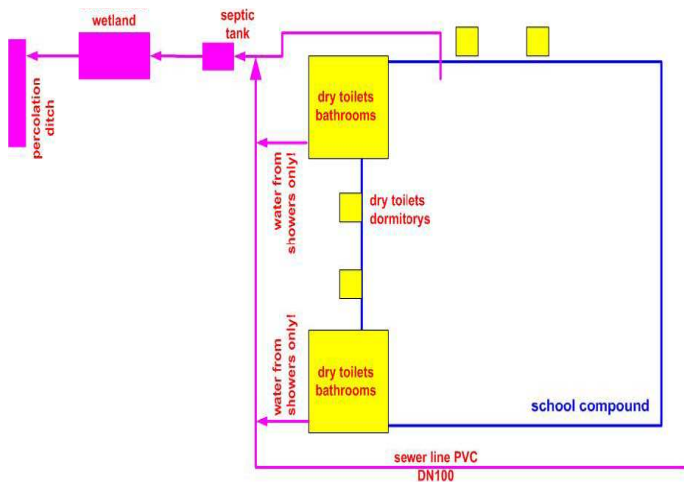


Fig. 10: Scheme of the sanitary system (source: EcoSan Club)

There is a gain in agricultural productivity, however this is not measured. Agricultural products are not sold but entirely consumed by the school itself.

8 Further project components

Water supply

The existing water catchment of the spring near the school compound was renewed including filtration, pump and overflow: A solar driven submersible pump and a drinking water tank were installed and the piping network was restored as far as necessary. Water for general use is now pumped from the new water catchment unit to the existing main water tank and distributed to the users (school, sisters and teachers). The overflow being filled during pump running time is made available for the local population. This facility is large enough to include an additional storage tank for the local population in the

future. In addition, a borehole with a hand pump (to avoid pollution of spring water by surface water) was installed to be used for drinking water supply on the school compound.

Participatory Planning

The idea of having a demonstration toilet for teachers and visitors came up during the discussions to convince the users of the advantages of UDD toilets. Constructing the same type of toilets for both students and teachers seemed to be the most suitable way to ensure a proper handling of the installations with support of shared knowledge. Based on that idea, particularly the design of the demonstration toilet unit was developed in a participatory way: The details of the unit were developed together with the teachers to create a consciousness of ownership and responsibility. A series of possible designs were presented to the teachers and any decisions (e.g. location of the toilet, sitting or squatting type; urinal for men) were discussed with them.



Fig. 11: Teachers workshop (source: EcoSan Club)

9 Costs and economics

A cost comparison was done during the planning phase of the project, meant to serve as one information among others for the client's decision making. The compared options are:

- Option 1: Ecosan concept with 45 UDD toilets. The different material flows are separated at the source and separately treated as far as possible. The main components are: For greywater: a sewer and a horizontal subsurface flow constructed wetland (area approx. 100 m²).
- Option 2: Conventional sanitation concept with 30 flush toilets. Wastewater is collected in a sewer and treated according to Ugandan standards. The main components are: a sewer, a mechanical pre-treatment, a pumping station and a vertical subsurface flow constructed wetland (area approx. 500 m²).

For the cost comparison the following costs were considered:

- Investment costs
- Reinvestment costs
- Operating costs

The calculation is based on the following assumptions: Timeframe is 50 years; reinvestments depend on lifespan of individual parts of the system; interest rate is 8%.

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Option 1 (ecosan)	no.	unit	unit cost [€]	total cost [€]
pipng	250 m		8	1.911
manholes incl. covers	5 pcs		49	243
fittings	1 lump-sum		850	850
filter unit	1 lump-sum		3.823	3.823
greywater treatment system	100 m ²		30	2.973
UDD toilets	45 pcs		194	8.738
sum				18.538

Option 2 (conventional)	no.	unit	unit cost [€]	total cost [€]
pipng	250 m		8	1.911
manholes incl. covers	5 pcs		49	243
fittings	1 lump-sum		850	850
filter unit	1 lump-sum		3.823	3.823
pumping station	1 lump-sum		971	971
wastewater treatment system	500 m ²		30	14.867
flush toilets incl. plumbing	30 pcs		291	8.738
sum				31.402

Fig. 12: Investment costs of two alternative options (source: EcoSan Club)

The results in Fig. 12 show the calculated actual cash value of both options based on average costs in Uganda. The costs are indicated in Euros calculated at an exchange rate of 2060 UGX = 1 € (09/2004).

The comparison of cost analysis between an ecosan concept (option 1) and a conventional concept (option 2) shows clearly that also economic reasons support the decision to invest in ecological sanitation. The main difference is caused by the significantly smaller wastewater treatment system for option 1 and the additionally required pumping station for option 2. Urine diversion significantly reduces the nitrogen load which results in a reduction of the required expenditure for the biological wastewater treatment system.

The actual entire costs for construction and consultancy were approx. 70,000 €, O&M costs are approx. 500 € per year for one full time person and some minor spare parts.

10 Operation and maintenance

Sustainability of the system strongly depends on a proper use and the quality and frequency of operation and maintenance carried out. For this reason both teachers and students were trained in principles and proper operation of the newly constructed units, in particular the UDD toilets. The involvement of the teaching personnel responsible for health issues was particularly emphasized. The UDD toilet unit used by the teachers and serving as a demonstration unit for visitors, located near the main entrance of the school, supports this target. For the teachers a brief written summary on the principles of UDD toilets, their operation and maintenance was prepared. The responsible personnel for operation and maintenance (gardener) was trained both on-site by the contractor's personnel and in a training course at the Lacor Hospital in Uganda.



Fig. 13: User training for Urine diverting toilets (source: Ecosan Club)

11 Practical experience and lessons learnt

Since the project has been realized, the school became "famous" for the innovative sanitation concept. Delegations from all over the country and from abroad come to visit the school toilets. The students and the teachers are proud of their well working toilets which are kept clean and well maintained. Since this project was a success, the head of the school reported on visitors and students' families who are copying the idea. More research would have to be done in the future to document these.

The experience shows that a variety of reasons contributed to the well working sanitation system:

- Teachers and students use the same type of toilets and the teaching personnel is convinced of this new technology.
- All stakeholders were involved in the planning from the beginning of the project; design decisions were made by the users.
- The presence of the civil engineers was utilized to sensitize and train teachers and students.

During an interview in February 2006 with the operator of the sanitation system and the school administration, both parties stated their satisfaction. Especially the administrator underlined the high value of the produced fertilizer for the school gardens. More information can be found in Jemsby (2008).

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 emphasized (weaknesses).

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Table 1: 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).

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	

The main long-term impact of the project is improved public health. A detailed monitoring regarding the quality of dried human excreta has been done by the EcoSan Club from 2004 - 2006 which showed very satisfying results. The main results of the monitoring are:

- The implemented infrastructure is still in a good condition and is used.
- Both human excreta and urine are used in the school gardens as fertilizer.
- Treatment of the faecal material is based on long storage and drying period combined with a relatively high addition of ash.
- Apart from one sample no pathogenic organisms were found in the dried material.

13 Available documents and references

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- Müllegger E. and Lechner M. (2005): Sanitation for a rural school in Uganda – a successful implementation process. In: Conference Documentation of the 3rd International Ecological Sanitation Conference, May 2005, Durban, South Africa. http://www.ecosan.at/download/Durban_KalunguPresentation.pdf.
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- Lechner M. (2004): Kalungu Girls Secondary School – Improvement of Water & Sanitation Infrastructure (project report). <http://www.ecosan.at/download/projects/kalungu.pdf>

14 Institutions, organisations and contact persons

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Case study of SuSanA projects

UDD toilets for a Girls Secondary School

SuSanA 2008

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