



Fig. 1: Project location

1 General data

Type of project:

Improvement of the sanitation system of a rural public health center

Project period:

Start of construction: January 2004

Start of operation: July 2004 (and ongoing)

Project scale:

Sanitation facilities for approx. 150 patients and 15 staff members.

Total cost approx. € 20,000 for consultancy and realization of 6 pit latrines, 1 UDD toilet block with 4 cubicles and other infrastructure components.

Address of project location:

Kanawat, Kotido District, Uganda

Planning institution:

EcoSan Club

Executing institution:

Norman Construction and Engineering Services, Kampala, Uganda

Supporting agency:

Austrian child care organisation "Dreikönigsaktion" (DKA): 100% fund

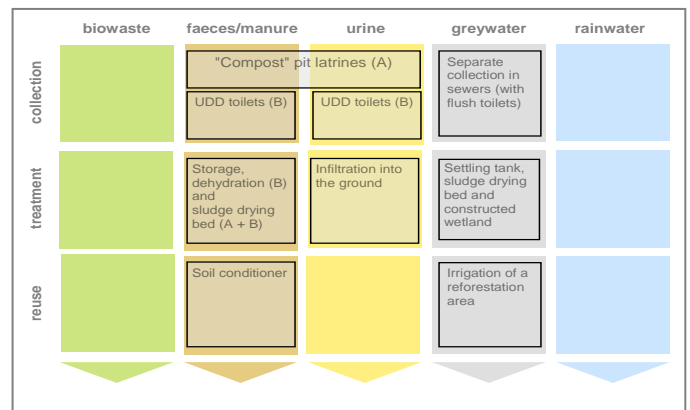


Fig. 2: Applied sanitation components in this project (A and B refer to two types of toilets used)

2 Objective and motivation of the project

The objectives of the project were to:

- improve the hygienic situation of the Kanawat Health Center with regard to water and sanitation as well as clinical waste.
- prevent the spreading of water-related diseases.

3 Location and conditions

The health center is located in Kotido District in the North-Eastern Karimojong region of Uganda. The is characterized by short rainfalls with long dry and hot periods. The different Karimojong tribes living in this region are still following a semi-nomadic lifestyle, mainly based on traditional livestock keeping and subsistence agriculture. The health center was founded in 1976 by Comboni missionaries and is being used by about 150 patients per day, and this number is steadily increasing.

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



Fig. 3: Shower and laundry washing area of the Health Center (source: EcoSan Club, 2004)

The sanitary situation before project implementation was as follows:

- Wastewater produced in the Health Center, nurses' houses and staff quarter (originating from some flush toilets and

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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greywater from kitchen and showers) was collected in settling tanks and the overflow was drained into soak pits.

- Pit latrines served as toilets for patients' family members on the health center's compound. Due to hard rocky soil it was not possible to dig sufficiently deep pits. Thus, the toilet slab was raised by approx. 1.20 m above ground to achieve a sufficient storage volume and to ease emptying. Adjacent to these pit latrines, shelters were provided to be used as showers which however were misused for defecation. The Health Center staff used pit latrines located near the staff houses.
- Wastewater was not treated at all. Drinking water wells within the compound were directly located near the pit latrines, showers and soak pits. Thus, the situation was dangerous for human health.
- In addition also the incinerator for the burning of medical waste was located on the small compound of the Health Center. Due to the malfunctioning of the incinerator, black and dense smoke polluted the air and insufficiently burnt medical waste was dumped uncontrolled.

4 Project history

In 2002 the Austrian NGO named "Dreikönigsaktion" (DKA) started to support the health center in a first phase with an electrical solar system to supply electricity day and night independently of fuel (before that a generator with insufficient fuel supply was the only energy source).

In 2003 the second phase of the project addressed the hygienically insufficient conditions regarding sanitation, washing facilities and waste discharge.

Planning, technical design, supervision of the construction works and parts of the user training were carried out by EcoSan Club. Realization of the project was carried out by Norman Construction and Engineering Services. One site engineer, organizing and supervising the construction work of local contractors, was employed for the duration of the project implementation. The construction was completed in July 2004.

5 Technologies applied

The project consists of following 6 main components:

1. The 6 old pit latrines for the patients were reconstructed as pit latrines that can be emptied (without urine separation, for details see section 6), hereinafter referred to as "compost" pit latrines (however, the term "compost" is misleading because in fact there is no composting process taking place here). This decision was due to the following reasons:
 - The previously existing latrines which were already located above-ground had a large storage volume.
 - Local staff is familiar with their maintenance.
 - The pit content was planned to be reused at the Health Center's own cottage plantation for soil conditioning.
 - A change of users' behavior is not required.
2. A urine diversion dehydration (UDD) toilet block with 4 cubicles was constructed for the staff in order to avoid problems related to conventional latrines and to demonstrate modern technologies. The staff was regarded as able to modify their user behavior according to the demands of such a toilet system, which they did. The toilets are equipped with urine diversion squatting pans produced by Cress tank in Uganda (for details see section 14).

3. Renovation of showers and laundry washing place, connection to a sewer system in order to avoid mosquito breeding and groundwater pollution.
4. A PVC sewer was built in order to collect the remaining wastewater from the Health Center's flush toilets, showers and laundry washing place.
5. The sewer drains into a wastewater treatment system consisting of a settling tank, a sludge drying bed and a horizontal subsurface constructed wetland for secondary treatment of the settling tank's outflow. When reaching a certain level (ideally every 3 months, realistically once a year), the sludge from the settling tank is stirred and discharged by gravity via a pipe into the drying bed.
6. This treated wastewater is collected in a concrete tank to be reused as irrigation water (see section 7). The water tank is designed to store the maximum daily wastewater flow which was estimated to be 5 m³. Surplus water overflows to a subsurface percolation trench irrigating tree plantations.



Fig 4: New UDD toilet block with 4 cubicles for the staff (source: EcoSan Club, 2004)

6 Design information

"Compost" pit latrines

The existing pit latrines were not significantly changed, only the vaults were renewed to support some composting to take place by providing emptying openings and a small extension with a metal cover for solar heating of the vault.

The health center management feared a misuse of urine diversion toilets by the patients and thus decided to stick to the traditional latrine system.

The bottom of the latrines has been sealed ex post with cement mortar. Liquids are discharged by a sewer into the constructed wetland and faecal material is emptied manually.

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Fig. 5: New "compost" pit latrines for patients after reconstruction, side view (source: EcoSan Club, 2004)



Fig. 6: New "compost" pit latrines for patients, rear view, showing access openings for the removal of faecal sludge (source: EcoSan Club, 2004)

UDD toilets

The UDD toilet vaults can be emptied from the backside. Each toilet consists of an elevated concrete floor including a sealed plastic squatting pan (produced by Cress tank, Uganda). Ash is added after each defecation in order to absorb the moisture of the faeces and to raise the pH level so as to enhance pathogen destruction. The squatting pan leads faeces (together with anal cleansing material and ash) to a wooden basket located underneath in an above ground dehydration vault. These dehydration vaults are covered by metal sheets in order to benefit from solar heating. The baskets are emptied once a year and brought to an outside drying area for further dehydration. The drying area is situated close to the toilets in order to avoid long transport distances. After further drying the material is used as a soil conditioner.

Urine is infiltrated via a soak pit into the ground because its usage is not intended by the beneficiaries (see section 7). The soak pit is located next to the toilets.

Constructed wetland

For the treatment of the remaining wastewater (some flush toilets and greywater) a horizontal subsurface flow constructed wetland system was built on an area of 45 m² growing indigenous non-fruit plants. 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 faecal sludge from the settling tank is regularly emptied (ideally every 3 months, realistically 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 wastewater which is piped via an outlet manhole to an underground percolation ditch in the nearby reforestation area (10m of drain pipe DN 100 in a layer of coarse aggregate and covered with excavated material and soil).



Fig. 7: Constructed wetland (5m x 9m) before greening in 2004 (source: EcoSan Club)



Fig. 8: Constructed wetland in 2006 (source: EcoSan Club)

7 Type and level of reuse

The project focused on the improvement of the hygienically poor situation while reuse was rather a minor point due to urgency of the first target.

But within a few months the use of the treated wastewater gained attention and local project partners started the construction of an irrigation system for its use in a reforestation area near the Health Center (different owner).

Urine is infiltrated via a soak pit into the ground. Currently there is no demand for urine as a fertilizer since the Health Center does not own plantations that could use urine as a fertilizer.

Dried faeces from the UDD toilets, so called "compost" from the pit latrines and the settling tank's faecal sludge discharged onto the sludge drying bed are buried in furrows next to the Health Center's own cottage plantation for soil conditioning.

8 Further project components

A low cost medical waste incinerator based on a project of the Applied Sciences Faculty of De Montfort University in Leicester was constructed. Burnt residues are disposed in a covered and fenced dumping area, built on request of the project owner.



Fig. 9: Medical waste incinerator constructed on the Health Center's compound, 2004 (source: EcoSan Club)

9 Costs and economics

A detailed cost breakdown is not available. However, the actual entire costs for construction and consultancy were approx. € 20,000. O&M costs are approx. € 500 per year as salary for one full time operator and some minor spare parts. Those costs are covered by the Health Center's budget.

10 Operation and maintenance

The responsible person for O&M is employed by the Health Center. He was trained in two workshops on water supply and sanitation at the Matany Hospital (September 2003, June 2004). He has also implemented parts of the ecological sanitation concept at his own home.

His main O&M activities are:

- Checking of the treatment plant
- Cleaning of the settling tank

- Emptying the UDD toilets
- Maintenance of the "compost" pit latrines
- Checking the sewer for blockages and removal of blockages

An O&M manual was prepared together with the water and sanitation workshop participants in June 2004. Back-stopping for additional questions on-site was provided by the EcoSan Club for 2 years after implementation (i.e. up until 2006).

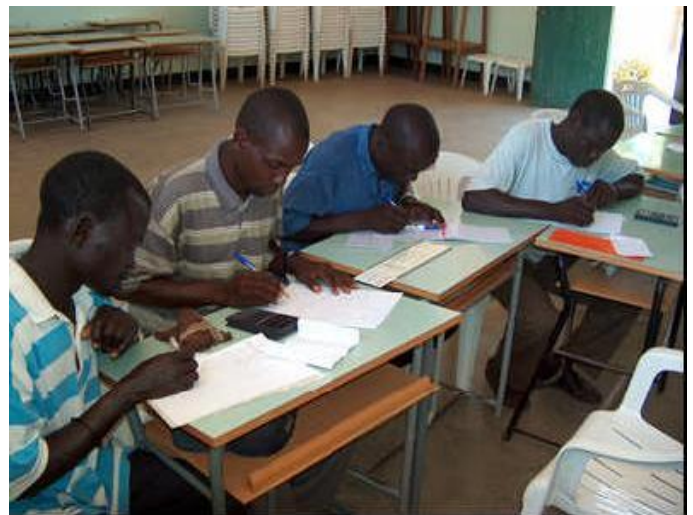


Fig. 10: Sanitation workshop at Matany Hospital, Uganda, 2003 (source: EcoSan Club)

11 Practical experience and lessons learnt

The hygienic situation of the Health Center has improved a lot and a certain demonstration effect has been achieved. The new system still allows for further improvement and additional options.

In the case of wastewater reuse, it could be noted how a well functioning treatment system created a demand for the "product" (i.e. treated wastewater) just due to its availability and thus contributes to a multiplying effect.

However, the aspects of hygienization and reuse of faeces and urine could not be considered in detail due to financial restrictions and the special setting of this project (majority of temporary users, focus on dealing with health problems rather than agriculture).

Experience has shown that the partly reconstructed pit latrines to so called "compost" pit latrines did not lead to satisfying results. Due to their poor design and subsequently difficult maintenance the "compost" pit latrines never worked properly.

Other problems were the limited capacity of workers to read and understand technical drawings, the lack of knowledge of sanitation concepts and the partly poor workmanship of local construction companies. Thus, a certain extent of constructive adaptations became necessary which delayed the project and increased the costs.

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).

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 ¹		
	+	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	

¹) Reuse of the treated wastewater only (urine and faeces are not reused)

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).

The main long-term impact of the project is the prevention of the spreading of water-borne diseases. A two year monitoring (2004-2006) showed that the toilets are well accepted by both staff and patients, that the treated excreta (dried faeces from UDD toilets) is used in the Health Center's cottage production and the treated material is pathogen poor.

13 Available documents and references

- Müllegger E. (2004): Kanawat Health Center – Improvement of Sanitation Infrastructure (project report). <http://www.ecosan.at/download/projects/kanawat.pdf>
- Information on low cost medical waste incinerator, Applied Sciences Faculty of De Montfort University Leicester: http://www.mw-incinerator.info/en/101_welcome.html

14 Institutions, organisations and contact persons

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Case study of SuSanA projects

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