TBL

EcoSan Club

Norman

Constructions and Engineering Services

Sacred Heart Sisters

Kalungu Girls Secondary School

Improvement of Water & Sanitation Infrastructure

February 2003 – December 2003

1 Summary

To improve the situation of the Kalugu Girls Secondary School with regard to water and sanitation – insufficient supply with water with regard to both quality and quantity, groundwater and drinking water source pollution due to inadequate sanitary infrastructure – the following measures were implemented:

Water Supply

- renewal of spring catchment incl. filtration, storage, pump and overflow to provide local population with water
- renovation of pipe network were required
- installation of submersible solar pump in existing borehole to provide water of a high quality mainly for drinking incl. piping and storage

Sanitation

- construction of dry toilet units to replace existing pit latrines and minimise ground water pollution incl. storage area
- construction of dry toilet demonstration units for teachers and visitors
- construction of a constructed wetland system for biological treatment of remaining wastewater

Training

- training of students on the use of dry toilets
- training of teachers on principles and use of dry toilets
- training of o&m staff in theory and practice

2 Project organisation

While planning, technical design, control of implementation and parts of the training were done by TBL with support by the EcoSan Club the realisation of the project was carried out by Norman Construction and Engineering Services, Kampala. Two site engineers, organising and supervising the work of local contractors, were employed for the duration of the project implementation.

3 Situation before the project

Wastewater which was produced in low quantities from the staff quarters and sisters house (flush toilets and grey water from kitchen and showers) was drained away in soak pits. Human waste from the pupils was disposed of via app. 35 pit latrines. Grey water from showers and kitchen was discharged into a ditch outside the school's compound and drained.

Picture 1: old water source of the school

No wastewater treatment of any kind was available. Due to the shallow ground water level and the location of the soak pits and pit latrines directly upstream of the school's and the nearby villages' water source the situation was clearly unsatisfying and potentially dangerous.

Picture 2: old pit latrines

Picture 3: water source for the village

In addition also the water sources were not constructed properly, minimizing the risk of secondary pollution. Therefore, to reduce the groundwater (drinking water) pollution, it was planned to replace the pit latrines by dry toilets and treat the remaining

wastewater – grey water with a small share of black water – in a horizontal subsurface flow constructed wetland. The basic scheme is shown in Figure 1 below.

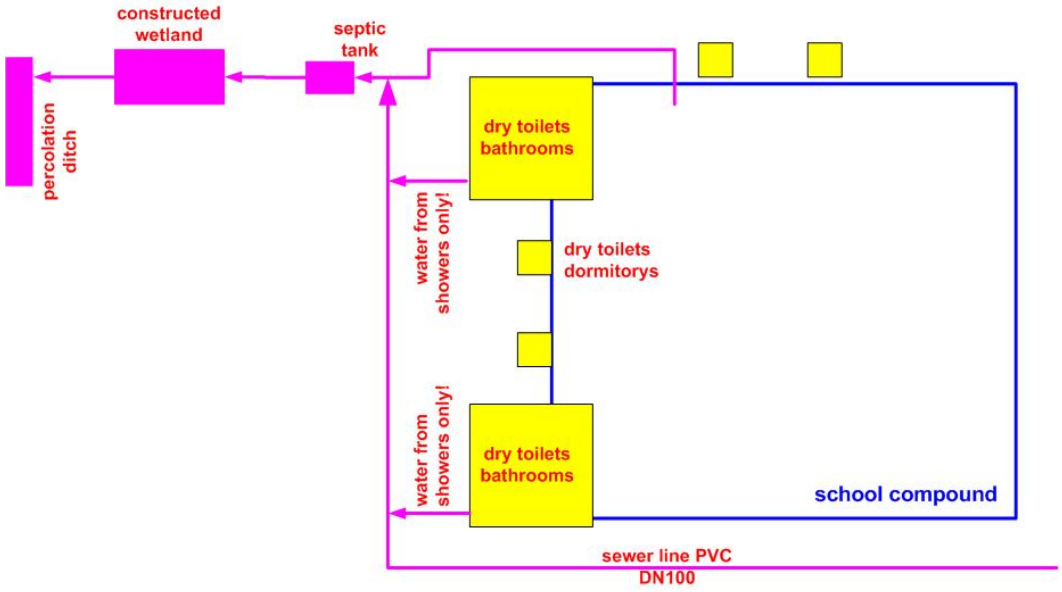

Figure 1: sanitation system KGTC

In addition it was foreseen to renew the spring catchment to reduce the risk of water pollution due to entry of surface water. A borehole on the schools compound, which was equipped with a hand pump, was planned to be used for supplying drinking water to the sisters house and the schools kitchen by installing a submersible solar pump and a drinking water tank.

4 Sanitation

4.1 Dry toilets

In line with the National Strategy to promote Ecological Sanitation in Uganda dry toilets for the children were constructed. Since only insufficient experience for composting toilets in Uganda was available diversion toilets were selected. In addition, though secondary treatment of the excreta has to be considered, maintenance is less complicated then for composting toilets.

Picture 4: dry toilets

One employee attending the garden behind the schools compound was trained in operation and maintenance. In addition both students and teachers received information and training on the use of this type of toilets.

In addition to these dry toilets a dry toilet unit was constructed for the staff and in serving as a demonstration unit for guests. It is located near the main entrance to the school.

Picture 5: dry toilet, detail

Picture 6: dry toilets; backside with door and basket for faeces

Presently diverted urine is drained in soak pits although reuse as a nitrogen rich fertilizer is optional. Faeces are collected in baskets which are changed regularly. Reuse for agriculture is planned, another project presently in preparation.

Picture 7: Demonstration toilet

4.2 Wastewater treatment

For treatment of the remaining wastewater a horizontal subsurface flow constructed wetland system was constructed. Main reasons for this decision were

- simplicity in construction and operation & maintenance
- low operation and maintenance cost
- enhanced nutrient removal is not required since the amount of nutrients is low due to the implementation of dry toilets
- legal environmental standards in Uganda can be fulfilled
- treatment system has no free water surface

Wastewater is pre-treated in a septic tank to remove solids (by sedimentation and flotation) before it flows by gravity to the inlet area of the constructed wetland system.

Picture 8: Constructed wetland system during construction

This inlet area comprises coarse aggregate (6-8cm) to distribute the wastewater horizontally before it enters the actual treatment part which consists of sand (4-8mm). At the lower end (bottom slope app. 1%) of the filter bed another area of coarse aggregate, covering a drain pipe (PVC DN100) collects the purified wastewater, which is piped via an outlet manhole to an underground percolation ditch (10m of drain pipe DN 100 – parallel to contour lines – in a layer of coarse aggregate and covered with soil/excavated material).

Picture 9: Constructed wetland completed (not yet planted)

4.3 Training

Sustainability of infrastructure strongly depends on operation and maintenance from users and o&m staff. For this reason both teachers and students were trained in principles and proper operation of newly constructed units, in particular the dry toilets. For the teachers a brief written summary on the principles of dry toilets, operation and maintenance was prepared.

The responsible personnel for operation and maintenance was trained both on site by the contractor's personnel and in a training course at the Lacor Hospital in Uganda.

Picture 10: Site engineer explaining & demonstrating the use of dry toilets

Picture 11: Sanitation training course at Lacor Hospital

4.4 Comparison of costs

Following an analysis of the situation before the project, a detailed comparison of costs was carried out for two alternative sanitation solutions. This cost comparison was meant to serve as one information among others for the client in the decision making process.

The options which were compared were a "conventional" sanitation concept, comprising collection of wastewater in a sewer line and treatment according to Ugandan standards and an "EcoSan" solution, relying on prevention and split flow treatment as much as possible. The main components of the concepts are:

- Option 1 - EcoSan concept: dry urine diversion toilets (45 units), sewer line for greywater and a horizontal subsurface flow constructed wetland (area app. 100m²)
- Option 2 - conventional sanitation concept: flush toilets for the students (30 units), separate sewer system for black water, mechanical pre-treatment, pumping station and a vertical subsurface flow constructed wetland (area app. 500m²)

Figure 2: Detailed comparison of costs

for a conventional sanitation concept (option 2) and an EcoSanitation concept (option 1). Figures are in Ugandan Shillings (exchange rate by 22.09.2004: 1€ = 2060 UGX).

Option 1	no.	unit	unit cost	total cost
piping	250	m	15.750,00 UGX	3.937.500,00 UGX
manholes incl. covers	5		100.000,00 UGX	500.000,00 UGX
fittings	1	lump sum	1.750.000,00 UGX	1.750.000,00 UGX
filter unit	1	lump sum	7.875.000,00 UGX	7.875.000,00 UGX
wastewater treatment system	100	m²	61.250,00 UGX	6.125.000,00 UGX
dry toilets	45	units	400.000,00 UGX	18.000.000,00 UGX
				38.187.500,00 UGX

Option 2	no.	unit	unit cost	total cost
piping	250	m	15.750,00 UGX	3.937.500,00 UGX
manholes incl. covers	5		100.000,00 UGX	500.000,00 UGX
fittings	1	lump sum	1.750.000,00 UGX	1.750.000,00 UGX
filter unit	1	lump sum	7.875.000,00 UGX	7.875.000,00 UGX
pumping station	1	lump sum	2.000.000,00 UGX	2.000.000,00 UGX
wastewater treatment system	500	m²	61.250,00 UGX	30.625.000,00 UGX
flush toilets incl. plumbing	30	units	600.000,00 UGX	18.000.000,00 UGX
				64.687.500,00 UGX

For the cost comparison the following costs were considered:

- investment costs,
- cost for reinvestment and
- operating costs.

The calculation is based on the following assumptions:

- timeframe for cost comparison: 50 years
- reinvestments depend on life-span of individual parts of the system
- interest rate 8% (UCB 2002)

The following results show the calculated actual cash value of each option for the period under consideration based on average costs in Uganda.

The comparison of costs between a conventional (option 2) and an EcoSan concept (option 1) shows clearly that not only ecological but 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 pumping station additionally required for option 2.

Urine diversion significantly reduces the load of nitrogen which results in a reduction of the required expenditure for the biological wastewater treatment system (NH_4-N discharge limit in Uganda is 10mg/l).

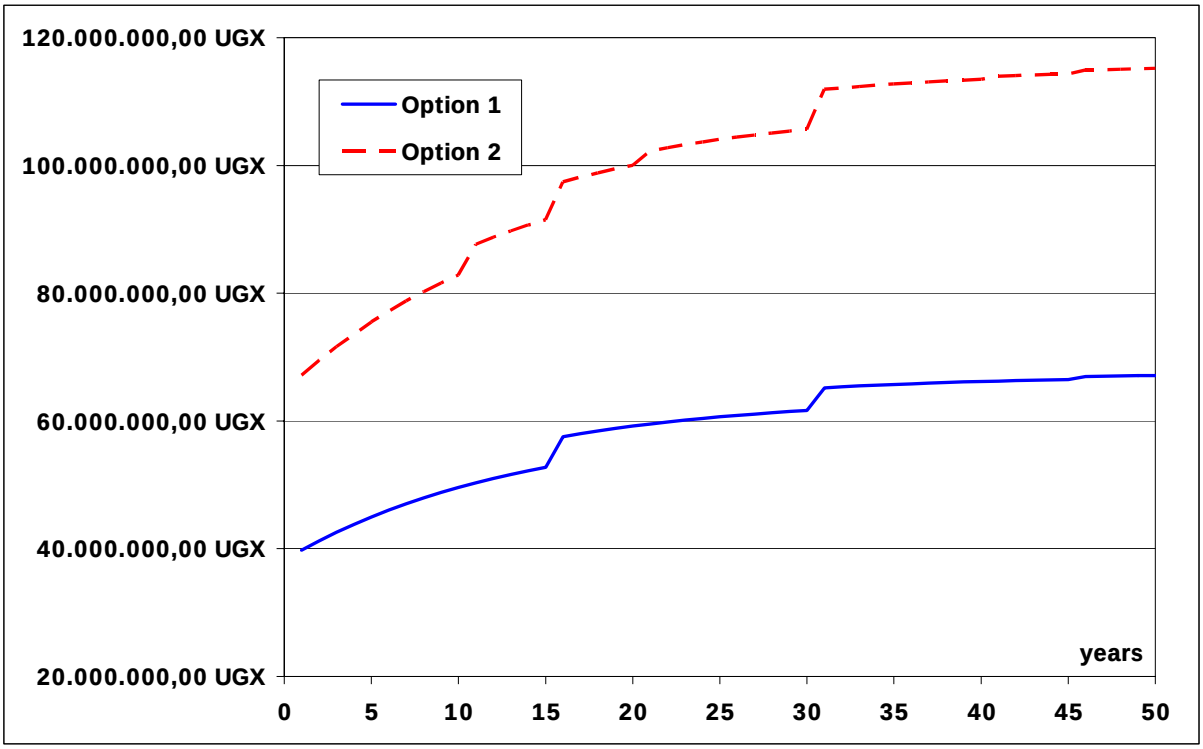

Figure 3: Comparison of costs

for a conventional sanitation concept (option 2) and an EcoSanitation concept (option 1). Figures are in Ugandan Shillings (exchange rate by 22.09.2004: 1€ = 2060 UGX).

5 Water Supply

In order to sustain the improvements of the water quality (by the introduction of a proper sanitation system) the following activities on the side of the water abstraction were realised:

- replacement of the old spring by a new spring catchment including filtration, storage and overflow of surplus water for the local population
- installation of automatically operated pump

Picture 12: catchment chamber during construction

- installation of solar submersible pump in borehole for drinking water incl. pipeline and storage tank

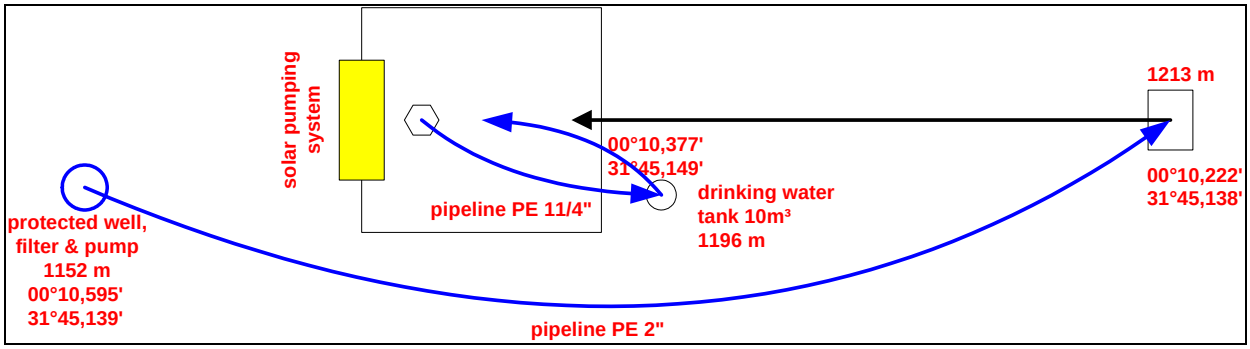

Figure 4: water supply scheme Kalungu

Picture 13: Spring overflow during construction

Water for general use is now pumped from the new catchment unit to the existing main water tank and distributed to the users (school, sisters, staff). The overflow, which is available also during pump running time is made available for the local population. This facility is constructed to include an additional submersible storage tank for the local population in future.