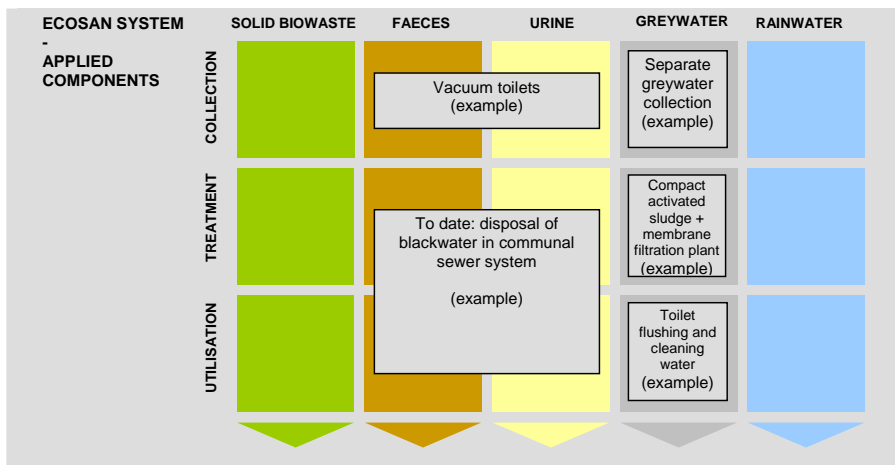


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Constructed Wetland for a peri urban housing area

**Bayawan City,
Negros Oriental Province,
Philippines**



1 General Data

Type of Project:

Periurban upgrading

Project Period:

start of planning: 02/2005,
start of construction: 06/2005
start of operation: 09/2006

Project Scale:

Relocation housing area for 700 households.

Address:

Fishermen's Gawad Kalinga Village, Barangay Villareal, Bayawan City

Planning Institution:

City of Bayawan, Oekotec GmbH, Belzig, Germany
Gerry F. Parco & Marc Mulingbayan, Philippines

Executing Institution:

City of Bayawan, City Engineering Office

Supporting Agency:

DILG-GTZ Water & Sanitation Program

area for families that lived along the coast in informal settlements without safe water supply and sanitation facilities. Records from the City Health Office showed a high incidence of morbidity and mortality arising from water-borne diseases.

The families have been resettled to a 7.4 hectares social housing site which consists of 704 terraced houses, a day-care centre, a health centre, a multi-purpose hall and community. The majority of the households that moved into the relocation area make their living through fishing.



Figure 1: Relocation housing area (source: Bayawan City)

One of the livelihood projects recently introduced in the Fishermen's Gawad Kalinga Village, is a vegetable production using organic farming methods.

4 Technologies applied

The houses of the Fishermen's Village have pour-flush toilets.

The waste water from the toilets, bathrooms, and kitchen sinks are partially treated in the septic tanks

reducing the biological oxygen demand and solids content. The overflow from these tanks is transported through a sewer system to the main sump for storage and further removal of solids.

From the main sump, the wastewater is pumped into 4 header tanks and flows by gravity into the first cell of the constructed wetland, which is a vertical soil filter. From here, the wastewater flows by gravity into the second cell. This cell is a horizontal soil filter. The effluent from the second cell is collected in the effluent sump. The sludge from the septic tanks will be treated either in soilfilters or will be co-fermented in a biogas reactor on the planned sanitary landfill site. The treated waste water is reused for irrigation.

The combination of septic tanks and constructed wetland was chosen because the construction of the relocation area was already in progress when the City of Bayawan decided to upgrade the treatment process. The City looked for an affordable and reliable treatment technology that could be easily implemented, operated and maintained. At the same time the treated waste water should be clean enough for different re-use options, i.e. as water for construction or irrigation.

The consultants recommended a combination of a vertical and a horizontal soil filter to ensure sufficient treatment efficiency, taking account of the available space.

3 Location and general conditions

Bayawan City is located in the south-western portion of Negros Island, it encompasses a total land area of about 70,000 hectares and has a population of about 105,000.

The project is located in the peri urban part of Bayawan. It is a resettlement

commissioned by

ecosan program
recycling oriented
wastewater management
and sanitation systems

Federal Ministry
for Economic Cooperation
and Development



Figure 2: Constructed wetland (source: GEOPLAN Cebu)

5 Type of reuse

In the beginning the waste water was used for construction, i.e. concrete production. Bayawan, realizing the majority of its infrastructure projects by its own resources, used the waste water to reduce construction costs.

Frequent analysis of the treated waste water showed that it is safe for re-use in vegetable farming. During dry season the treated waste water is used for the organic farming project of the Fishermen's village.



Figure 3: Reuse of effluent for watering in Fishermen's Village (source: DILG-GTZ Program)

Through information campaigns during the implementation phase of the wetland project as well as by the trainings of the organic farming project people learned about the benefits of re-using treated waste water. Its use for irrigating of the vegetable fields was willingly accepted.

6 Further project components

The constructed wetland project complements other programs being implemented and developed by Bayawan

City such as the Healthy City, Food Security, Integrated Solid Waste Management, the 'Character First', and the Organic Farming programs.



Figure 4: Social preparation of village association (source: DILG-GTZ Program)

The implementation phase included social preparation activities for the future inhabitants of the relocation area. As part of the relocation project a village association was set up to organize the affairs of the relocation area.

The staff of City Engineering as well as members of the village association attended trainings in the operation and maintenance of the waste water treatment plant.

The planning process was a joint undertaking of German and Philippino Consultants, supporting the knowledge exchange and introduction of a new technology option: the vertical soil filter.

The local water service provider regularly analyses the influent and effluent of the constructed wetland in its water laboratory. The Analysis includes selected physico-chemical parameters, i.e. TDS, pH, BOD, Ammonia, Nitrate and Phosphate as well as microbiological parameters.

The implementation process was documented through a video documentary that covers the social as well as the technical aspects of the project.

7 Project History

The concept of ecological sanitation was introduced to the Visayas and Mindanao Regions of the Philippines through the "1st International Symposium on Low Cost Technology Options for Water Supply and Sanitation" in September 2004 in Bohol. This conference was organized by the DILG-GTZ Water & Sanitation Program and the WSP (Water & Sanitation Program) of the World Bank. The City of Bayawan attended this symposium and a group of German and Philippino experts visited Bayawan City right after the conference to conduct a rapid assessment. Two

waste water management and sanitation options were identified: a constructed wetland for domestic waste water of a peri-urban resettlement area and a dry sanitation concept for the sparsely populated rural areas.

The first joint visit of the international and local consultants took place in March 2005. The experts assessed the location, decided on design parameters and discussed different technology options. The detailed design was prepared by the local consultants and the construction process was agreed by the City Engineers Office of Bayawan. The local consultants were also responsible for construction supervision.

In April 2005, the partnership between the City Government of Bayawan and the GTZ was formally sealed with a Memorandum of Agreement providing technical assistance in the construction of the constructed wetland treatment facility.

In May 2005, the construction started with a ground-breaking ceremony.

The construction was carried out by the City Engineering office and was completed in August 2006.



Figure 5: Preparation of drainage system (source: DILG-GTZ Program)

The international consultant visited Bayawan twice during the construction phase, so in November 2005 and June 2006. The first visit included the selection of a filter material for the soil filters as well as the assessment of other locations that were proposed for additional waste water treatment facilities. A manual for operation and maintenance was developed together with local consultants and the City Engineering. The second visit took place when the pipe system was installed in the vertical soil filter.

The constructed wetland was inaugurated in September 2006 and is in operation since then.

A number of measures to improve the facility have been undertaken since the operation started. The header tanks were covered to minimize the odour

during the filling process. The collection sumps between the two wetland cells and after the second cell were covered to reduce algae growth. A large storage tank for the treated waste water was built.

Treatment and reuse options for the sludge of the septic tanks as part of the solid waste management program of Bayawan are still in the planning stage.

8 Costs

The total cost for the construction of the constructed wetland are about 200,000 US\$ including cost for consultancy and labour.

The cost for operation and maintenance are estimated at 1,600 US\$ per year. This figure does not include the cost for electricity because it has not been recorded yet.

9 Operation and Maintenance

Operation and maintenance are carried out by different teams that are employed by the City and include:

Field Operations

- Pumping and distribution; wastewater feeding schedule; recirculation (The filling and emptying of the header tanks is done manually)
- Management of treated effluent
- Management of plants / vegetation
- Site security and record keeping of daily activities



Figure 6: Distribution of waste water on vertical soil filter (source: DILG-GTZ Program)

Engineering and Maintenance

- Inspection and repair of electrical lines, pumps, and other equipment
- Regular inspection and clearing of piping system

- Regular inspection and cleaning of wastewater pretreatment collection system
- Emergency engineering work

Water Quality Monitoring

- Effluent Sampling and Analysis
- Operation of a database on water quality analyses and submission of findings and recommendations to the Project Coordinator for appropriate action.

The relocation village and the constructed wetland are located close to the sea shore. In rainy seasons the groundwater level reaches ground level. Therefore the cells of the wetland were built in concrete and concrete hollow blocks. Both cells have a drainage pipe system at the bottom and are filled with a drainage layer, separation layer and filter layer. The plant material is a locally available reed called 'tambok' (Phragmites ssp). It was propagated during the construction phase in a nursery at the relocation site.

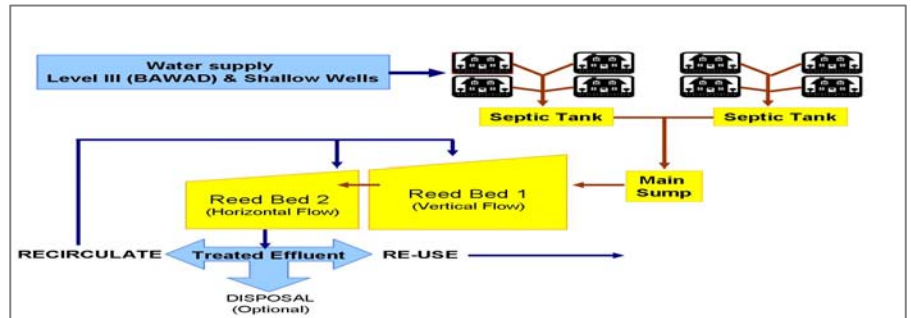


Figure 7: Flow chart of the treatment system (source: CEO Bayawan)

10 Design information and technical specifications

The constructed wetland is designed for 50 litres of wastewater per person and day with a BOD concentration of 300 mg/l.

Based on these design parameters the area of the vertical soil filter (cell 1) was calculated with 1800 m² and the horizontal soil filter with 880 m². Cell 1 is about 48 x 36 m and cell 2 is 33 x 27 m.

The distribution system for the wastewater is composed of 4 concrete header tanks and a system of perforated HDPE pipes. The system is operated manually, i.e. switching on and off of the pump and emptying the header tanks into the distribution system. The header tanks are filled 2 – 3 times a day.

11 Practical experience and lessons learned, comments

The constructed wetland is a technology option easy to build and operate.

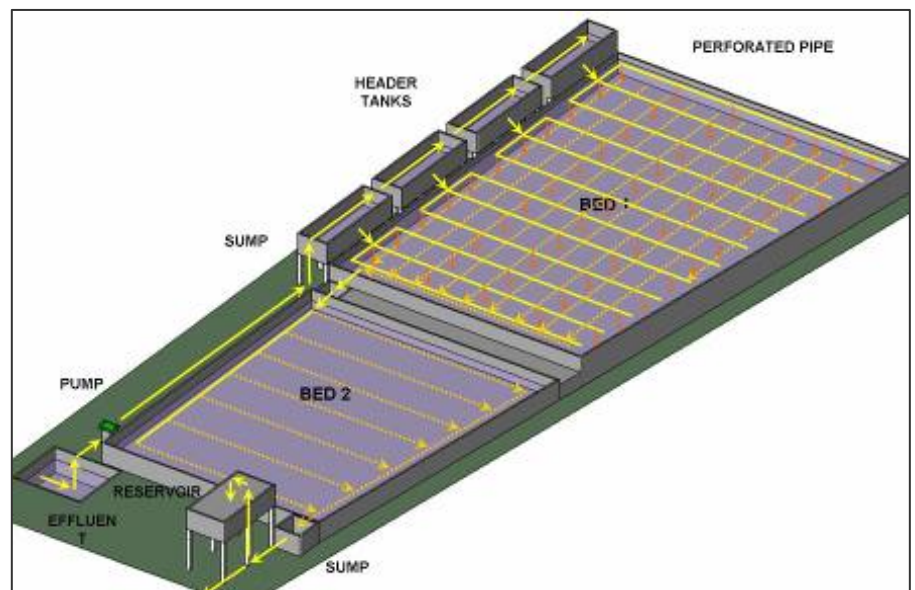


Figure 8: Flow directions of cells 1 & 2 (source: CEO Bayawan)

The vertical soil filter in combination with the horizontal soil filter achieves



good treatment results. The effluent quality complies with the standards for irrigation water.

Labour force is comparably cheap. That made it possible to opt for a manually controlled filling of the distribution system. This option saved implementation cost for a bigger pump and reduces the operating costs for electricity.

Regular monitoring of raw and treated waste water ensure that water with acceptable quality is re-used.

The combination of an international-local consultant team facilitated an intensive knowledge exchange and the introduction of the vertical soil filter as a new technology option in the Philippines.

The inventiveness of City Engineering staff and the responsiveness of the consultants made it possible to continuously adjust the design to the local conditions.

Bayawan City plans to build additional constructed wetlands in strategic areas of the city, starting with a waste water treatment facility for the District Hospital.

12 Available documents and references

DILG-GTZ Water & Sanitation Program, "1st International Symposium on low cost technology options for water supply and sanitation" September 2004

Dr. Joachim Niklas, Oekotec GmbH, 1st expert report "Implementation of a soil filter treatment plant for water reuse in Bayawan, Negros Oriental", March 2005

Dr. Joachim Niklas, Oekotec GmbH, 2nd expert report "Implementation of a soil filter treatment plant for water reuse in Bayawan, Oriental Negros, Status report of the site supervision in November 2005", December 2005

Dr. Joachim Niklas, Oekotec GmbH, "Proposal for an Operation and Maintenance Manual", December 2005

Dr. Joachim Niklas, Oekotec GmbH, "Mission Report III "Implementation of a soil filter treatment plant for water reuse in Bayawan, Negros Oriental", July 2006

All documents can be requested through the DILG-GTZ Water & Sanitation Program, www.watsansolid.com.ph

13 Institutions, organisations and contact persons:

Office of the City Mayor,
City Hall,
Bayawan
Philippines
www.bayawancity.gov.ph

DILG-GTZ Water & Sanitation Program,
5th Fl. DILG-WSSPMO,
Francisco Gold Condominium II,
EDSA corner Mapagmahal Street,
PO Box 1176 QCPO, Diliman,
Quezon City, Metro Manila
Philippines
gtzwater@info.com.ph
www.watsansolid.com.ph

Dr. Joachim Niklas
Oekotec GmbH,
Rosa - Luxemburg - Str. 89
D - 14806 Belzig
info@oekotec-gmbh.com
www.oekotec-gmbh.com

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data sheets for ecosan projects

authors: ecosan team

Deutsche Gesellschaft für Technische
Zusammenarbeit (GTZ) GmbH
ecosan program

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 6196 79-4220
F +49 6196 79-7458
E ecosan@gtz.de
I www.gtz.de/ecosan

