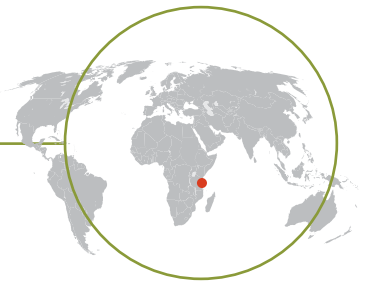
CASE STUDY 6 EXTENDED



Resource-efficient decentralized wastewater treatment systems in Dar es Salaam, United Republic of Tanzania

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The issue

In 2013, two decentralized wastewater treatment systems (DEWATS) were implemented at the comprehensive community-based rehabilitation (CCBRT) hospital in Dar es Salaam, United Republic of Tanzania. The motivation for the project was to provide sustainable wastewater treatment and biogas production for a maternity hospital located in a flood prone area with no connection to any sewer system.

The response

The wastewater from toilets, bathrooms and kitchens (domestic black and grey water) is treated in two DEWATS. DEWATS operate without any external energy and apply only locally available resources. The larger of the implemented DEWATS (capacity of up to 90 cubic metres per day) applies biogas digesters/settlers as the first treatment unit and produces approximately 12 cubic metres of biogas per day. The total wastewater treatment capacity of the two DEWATS is up to 100 cubic metres per day. The nutrient-rich treated wastewater is stored and further used for landscape irrigation on the hospital compound and is also available for firefighting. The excess treated wastewater is discharged to a pond on the compound, which created a valuable niche for biodiversity within the urban context.

The total construction cost was EUR 96 000. Selecting a DEWATS instead of the conventional septic tank system reduced the operational costs, which would have occurred due to frequent (e.g. monthly) desludging of the faecal sludge from the septic tanks. Additionally, this approach provided free water for irrigation.

The smaller DEWATS (capacity of up to 10 cubic metres per day) consists of a septic tank (ST), an anaerobic baffled reactor (ABR), an anaerobic filter (AF), a constructed wetland (CW) and an oxidation channel (OC). Figure 1 visualizes the DEWATS treatment process, and Figure 2 the treatment performance during rain and dry seasons.

Flow diagram with sampling points of the smaller decentralized wastewater treatment systems (DEWATS) at the comprehensive community-based rehabilitation hospital.

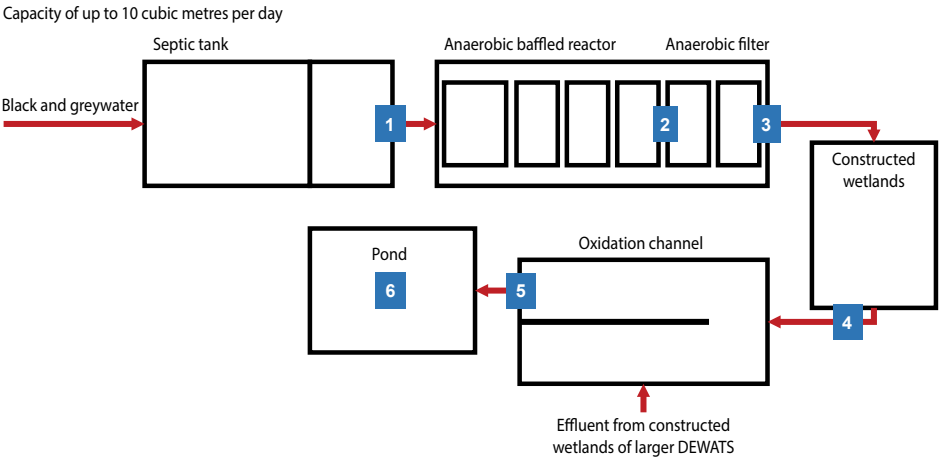

Figure 1: *Constructed wetland and oxidation channel (left) and flow diagram with sampling points (right) of the smaller DEWATS system at CCBRT Hospital. Source: Photo by Tim Fettback, 2022. Flow diagram based on BORDA e.V. 2017.*

Sampling point	pH		Temperature (°C)		Dissolved oxygen [mg/l]		Settable solids [ml/l]		Chemical oxygen demand [mg/l]	
	Rain	Dry	Rain	Dry	Rain	Dry	Rain	Dry	Rain	Dry
ST out	7.20	6.90	27.80	27.50	0.00	0.36	0.10	3.00	352	278
ABR out	7.01	6.93	28.20	27.50	0.04	0.40	0.00	0.20	278	215
AF out	5.32	6.99	28.70	27.20	0.02	0.33	0.00	0.40	124	105
CW out	7.23	7.22	27.20	26.00	0.03	1.40	0.10	0.10	106	93
OC out	7.40	7.27	27.70	28.60	0.22	0.46	0.00	0.00	96	84
Pond	-	7.90	-	26.30	-	7.25	-	0.00	-	38

Figure 2: *Treatment performance of smaller DEWATS at CCBRT Hospital. Source: BORDA e.v. 2017.*

Partnerships and support

The system was designed and supervised by BORDA, constructed by Estim Construction Co. Ltd. and funded and owned by CCBRT.

Results, accomplishments and outcomes of the biogas system

Initially, the biogas produced in DEWATS was intended to be used in the hospital's kitchen. During implementation, there were doubts about whether the biogas production (quantity) was stable enough to fully depend on, or if a backup system would be required, so the utilization of biogas in the kitchen was not approved. Furthermore, there were doubts if the quality (calorific value/methane content) was sufficient for alternative appliances, such as for the sterilization of hospital equipment. The challenge of using the produced biogas is common in other small-scale systems in the United Republic of Tanzania. During the monitoring and evaluation of DEWATS with biogas settlers in the United Republic of Tanzania, it was observed that only two out of seven had functioning biogas appliances (BORDA e.V. 2017).

Based on the experiences from the United Republic of Tanzania, we conclude that biogas from DEWATS cannot substitute other sources of energy for all applications, but there are several opportunities, such as heating water for bathing or laundry, or providing it to DEWATS operators for cooking. In the best case, these applications are not fundamentally required (i.e. it is a good added value, but in times where biogas is not available or the demand is too high, no significant problems occur or a backup system can be easily implemented and maintained). BORDA, in cooperation with partners, has also tested approaches for storing and transporting the produced biogas to consumers. Mainly, biogas bags and pressurizing and bottling of biogas were piloted. Biogas bags were not as efficient because the large volume is difficult to transport. For the bottling, locally fabricated appliances of low cost are required. A manually powered compressor was tested, which showed to take too much time and thus was not yet market ready.

Opportunities for replication and scaling

DEWATS systems have been implemented in many countries and at scale (e.g. community-based DEWATS in Indonesia). In Dar es Salaam, faecal sludge treatment plants and hospital-placenta-biogas systems, which receive an inflow with high organic concentrations, are operational. The production of biogas from wastewater and faecal sludge is significant, but its utilization has to be well planned and requires further development.

References

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