Factsheet

CUVE integrated water resources management waters

Sanitation and Water Reuse in Central-Northern Namibia

Challenge

Outapi is a municipality in central-northern Namibia. The city is facing challenges such as water scarcity and rapid population growth in informal settlements without access to sanitation facilities. Hence, appropriate technological options for wastewater treatment and reuse have been implemented and operated here since 2012 by the CuveWaters research project in cooperation with the Outapi Town Council (OTC). It pursues the conceptual development and practical implementation of an integrated water resources management (IWRM) in the Cuvelai-Etosha Basin in central-northern Namibia. The central goal of CuveWaters is to strengthen the potential of the region's resources by combining new and adapted technologies in a multi-resource mix for water supply and sanitation. In this context, water reuse can contribute to improve resource efficiency and mitigate pressure put on available water resources. In this way, the project is targeting social welfare, particularly with regard to hygiene, job creation, and better nutrition.

Approach

Sanitation facilities were built in three settlements of Outapi which formerly did not have access to sewage and only limited access to water. Vacuum sewers are used to collect and convey wastewater from the facilities to a treatment plant with a combined anaerobic and aerobic treatment, lamella clarifiers, a micro strainer and UV disinfection. After retention in a storage pond, the nutrient-rich wastewater serves to irrigate an agricultural area by drip irrigation in order to produce crops for human consumption. The project is jointly conducted with the Outapi Town Council as well as the German industry partner Bilfinger Water Technologies and is funded by the German Federal Ministry of Education and Research (BMBF).

Sanitation Concept

Sanitation facilities

- Communal washhouse (Onhimbu/Okayekongwe settlements): A communal washhouse offers toilets, showers, hand wash basins and sinks for laundry and dish washing. The washhouse is located between Onhimbu, a rather old part of Outapi with a lively market, and Okayekongwe, a new settlement with corrugated iron sheet houses erected since 2010.

Communal washhouse in Outapi

- Cluster units (Tobias Hainyeko settlement): 30 small washing houses with showers, toilets, hand wash basins, and laundry sinks are shared by three to four households each. In this area, most people live in corrugated iron sheet houses and some in brick houses.
- Individual houses (Shack Dwellers Federation): 55 houses are connected to the sanitation system. The settlement consists of brick houses that are already equipped with a bathroom.
- These three kinds of sanitation were developed through a participatory process (demand-responsive approach) with the inhabitants of the corresponding districts.

Vacuum sewer system

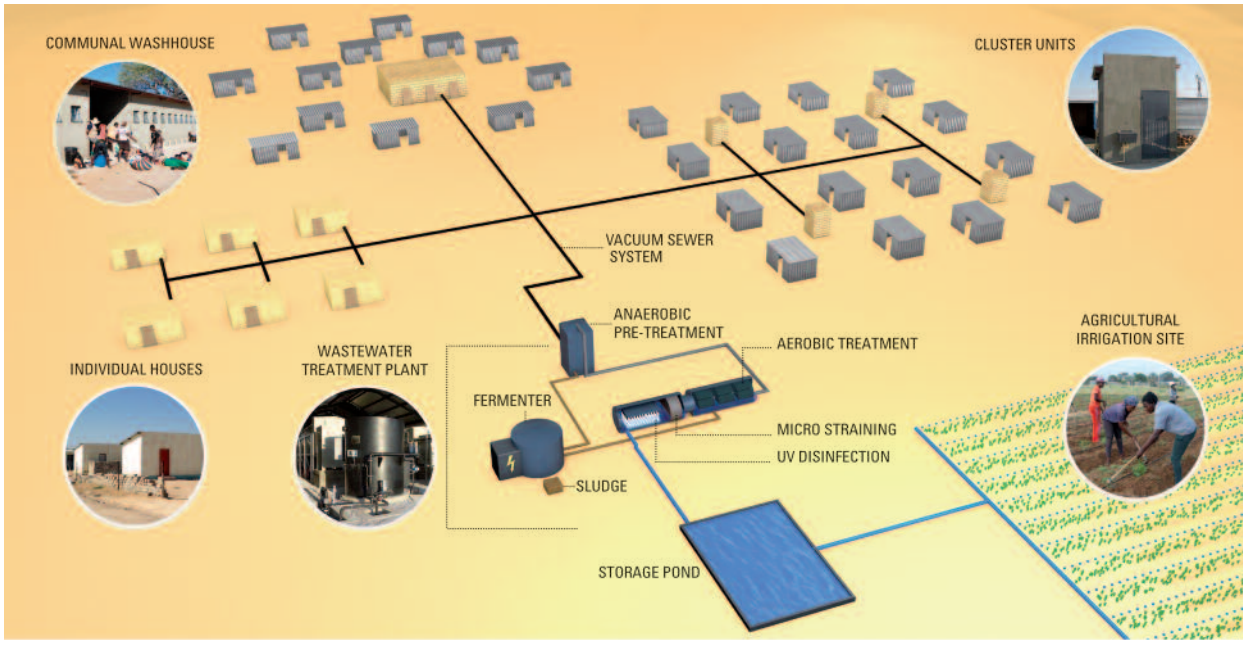
- Vacuum sewers connect the sanitation facilities to the treatment and recovery plant and convey the wastewater from the settlements to the plant. During the rainy season, waterborne diseases may occur in the Cuvelai-Etosha basin. To prevent a spread of pathogens contained in wastewater, the implementation of a watertight vacuum sewer system is essential.

Treatment and recovery plant

- Anaerobic pre-treatment: Wastewater is pre-treated in an upflow anaerobic sludge blanked reactor (UASB) in the absence of oxygen to form biogas.
- Aerobic treatment: The wastewater is purified with a rotating biological contactor (RBC). Microorganisms are attached to discs mounted on a rotating shaft. The rotation brings microorganisms in contact with wastewater and oxygen. Carbon compounds are oxidised, while the nutrients largely remain in the water. Before leaving the RBC the purified water passes a lamella separator for final clarification.
- Micro straining: A 15 µm micro strainer removes suspended solids and helminth eggs.
- UV disinfection: A mercury arc lamp emits UV radiation. It penetrates the cells of microorganisms and destroys their ability to reproduce themselves.
- Fermenter: Sludge from wastewater treatment and agricultural residues are digested anaerobically in order to produce biogas and stabilise the sludge. Biogas is used to produce electricity and waste heat for the fermenter heating. Stabilised sludge is dried in the sun and can be used as manure.

Agricultural irrigation site

- Net field size of drip irrigation area: 3 ha
- Crops produced comprise tomatoes, green peppers, maize, water melons, pumpkins etc.
- Wastewater is generated daily throughout the year in almost equal quantities. A pond with a capacity of 3700 m^3 is used for irrigation water storage.



Overview of the sanitation and water reuse concept (Layout: tvt.film+vfx, 2013 – modified)

Findings

- The sanitation facilities serve up to 300 users in individual households and up to 360 users in cluster units. Furthermore, the communal washhouse is used around 200 times per day.
- With full utilisation of the plant's capacity (90 m^3/day), the system can be operated almost without financial subsidies. (The current wastewater volume is approx. 30 m^3/day.)
- The irrigation site produces up to 40 tonnes of fruits and vegetables per hectare and year. Hence, a turnover of up to 300,000 NAD can be achieved per hectare and year.
- During the planning phase, several community workshops were held to determine the specific needs and opinions of the users and factor them into the concept. In doing so, acceptance and interest for the new infrastructure was raised among users.
- The opening of the sanitation facilities was accompanied by Community Health Clubs (CHC). People met regularly for one year and were able to learn about and discuss various topics such as proper use of the facilities, household hygiene and health. The knowledge gained led to improved hygiene and health behaviour and contributes to better living conditions.

	Untreated wastewater	Treated wastewater
Total chemical oxygen demand TCOD	742 mg/L	56 mg/L
Biochemical oxygen demand BOD_5	236 mg/L	6 mg/L
Total solids TS	781 mg/L	383 mg/L
Total nitrogen TN	57 mg/L	34 mg/L
Total phosphorus TP	10 mg/L	8 mg/L
E. coli	$31.7*10^7$ MPN/100 ml (median)	34 MPN/100 ml (median)

Mean concentrations in untreated and treated wastewater

Benefits and Risks

Benefits and achievments

- Adequate sanitary facilities and thereby improved health and hygiene – the rate of open defecation in the addressed area dropped from 58% to 12% (percent of respondents of population surveys from 2012 and 2015)
- Access to a communal washhouse for around 900 inhabitants of Okayekongwe and Onhimbu who had no access to improved sanitation facilities nearby
- 360 residents at Tobias Hainyeko Settlement benefit from shared facilities but within a small group of users, which raises comfort and safety
- 300 residents from 55 private households in the Shack Dwellers Federation benefit from the highest comfort and privacy standard of sanitation facilities
- Hygiene and health education among the inhabitants
- Relief for the overburdened stabilisation ponds for wastewater collection used so far
- Avoiding overflowing sewers during floods in the rainy season due to the waterproof vacuum sewer system
- Reclaimed nutrient-rich water available for irrigation and agricultural food production while minimising environmental impact
- Income generation by selling crops grown on the irrigation site
- Creation of 11 full-time and 15 part-time jobs

Risks and challenges

- Financial shortfall of the system vs. financial overburdening of users
- Management and maintenance with well-trained operators and farmers
- Fluctuation of personnel and lack of O&M capacities (e. g. regarding spare parts) threatens continuity and long-term technical sustainability
- Quality management and control of reuse water

Success Factors for Implementation

- Clear allocation of responsibilities (e.g. within the operator) and set-up of contracts (e.g. with farmers) as well as institutional structures
- Set-up and design of monitoring and controlling structures by the operator
- Participation of users in the planning process
- Creating an understanding and acceptance of the facilities as well as the payment structures among users
- Discussing and learning about hygiene prepares users about the benefits and costs of the new facilities
- The frequent and regular use of facilities is impacted by their maintanance and degree of cleanliness

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