Factsheet

CUVEwaters integrated water resources management

Groundwater Desalination in Central-Northern Namibia

Challenge

Central-Northern Namibia, like many arid and semi-arid regions, is characterised by its lack of perennial surface water bodies and its saline groundwater. The urban and peri-urban areas in the region are supplied by a big water supply scheme, fed by water from the Kunene River in Angola through an open channel. However, people in remote rural areas rely on either water transported by tank trucks or on shallow hand-dug wells. These wells fill up during the rainy season while the chemical and microbiological quality of the water in them rapidly deteriorates during the dry season and becomes saline and generally not suitable for human consumption.

Approach

Against this backdrop, innovative small-scale desalination plants were installed in 2010 as part of the CuveWaters project in the villages of Akutsima and Amarika, Omusati region, with the aim of supplying the local population with safe drinking water in a sustainable way. All plants run exclusively on solar energy and without any chemicals added. This minimises the adverse impact on the environment, while at the same time securing the self-sufficiency of the villages. Planning and implementation of the plants has been accompanied by community participation in the two villages to ensure that the offer of fresh water meets the needs of the local population and generates additional benefits, i.e. regarding health. Locals were trained in the everyday operation of the plants so that, on the one hand, their long-term operation is secured, and employment opportunities are created on the other.

Findings

Institutional framework

The MAWF took ownership of the plants and a clear structure of responsibilities was implemented: Local caretakers are in charge of the everyday operation of the plants, as well as minor maintenance work. They are nominated by the Water User Association (WUA) which is made up of the residents of the village. In case of any problems and needs for maintenance, the local caretakers inform the local offices of the DWSSC. The DWSSC decides whether to act independently or ask for external technical support

CuveWaters desalination plant in Akutsima, Namibia

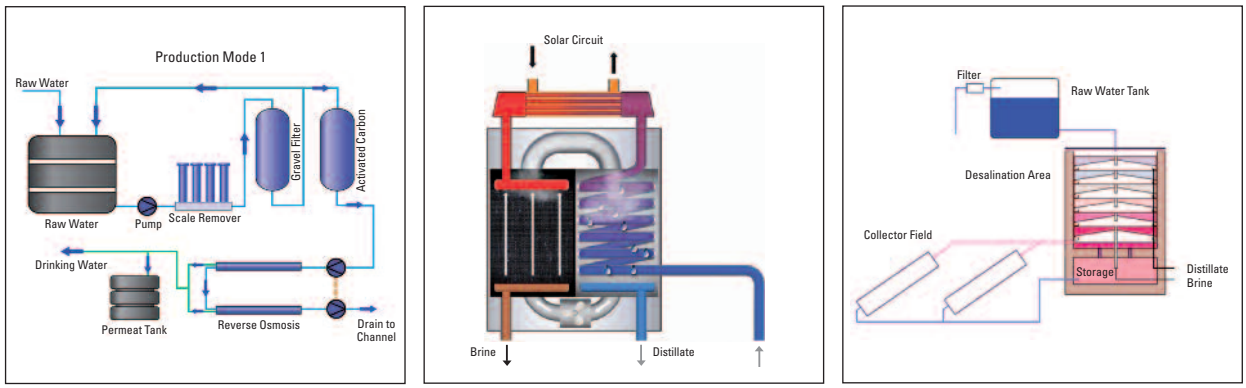
when specialised expertise is necessary. Both local caretakers and the staff of the DWSSC are trained by the industrial partners and by CuveWaters at each of the three plants. The responsibility of selling the water and managing the revenues lies with the Water Point Committee (WPC) which is nominated by the WUA.

Technical, ecological, socio-cultural and economic results

- The plants have been adapted to the local conditions and have proved to work reliably when properly maintained.
- The simple set-up and functioning principle allows local personnel to solve many of the problems which arise by themselves.
- The plants are environmental friendly because they are powered exclusively by solar energy and no pre-treatment with chemicals is required.
- Disposal of the concentrate to evaporation ponds is the most favourable solution both in environmental and financial terms; preconditions are the availability of land and the existence of an impermeable clay layer.
- Community participation is vital for creating ownership of the plant. Crucial aspects to be considered are site selection, setting up an institutional framework, transparent water tariffs, payment modes, opening times of the water point, and the general exchange of information.
- Monitoring results show the positive impact of the fresh water for the village inhabitants, i.e. improvements in health perception and lower vulnerability to low-quality water through practicing a multi-resource mix.
- There is a general need for better local knowledge about how to choose the right water quality for different purposes and how to manage the water sources.
- Costs are highly dependent on site conditions, i.e. prevailing salt content and the preferred freshwater quality.
- Existing infrastructure (electricity, tarred roads, foundations, security etc.) makes a remarkable difference for investment and maintenance costs.
- Dynamic generation costs are comparable to full-cost estimates for supplying the sites with alternative options, i.e. tanker water, extension of the pipeline supply, or rain water harvesting with filter and disinfection.
- O&M costs can be further reduced when more similar plants are clustered in a region or if maintenance work is taken over by in-house personnel.

Company	pro|aqua	terrawater	SIJ/IBEU
Technology	reverse osmosis (RO)	humidification-dehumidification (MEH)	multi-stage desalination (MSD)
Location	Amarika	Akutsima	Akutsima
Salinity of raw water	35,000 µS/cm	7,500 µS/cm	7,500 µS/cm
Salinity of product water	980 µS/cm	6 µS/cm	5-10 µS/cm
Daily freshwater production (max. reached in brackets)	3.3 m^3/d (4.7 m^3/d)	1.4 m^3/d (2.1 m^3/d)	0.25 m^3/d (0.6 m^3/d)
Daily raw water demand	14.1 m^3/d	16.7 m^3/d	0.5 m^3/d
Daily brine production	10.8 m^3/d	15.3 m^3/d	0.25 m^3/d
Specific electric energy demand Specific thermal energy demand	7.9 kWh/m^3 0 kWh/m^3	3.0 kWh/m^3 436 kWh/m^3	0 kWh/m^3 404 kWh/m^3

Table 1: Key technical data for the CuveWaters desalination plants



Technical Schemes: pro|aqua (left), terrawater (middle), SIJ/IBEU (right)

Water supply option	RO plant (pro|aqua)	MEH plant (terrawater)	MSD plant (SIJ/IBEU)	Tanker Water	Pipeline Extension	RWH & Disinfection
Investment	5.83 €/m³	7.92 €/m³	9.38 €/m³		9.26 €/m³	10.81 €/m³
O&M	7.75 €/m³	6.18 €/m³	2.56 €/m³		2.10 €/m³	3.43 €/m³
Total	**13.58 €/m³**	**14.10 €/m³**	**11.94 €/m³**	**14.59 €/m³**	**11.36 €/m³**	**14.24 €/m³**

Table 2: Dynamic Generation Costs [€/m³] for the three desalination plants (market case) and possible alternatives. Costs for desalination plants include the solar energy supply, data transmission (for pro|aqua and terrawater), spare parts, service and local personnel.

Benefits and Risks

Benefits and achievements

- Safe drinking water all year round for the local population
- Decreased health risk related to the consumption of salty or contaminated water
- Creation of jobs in the villages
- Enhancement of skills and capacities at the local, regional and national level
- Further developments of innovative small-scale desalination technologies which are chemical-free and solar-coupled
- New practical experiences with desalination technologies applied under challenging conditions

Risks and challenges

- Service chain needs clear responsibilities, with information and financial flows through all levels of the entities involved.
- Operation and maintenance structure critically depends on capacities and skills of persons in charge and can fail without a certain degree of redundancy.
- Seasonality and inter-annual variability of natural water availability can lead to time periods with low water demand, leading to low pressure on keeping the plants functional. This happens especially if the health benefit of the fresh water is not continuously communicated through public campaigns.
- The properties of desalinated water – like its taste – can differ from that of traditional sources, which can lead to aversion and decreased demand if no active and transparent communication with the beneficiaries/consumers is initiated.

Children at the groundwater desalination plant

Success Factors for Implementation

- Successful operation and maintenance needs a multi-level responsibility structure which is embedded into the existing structures, processes and routines.
- A strong sense of ownership of the plants needs to be developed at the operating institution (here: the DWSSC) in order to avoid a feeling that the plants are too high-tech, too sensitive or too "alien".
- Maintenance needs have to be addressed in a timely manner (both identification of faults and reaction – due to the remoteness of the plants and the fact that spare parts are often not stocked by local providers.
- Technical implementation needs to be accompanied by awareness-raising within the communities on the benefits of the desalinated water, in order to support demand.
- Utilisation of the revenues from the sale of water needs to be transparent through a viable scheme which is communicated to the community. In addition, non-revenue water should be kept at a low level.

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