Factsheet on groundwater desalination pilot plants

CUVE integrated water resources management waters

Background

Arid or semi-arid regions are often characterised by a lack of perennial surface water bodies and by saline groundwater. This is particularly true of central northern Namibia near the Etosha salt pan. Supplying peripheral rural areas with clean and healthy drinking water is a very challenging task. Thus, the CuveWaters project has installed innovative desalination pilot plants (prototypes) in the two villages of Amarika and Akutsima in the Omusati region (see map). In both villages, two technologically independent small-scale solar-driven groundwater desalination plants were implemented in July 2010. During the project the plants were adapted to Namibian conditions and enhanced in order to achieve better performance.

Desalination plants in Amarika (top) and Akutsima (bottom)

The usage of solar power for operating the plants is motivated by four reasons:

1. the availability of high solar radiation in these climate zones,
2. high energy demand of the desalination process,
3. restricted availability of other energy sources in remote areas, and
4. considerable environmental impacts of conventional energy sources.

The research project is sponsored by the German Federal Ministry of Education and Research (BMBF) and the Namibian Ministry of Agriculture, Water and Forestry (MAWF). In addition to the desalination subproject, the CuveWaters project includes sanitation with water re-use for irrigation purposes in Outapi, rainwater harvesting for micro-scale gardening purposes in Epyeshona (Green Village) and subsurface water storage of Oshana water for micro-scale gardening purposes in Iipopo.

Operational Concept

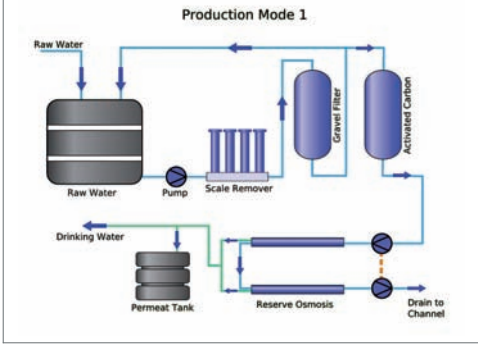
Elected people from the villages take care of the plants ("local caretaker") and are responsible for their protection ("guards"). A professional service provider (Aqua Services & Engineering) conducts major maintenance, repairs and monitoring on a monthly basis. Via data transmission (satellite or network), the German industry partners can monitor the plants' operation.

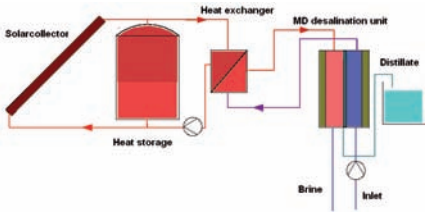
Benefits

Clean water for human consumption and thus prevention of usage of unsafe drinking water sources (like hand dug wells which are contaminated by algae, faeces and parasites) is an essential contribution for better living conditions of the people in these two villages.

Technical facts pilot plants (prototype) after 1.5 years of operation

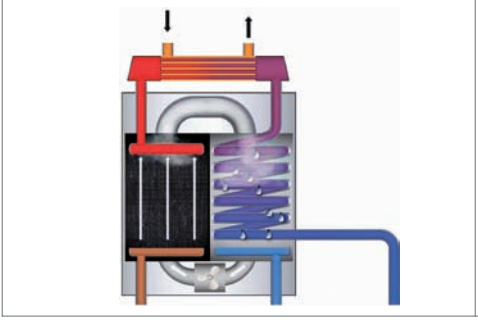
Description	Amarika		Remarks
Location	Namibia S 18°21.516' E15°11.642'		Nearest town: Okahao (70 km from Oshakati, northern Namibia)
No. of households 2010	50		About 10 people per household
Precipitation	470 mm/a		
Evaporation	2,700 mm/a		
Solar radiation	6 kWh/m²d		
Installed electric power	19.8 kWp		
PV collector area	142 m²		
Battery capacity	1500 Ah, 48 V		
Borehole depth and location	50 m, at the plant		
Salinity/conductivity of raw water	35,000 µS/cm (23,000 mgTDS/l)		Both plants are suitable for higher salt contents.
Brine disposal	3 re-injection boreholes (depths: 150 m, 126 m and 90 m) and evaporation pond (3,364 m²)		
Company	proaqua GmbH	Fraunhofer ISE	
Prototype of plant	Chemical free reverse osmosis (RO)	Membrane distillation (MD)	2 technologically independent plants
Production of freshwater	Average: 3.3 m³/d Max reached: 4.7 m³/d	Average: 0.8 m³/d Max reached: 1.7 m³/d	
Salinity/conductivity of freshwater (average)	980 µS/cm	480 µS/cm	Salinity of freshwater of the proaqua plant depends on membrane type.
Raw water demand (average)	14.1 m³/d	6.7 m³/d	
Brine production	10.8 m³/d	5.9 m³/d	
Start of operation	July 2010	July 2010	

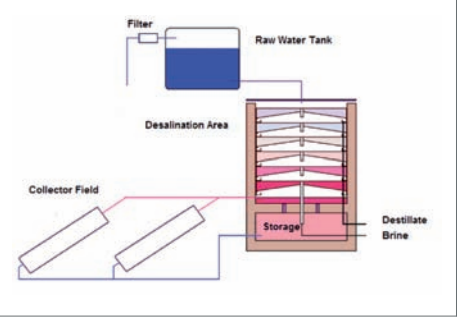




Technical facts pilot plants (prototype) after 1.5 years of operation

Description	Amarika		Remarks
Location	Namibia S 18°07.277' E14°48.049'		Nearest town: Okahao (70 km from Oshakati, northern Namibia)
No. of households 2010	50		About 10 people per household
Precipitation	470 mm/a		
Evaporation	2,700 mm/a		
Solar radiation	6 kWh/m²d		
Installed electric power	14.8 kWp		Including power supply for locals
PV collector area	102 m²		
Battery capacity	1200 Ah, 48 V		
Borehole depth and location	50 m, 5 km away from plant (at cattle post)		No groundwater found at the plant's site
Salinity/conductivity of raw water	7,500 µS/cm (5,000 mgTDS/l)		High salinity waters up to the salt saturation are suitable for both plants.
Brine disposal	evaporation pond (2,704 m²)		Due to the impermeable clay layer, only an evaporation pond is suitable.
Company	Terrawater GmbH	Solar-Institute Jülich/IBEU	
Prototype of plant	I.S.E.T.T. evaporation (chemical free)	Multi Stage Desalination (chemical free, runs without electrical power	2 technologically independent plants
Production of freshwater	Average: 1.4 m³/d Max reached: 2.1 m³/d	Average: 0.5 m³/d Max reached: 0.6 m³/d	
Salinity/conductivity of freshwater (average)	6 µS/cm (distillate)	5–10 µS/cm (distillate)	
Raw water demand (average)	16.7 m³/d	1.2 m³/d	The raw water is also used for livestock watering. Therefore 10 m³/d are additionally provided at the cattle post.
Brine production	15.3 m³/d	0.6 m³/d	Adjustable to near zero
Start of operation	July 2010	July 2010	





Intended Beneficiaries

- People in remote areas
- Lodges
- Farms
- Industry that needs pure or very pure water

Costs

Costs for desalination are highly dependent on site conditions, especially on the prevailing salt content and the preferred freshwater quality. The existing infrastructure (electricity, tarred roads, foundations, security, etc.) makes a remarkable difference in terms of investment costs and maintenance costs. The source of energy is also very important with regard to running costs (when conventional energy sources are used) or investment costs (when regenerative energy sources like solar power are used). Therefore, taking only the investment costs of the desalination plant into account, plants similar to these pilot plants can be provided for 4–10 EUR/m³.

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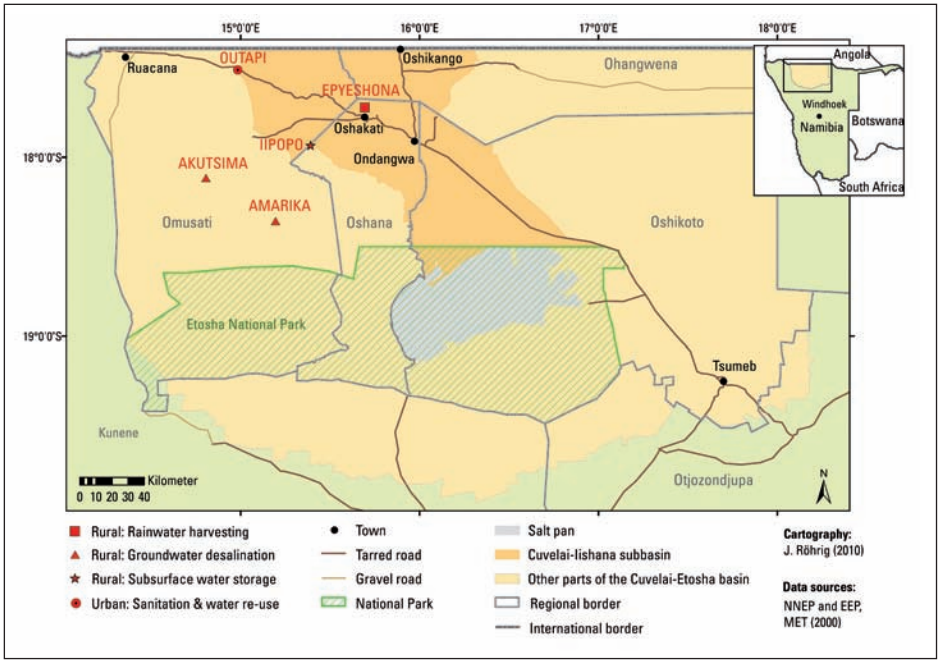

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