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WASH Field Note FN/17/2018

Combining Manual Drilling and Solar Energy to Ensure Drought Resilience in Mauritania

SUMMARY

- Around 80% of Mauritania's communities have populations of less than 500, many of them located in remote, desert, off-grid areas.
- In order to reach remote populations, UNICEF and the Government of Mauritania are combining manual drilling techniques with solar powered water systems.
- These combined systems are helping to ensure drought-resilience in the poorest regions, thereby supporting livelihoods and reducing poverty.
- System management models are determined based on the size of the community; larger communities are managed by "delagateurs" (private sector), whereas the smaller ones are managed by the Government. The delegateur system has been found to be more effective.

Introduction

Mauritania is located in the Sahelian region of West Africa. Around two thirds of the country is classed as desert; these regions receive less than 150mm of rainfall per year while the rest of the country around 600mm.

Around 38% of the population do not have access to safe drinking water. The situation is worse in rural areas where around 49% of the population are living without access, with many women and children being forced to walk several kilometres a day to collect water.

Groundwater remains the country's main source of drinking water and faces significant pressure from human, livestock and agricultural needs. Aquifers are often located deep below the earth's surface, limiting the use of handpumps.

According to Mauritania's Directorate of Hydraulics, around 60% of the country's drinking water systems are currently powered by solar energy, up from 20% in 2015. This dramatic shift has largely been due to the

Government's strong support for solar powered water systems over the past few years.

The systems are specifically mentioned as a priority in the 2016-2030 National Strategy for Water Supply, with the Government meeting and exceeding its 2017 target of achieving 40% solarization of water systems.

Additionally, the country is committed to implementing climate change adaptation measures, as stipulated in their 2004 National Adaptation Program (NAP). This was recently reinforced by the Government's commitments resulting from the signing of the Paris Agreement in 2016.

Solar powered water systems are a major priority for the Government of Mauritania and are seen vital in improving access to safe water in isolated rural communities. By 2030, the Government plans to ensure that the the remaining 2664 unserved communities gain access to small water supply networks equipped with solar energy.

UNICEF is supporting national advocacy efforts to increase the use of solar energy for water pumping in the most isolated communities, and to strengthen the professionalization of solar water sector.

Description of Intervention

Around 80% of Mauritania's villages have populations of less than 500, many of them located in remote, off-grid desert areas. Many regions are inaccessible for traditional drilling rigs, due to the difficult terrain.

Due to the high costs and difficulties associated with reaching remote communities, villages of less than 150 inhabitants are not currently being prioritized by the Government.

KEY POINTS

- *Manually drilled, solar powered water systems are bringing safe water to Mauritania's poorest and most drought-prone communities.*
- *Manual drilling cost 4 times cheaper than motorized drilling. These cost savings are translating into UNICEF being able to reach more communities.*
- *The manual drilling toolkit, is manufactured locally, and costs just 10% of the price of an imported kit.*
- *Solar powered water systems are also being used to reduce costs. The systems cost 30% less than a diesel-generator based water system.*
- *Solar powered water systems also provide a useful water storage buffer for drought-prone communities.*

To address this issue, in 2015 UNICEF began advocating for these smaller communities, working with the Ministry of Water Resources (MoWR) to introduce solar powered water systems, paired with more cost-effective, manually drilled boreholes in these drought-prone regions.

The final list of project locations was determined by cross-referencing Ministry of Water and Sanitation (MoWS) water access data with malnutrition indicators, both indicative of drought-prone areas.

Fig.1: Local manual drilling toolkit costing

Kit components	Investment	Life cycle
Manual rotary equipment	2,500	20 years
Accessory tools	700	10 years
Small motor pump	550	10 years
Borehole development equipment	2,000	50 years
Total cost (USD)	**5,750**	

Source: UNICEF Mauritania/Practica, 2016

i) Manual Drilling

Five small local construction firms were formed in 2016 to carry out manual drilling in sedimentary areas along the Senegal River. The drilling utilized locally produced manual drilling kits (Fig.1) which are 90% cheaper than European manual drilling toolkits (60,000 USD).

Manual drilling techniques have now been scaled up in the region, reducing drilling costs and allowing UNICEF to reach more communities.

Drillers use locally produced manually drilling equipment in order to drill a borehole. © Practica\Mauritania\2016

ii) Solar Powered Water Systems

Solar powered water systems make the most of Mauritania's high sun irradiation levels (2099 - 2284 kWh / m^2, and average of 8h of sunshine per day). In addition, the systems provide an important water storage buffer for drought-prone communities, enough to cover cloudy days or system malfunction.

a) System design

Two types of system are currently being used:

Solar water points in smaller villages (standpipe)

Solar water points are being prioritized for the smallest, most isolated compact villages. The choice of specific technical option is also based on a maximum distance of 500m, between the water point and the furthest household.

Manually drilled boreholes are equipped with a simple solar powered water system – usually, for a smaller community of less than 250 inhibitants, the systems are equipped with about 500W of solar pannels, 7 to 10m^3 water tanks, and a water standpipe with 2 or 3 taps. A chlorination system is then installed in the technical cabin of the storage tank.

Solar water networks in larger communities (tapstands)

Larger, less compact communities are usually provided with solar water networks. Manually drilled boreholes are equipped with solar pumping systems (averaging around 9000W of installed power). The water tank storage volume is based on the size of the population, but is usually around 20-40m^3 in volume. Water is then piped to tap stands scattered across the community.

Example of a smaller-sized solar powered water system. ©UNICEF\Mahandriray\2018

Fig.1 Example of a medium-sized UNICEF-supported solar powered water system. © UNICEF\Mahandriray\2017

Establishing a solar water system training guide

In 2017, UNICEF, in collaboration with PRACTICA, developed a technical guide for solar pumping in Mauritania (UNICEF/Practica 2017). The guide was produced to address the technical gaps observed within the sector. The guide is specifically aimed at private operators, businesses and technical and financial partners supporting government-led solar projects.

It specifically provides guidance on siting, installation, operation and management of systems.

c) Management arrangements.

All users are expected to pay fees to access water to ensure the long-term economic sustainability of the systems.

Two main systems exist for the management of solar powered water systems in Mauritania, based on the size and the economic profile of the community: the privately run "delegateur" system (DSP), and, the publically managed systems (ONSER or SNDE).

Privately run "delegataire" system (DSP)

Around 10% of water systems in Mauritania are privately run by "delegateurs" (private utility companies). Management by a DSP is usually mandatory for communities with more than 500 people.

The DSP model is based on a 5-year lease agreement between the Ministry of Hydraulics and Sanitation or the municipality and a private legal entity.

A DSP contract includes the provision of solar water supply services in localities up to 3,000 inhabitants.

The "delegataire" corporation has a commercial department which is responsible for billing and collecting payments from households.

Out of all the systems used, the privately-run system has been found to be much more efficient in terms of user fee collection, operation and maintenance. This is because delagataires have an obligation to repair systems within 72 hours (as stipulated in their contract with the Government) or else they do not receive payment. Supervision with the DSP is also usually much stronger than within the publically managed system.

Publically managed systems (ONSER or SNDE)

The rest of the country's solar powered water systems are publically managed, either by Societe National De l'Eau (SNDE), who manages the water supply system in every district capital of the country, or the Office National des Services d'Eau Rurale (ONSER). ONSER usually then contracts out to private companies or local communities, as is the requirement for rural areas.

Rural solar water systems, implemented by UNICEF have now been handed over to ONSER via MoWS. They are not eligibale to be run by DSP due to their small size (less than 500 people).

The major benefit of the ONSER system is however, the assistance which is provided to the poorest, most vulnerable households. The households are provided with free or reduced cost water access. However, significant challenges exist. For example, publically-managed system repairs often take much longer than is the case under the DSP model. In addition, it is often a challenge for community-based water operators to effectively collect user fees.

The public system also requires smaller communities to pay directly for minor repairs (unlike the private system, in which this is solely the utility's responsibility). For major breakdowns, however, ONSER will step in to support the community as required. ONSER is also responsible for supervising the technical and financial management of rural water systems managed by their contractors.

The principle of roles separation between the owner and operator is effective for both the ONSER Management and the DSP systems, improving the overall effectiveness of water service delivery.

Outcomes

Between 2015 and 2017, 23,000 people have gained access to safe water, closer to their homes, as a result of UNICEF support.

A total of 19 mini solar drinking water networks and 40 solar powered water stations have been constructed, using manual drilling methods to reduce costs.

The table below provides a price comparision of water costs between a diesel-generator based system and solar.

Price comparison between solar and diesel-generator based systems

	Mauritanian ouguiya	US Dollars
M^3 of basic* consumption in Nouakchott water network (SNDE)	10	0.36
M^3 in rural with diesel generator system	22	0.62
M^3 in rural solar powered water system	15	0.42
*First 20 m3 of water consumed		

Lessons Learned

Overall, solar powered water systems have been found to be highly durable and effective in providing safe water to isolated, rural communities.

According to the contractors interviewed during the UNICEF Solar Powered Water System Assessment (2017), only an estimated 1 in 50 solar pumps fail and this was most often found to be due to issues with borehole siting. In comparison, diesel-generator pumps were found to break down 2-3 times a year on average.

However, in terms of financial sustainability, some solar powered water systems were found to be more viable than others, based on the effectiveness of user fee collection. As such, MoWS plans to review the management of the smaller isolated facilities and will likely switch to the more efficient, private "delegateur" management model.

In rural areas, the demand for water is often higher than in urban areas (30-100l/person/day) due to the water demands of livestock. It is important that the dimensioning of the systems fully accounts for the specific needs of agriculture and livestock (Multiple Use Systems), which is vital in ensuring climate resilience and poverty alleviation in the face of drought. Each system must be dimensioned strictly according to the environment and needs of the population.

Next Steps

- ✓ In 2019, UNICEF plans to scale-up their solar powered water systems programme to an additional 42 communities.
- ✓ The Ministry of Water and Sanitation has recently begun implementing a Water Resources Information System for the country. This system will help UNICEF and the Government identify coverage gaps and plan the siting of future solar powered water systems.
- ✓ An Action Plan for the Joint Monitoring and Evaluation of Water Resources has been developed, which aims to improve water use efficiency and conservation in response to the impact of climate change and water scarcity. This will be put into practice in the coming months.
- ✓ UNICEF plans to support an Impact Assessment for the new, locally-produced manual drilling tools. UNICEF will also continue working on strengthening local markets in collaboration with the Government and private sector.
- ✓ UNICEF and the Government aim to scale-up capacity building initiatives across the country, including the distribution of guidance materials and training for partners and private water operators.

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Authors

Dorica Mahandriray, WASH Specialist, UNICEF Mauritania; Emily Bamford, Water and Climate Change Specialist, UNICEF New York.

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United Nations Children's Fund
3 United Nations Plaza, New York, NY 10017, USA

For more information, please contact: WASH@unicef.org

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