USAID/E3 Water Communications and Knowledge Management (CKM) Project

GLOBAL WATERS RADIO

Natasha Wright on Solar-Powered Desalination in India

Interview Transcript

Global Waters Radio: You are tuned in to Global Waters Radio, a podcast series produced by the Water Team at the U.S. Agency for International Development. The series offers listeners insights from USAID officials, development partners, thought leaders, and experts from across the water sector, as they discuss current USAID water programming and cutting-edge research from around the world.

This week on the podcast, Natasha Wright. Natasha is a researcher with MIT's Global Engineering and Research Lab. In 2015, her team—a collaborative effort between MIT and Jain Irrigation Systems—won first place in the Desal Prize competition, an initiative of the Securing Water for Food Grand Challenge for Development which is funded by USAID alongside Sweden (through the Swedish International Development Cooperation Agency), the Ministry of Foreign Affairs of the Kingdom of the Netherlands, and the South African Department of Science and Technology. Today, Natasha is sharing insights about her team's prize-winning electrodialysis reversal technology, or EDR. It uses solar power to produce desalinated water for small-scale farmers and communities disconnected from irrigation and water supply networks. She's also going to share some experiences from her team's first EDR pilot project in India earlier this year.

So Natasha, to kick things off, give us a bit of background about your team's involvement with the Desal Prize competition.

Natasha Wright: So the Desal Prize competition was sponsored by USAID and took place in April 2015 in Alamogordo, New Mexico. The finalist teams had two 24-hour test periods to demonstrate their technology. At the end of each period, water samples were analyzed, and the quantity and the quality of both the product water and wastewater was measured. The teams were judged on high water recovery, on meeting quality indicators, on an economic analysis, and on sustainable maintenance and service gains. Our MIT-Jain team won first place at that competition, and the $140,000 prize. The Desal Prize encouraged teams to produce 8,000 liters of agricultural-quality water, and 250 liters of drinking water. That means that we are producing, you know, between eight and nine cubic meters of water every day. Now, that amount of water is about what you would need for a 3,000-person village if it was only being used for potable water, or what you would need for one small-scale farmer in the Indian context.

GWR: Right, and how big is it?

NW: The system itself fits in a very small building. So the one that is currently in Jain Irrigation, the entire system fits on a footprint of about two and a half meters by one meter.

GWR: Okay, great. So give us a sense of how EDR works, and if there's a growing number of desal technologies on the market, what's sets EDR apart?

NW: Our system uses a technology called electrodialysis reversal. The technology itself has actually been around since the 1950s. Essentially what happens is that salty groundwater contains dissolved salts. So you can think of sodium and chloride, like you find in your everyday table salt. When sodium chloride dissolves in water, it separates into two ions—sodium and chloride. These ions carry a charge, and because of this, it can carry a current. If I were to apply a voltage across a stream of filthy water, the ions would be attracted to the two electrodes, effectively pulling the salt out of the water. Electrodialysis is this process of pulling ions out of a solution through the application of an electric potential or a voltage. But in addition, there are a series of alternating anion and cathion exchange membranes. The membranes act to separate the streams into desalinated water and salty brine water. The system is powered entirely by photovoltaic panels, otherwise known as solar panels. Because EDR only pulls charged particles out of the water, we also use ultraviolet disinfection, or UV, to disinfect the water for biological contaminants prior to collection in the product water tanks.

As far as how the technology sets itself apart from existing technologies, with electrodialysis you can achieve a recovery ratio of more than 90 percent. That means that if I put one gallon of water in, less than ten percent of that gallon is wasted. This is much, much less waste than the small-scale systems that are currently installed in India. The existing systems use a technology called reverse osmosis, and in the way that they are currently applied, they waste closer to 50 to 70 percent of input water. So essentially, we are saving a lot more water, which means that in a water-scarce region, we're saving more of that limited water supply. In addition, electrodialysis uses about 50 percent less energy than reverse osmosis at the salinity level that we're treating. This means fewer solar panels and less capital costs associated with the power system in an off-grid system.

GWR: So what groups do you think are in the best positioned to benefit from solar-powered desalination?

NW: So the PV-EDR technology that we are working on is specifically designed for villages or for communities that currently use brackish ground water as their potable water supply. That means that it's most suitable to people who already have this access to groundwater—and to salty groundwater, specifically—versus surface water sources. In addition, since we are working on a solar-powered system, we are looking for communities that are located in areas with high solar radiance, so this is a big benefit in India, as well as areas of Africa and the Middle East, and other regions in the world. Along with that, we are looking for communities that have either intermittent or no access to grid power, and that's part of why we're pushing for the off-grid system.

The pilot plant that we built in January 2016 was built Jalgaon, India, and was installed really to validate how the technology behaved from a technical perspective, as well as to start gaining feedback on the operation of the systems from local communities. We also held a number of events in which community members would come in to see the plants. We would explain how the technology works, show them the control panel and the valving system, what type of maintenance and operation needed to be done, and interact to find out which aspects of these were feasible. After some of these members had come in to see the plant, we also then returned with them to their communities to speak with a larger group within their community, and we brought additional photos and video descriptions of the pilot plants so that we could continue the conversation and really help to communicate with them in their own context.

GWR: Right, and are there any particular aspects of your team's experience piloting this project that you think might be valuable for our listeners?

NW: Some of the things that worked really well with this pilot was that the energy consumption was right on target with what we thought it was going to be. We were able to validate kind of the analytical modeling that MIT had done. Additionally, it was great to see how quickly the pilot came together once all of the components were in India. Working with a large company like Jain, we really were able to pull together the system pretty quickly when they have all of their specialists that already work in water and were able to put everything together for us.

Another big takeaway from the learning we had with the pilot and with the interaction with the community, was really trying to understand the level of automation that the community members wanted, and the amount that was feasible. So for this first pilot in Jalgaon, we actually built the system to be 100 percent automated. So the idea was that you could walk into the room, the operator could come in and push "go," and the system would run for however long you had told it to—maybe it's a day, maybe it's a week. Maybe it's a month. And that you would really be able to do that whole process fully automated, and then would only have to change a few cartridge filters when their time was up.

And what we learned from our initial user interaction is that the community members really preferred a fully manual system. And the reason for that is that they were already expecting to have an operator at the plant pretty much all day. So there had to be someone there to sell the water, if it was a potable water plant. You know you would already have farmers in the field, or workers in the field. And so there was already someone there all day. So it really wasn't a problem to have to turn valves every once in a while, or to have to monitor certain conductivity or salinity of the water.

They preferred both the fact that a fully manual system was less expensive, and also the fact that a fully manual system was less likely to break. It was more robust. So you can use big ball valves that you know last forever versus these electronic solenoid valves that are likely to, you know, a wire might come loose, or the connection won't be made. And if that happens, then you have to bring out a technician to fix it. And so that was one of the big takeaways really, is that we were expecting a fully automated system to be more user-friendly, but they actually thought a fully manual system was more user-friendly. And that was one of the approaches that we're taking in our next pilot, is to build a fully manual system and really understand how well, and if, and when they are able to operate it in a fully manual mode.

GWR: Great. And real quick, how much of India might stand to benefit from desalinating brackish water?

NW: The prospects for this technology in India are huge. There is approximately 60 percent of the land area in India that has brackish groundwater underneath it.

GWR: Well Natasha, thank you so much. For more information about the MIT and Jain team's Desal Prize-winning EDR technology and their pilot project in India, have a look at the links below. And as always, if you have a topic you would like to see us cover in a future edition of the podcast, drop us a line at waterteam@usaid.gov.

This is Global Waters Radio.