Seawater Desalination

A Solution to Gaza's Lack of Safe Drinking Water

The seawater desalination plant as seen from the sky in April 2016. Photo courtesy of UNICEF.


By June Kunugi
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European Union, UNICEF, PWA, and CMWU are close to finalizing construction of a € 10 million seawater desalination plant.

In Gaza, there is a perfect storm, and it is underground. The shallow coastal aquifer, historically the main source of water for the population, is being over-extracted for domestic and agricultural use. The deficit created causes seawater to flow in, as well as surface water contaminated with fertilizers and untreated sewage. In some areas, levels of chlorides and nitrates are as high as six times the World Health Organization (WHO) limit. It exposes people to the risk of water-borne diseases and health disorders, which for the most vulnerable, including children, can be life-threatening.

More than 95 percent of the groundwater extracted from the aquifer is unfit for human consumption.[i] Meanwhile, the needs for fresh water keep increasing. As Gaza's population continues to grow at a steep annual rate of about three percent, a 2012 United Nations report[ii] predicted that water demand would increase by 60 percent over eight years, to reach 260 million cubic meters in 2020. It also warned that the aquifer could become unusable by the end of 2016, and that the damages may become irreversible as early as 2020.

Well aware that tap water makes them sick, 9 out of 10 people depend on desalinated water in Gaza, 81 percent of which comes from the private sector.[iii] This is not only a heavy burden on already impoverished families, but it also represents a health hazard: studies show that 72 percent of the population in Gaza depends on water that is contaminated in 68 percent of the cases,[iv] despite recent efforts led by the Palestinian Water Authority (PWA) to monitor its quality.

Drinking water comes from the desalination of brackish groundwater drawn from the aquifer, which has more salinity than potable water. The coastal enclave hosts about 155 ground (brackish) water plants – 130 private and 25 public, including 13 supplied by UNICEF (which source water from pre-existing wells). Public desalination plants provide clean water in the most vulnerable neighborhoods and where there is high groundwater pollution.

As a result, water consumption needs to be controlled effectively. A reduction can be achieved by better conservation – improving irrigation and agricultural practices as well as storage of domestic water supplies. The rehabilitation of infrastructure will increase the overall water distribution efficiency, which is on average as low as 63 percent,[vi] saving on water losses through leaks in Gaza's municipal water distribution system, and avoid raw sewage flooding in residential areas.

In addition, organizations such as UNICEF have advocated and invested in alternative water sources, using the resources at hand. Gaza's water should also come from the sea, as Gaza is blessed with an expansive Mediterranean coastline. This technique has already been used with success in several water-stressed Western and Gulf countries.

Seawater can be desalinated to produce fresh water suitable for human consumption, while avoiding overuse and the total depletion of the Coastal Aquifer. Today's advancements in reverse-osmosis technology have significantly reduced the price of desalinated water while making it cleaner and more energy-efficient, and enabling people to access safe drinking water at an affordable price.

Thanks to a generous € 10 million grant from the European Union, UNICEF embarked upon building a major seawater desalination plant in 2014, with a daily production capacity of 6,000 m3. The project, which is nearing completion, will provide at least 75,000 Palestinians living in the southern Gaza Strip with 90 liters of affordable potable water per person daily.

Despite the 51-day hostilities in 2014, major gains have been made over the past two years. A 2000 m3 storage tank for desalinated water, several administrative and operational buildings, a 1.5 km power transmission line and electrical systems, an 18 km water distribution line, and seawater desalination systems based on the reverse-osmosis process have been constructed.

On June 14, 2016, EU Commissioner Johannes Hahn, responsible for European Neighborhood Policy and Enlargement Negotiations, visited the EU-funded seawater desalination plant in southern Gaza, marking the beginning of extensive tests the plant will undergo this summer to check that the pumps, filters, and reverse-osmosis membranes function properly and at the required capacity. The desalinated water will be tested to ensure that it meets the required international quality standards before it starts being supplied to families.

> The near-completion of the plant – the largest seawater desalination project in Gaza – is a symbol of hope and positive change, increasing access to safe water, which is essential for life and well-being, and helping meet the urgent needs of the most vulnerable children and families in a sustainable manner.

Upon the successful completion of the testing phase, the plant will start operating to provide a reliable supply of safe drinkable water to 35,000 people in Khan Younis and 40,000 people in Rafah, in the southern Gaza Strip. This ambitious project, led by UNICEF and implemented in partnership with PWA and the Coastal Municipalities Water Utility (CMWU), will enable the residents to exercise their fundamental human right to safe drinking water.

During a visit of the plant on 14 June 2016, EU Commissioner Johannes Hahn announced an additional funding of € 10 Million for the second phase of the desalination plant. Photo courtesy of UNICEF SoP / El Bala.

During his recent visit to the plant, EU Commissioner Hahn announced an additional funding of € 10 million for the second phase of the desalination plant. Building is slated to begin in 2017 and a third phase one year later. Once the three phases are completed, the plant will produce of a total of 20,000 m3 of safe, drinkable water daily. When fully operational, the full extension of the project would provide drinking water and water for domestic use to at least 250,000 beneficiaries – including around 125,000 children living in the most vulnerable communities of the Gaza Strip.

The plant is also the first step in a major national effort to desalinate Mediterranean seawater. Seawater desalination is a strategic option chosen by PWA to help provide 1.8 million Palestinians in Gaza – including nearly one million children – with safe drinking water and to curb over-extraction of groundwater from the coastal aquifer, in order to prevent an environmental disaster.

Large-scale seawater desalination can be a long-term solution for the Gaza Strip, provided there is enough electricity and fuel available to power the plants. Currently affected by one of the most serious energy and electricity crises since the beginning of the 2007 blockade, Palestinian families in Gaza experience on a daily basis rolling blackouts lasting from 12 to 16 hours. Here again, the innovative use of technology can help alleviate and mitigate the slowing down of production. Renewable sources of energy, such as solar energy producing electricity through photovoltaic panels, are being provided. In the current phase, about 12 percent of the plant's peak energy requirement will be met by solar energy, and plans are drawn to harness the renewable energy potential to further increase this percentage.

To be sustainable, the plant will also need funds to support its operations and maintenance, something that can be achieved if all consumers pay their water bills. For families, paying their bill in exchange for the desalinated water will be considerably cheaper than buying water from private vendors. It will also provide them with higher-quality water, which will protect their own and their children's health, and will neither corrode nor damage their water pipes and equipment inside their homes.

No child should have to go without safe drinking water. Turning on a tap to drink water should not be considered a luxury. Children and their families throughout the Gaza Strip should have access to safe drinking water. By working together, partnerships and commitment can provide life-giving water to the most vulnerable families, their children, and the children of their children, in a sustainable manner.

How does the seawater desalination plant work?

The seawater desalination plant that UNICEF, CMWU, and PWA are building thanks to support from the European Union is based on a water treatment process called "reverse osmosis." This water purification technology uses a semipermeable membrane to remove various types of dissolved and suspended solids – ions, molecules, and larger particles – from the water.

First, seawater is pumped from four wells located on the beach close to the shoreline, to provide natural filtration and avoid any pollution that might exist in the seawater at its surface, which means that the need for expensive pre-treatment processes is reduced.

Second, seawater goes through several filtration and separation processes that remove any remaining suspended solids and most of the dissolved solids (the salts and minerals) in the water. The liquid is first pumped into a sand or multimedia filter to remove the large particles of the suspended solids. It then passes through a micro cartridge

Installation of the offshore part of the pipeline which will send brine (water with a high concentration of salt) back into the sea, far from the shore, after the plant has extracted drinkable water from seawater, in April 2016. Photo courtesy of UNICEF SoP / Barhoum.

filter to remove what remains of the fine particles of the suspended solids. Finally, it goes through the reverse osmosis membrane under very high pressure (60 times the atmospheric pressure). Only fresh water can pass through those membranes; the salts and pollution stay on the outer side of the membrane, forming a saline brine (liquid with a high salt concentration).

Third, the brine and the wastewater from the plant are safely discharged into the sea through a 200-meter-long pipeline partially installed on the seabed and a distribution system fitted with several nozzles to optimize dilution and dispersion 45 meters from the shore.

Fourth, the fresh water is pumped into a water tank for final disinfection and pH adjustment.

Fifth, the desalinated water is transferred to two mixing tanks, one in Rafah and one in Khan Younis. Once there, it will be mixed with water drawn from the aquifer and go through a final disinfection process with chlorine and a final quality test to meet drinking water standards. This will result in safe drinking water that contains the required salts and minerals that the human body needs, especially children's bodies, in line with the World Health Organization's water quality standards.

Sixth, the water is finally sent into the local water networks, through which it will reach the consumers.

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[i] http://gaza.ochaopt.org/2015/04/120000-people-across-gaza-disconnected-from-the-water-network-due-to-unrepaired-war-damage/.

[ii] "Gaza in 2020—a Liveable Place?" United Nations Country Team in the occupied Palestinian territory, 2012.

[iii] AFD, Public-Private-NGO Partnership for Adaptation to the Drinking Water Crisis in the Gaza Strip - Concept Paper - May 2016, page 1.

[iv] *Survey of Private and Public Brackish Desalination Plants in Gaza Strip which Will Provide the Necessary Data and Information to Improve the Drinking Water Supply in the Gaza Strip*, CEP, PWA, GiZ, September 2015.

[v] Ibid.

[vi] CMWU, Gaza Water Supply and Sewage Systems Improvement Program, Annual Progress Report, 2014, January 2015.