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WaterPyramids: Innovative Design Provides Sustainable Water Delivery


Water pyramids have been developed and are being installed in countries such as India, Indonesia, and Gambia where there is limited access to clean water and technological and financial resources are scarce.

In 2000, the leaders of 189 countries signed the United Nations Millennium Declaration. The declaration outlined global goals to address a variety of humanitarian needs, including increasing access to universal education, promoting gender equality, improving child and maternal health, and ending poverty and hunger. Another key goal was ensuring environmental sustainability, with a measurable outcome of achieving a 50% increase by 2015 in the number of people who have access to safe drinking water and basic sanitation.

Innovative technology will play a pivotal role in meeting the challenge to provide safe, reliable access to drinking water in developing countries around the world. WaterPyramid technology is among several sustainable solutions developed in the early 2000s. It was recently implemented through a partnership between Aqua-Aero WaterSystems (AAWS; the inventor of the technology) and MWH. WaterPyramid technology addresses the need for clean drinking water in developing countries where access to clean water is limited and resources are scarce. WaterPyramids use sustainable technology to process clean water out of saline, brackish, and polluted water, even removing contaminants such as arsenic and fluoride.

The WaterPyramid is about 26 ft (8 m) high and nearly 100 ft (30 m) in diameter and is shaped like a pyramid, covering about 625 m^3 of ground space. Solar energy provides the power for the fan, which maintains pressure in the pyramidlike structure, which is constructed of strong, sturdy plastic. Temperatures in the pyramid reach up to 167ºF (75ºC), evaporating the saline groundwater pumped into the pyramid. The evaporative process keeps dirt and salt on the ground, and clean drinking water is collected from along the inside of the canvas, routed into a gutter system, and then stored in tanks.

The pyramid's desalination process is particularly important because about 98% of the world's water contains salt. Saltwater intrusion is a growing problem, particularly in coastal and island communities around the world. Although desalination technology is a reliable and applicable solution, it is typically highly technical, expensive, and therefore hard to sustain in developing countries. In addition to purifying saline water through evaporation and condensa-

Residents of the villages where water pyramids are constructed are responsible for their operation and maintenance. This in turn creates jobs and fosters support for the projects in the community.

tion, the WaterPyramid harvests rainwater on the outside. Once collected, this water can be relied on as an additional source of drinking water and stored for drier periods when groundwater supplies are low. Each pyramid yields approximately 265 gpd (1,000 L/d). Various types of water, including drinking water, distilled water, and water that can be used for washing, cooking, and agricultural applications, are produced. The WaterPyramids are designed using a modular concept, allowing for future expansion as demand increases.

DELIVERING CLEAN WATER TO PAMANA ISLAND IN INDONESIA

The first WaterPyramid pilot projects were constructed in May 2005 in Gambia. Based on the results obtained in these pilots, the concept was awarded the World Bank's Development Marketplace Award in 2006 for small-scale water innovations. In March 2009, the first project was initiated using two fully integrated WaterPyramids on Pamana Island, an Indonesian island near Flores. MWH performed a feasibility study and coordinated the preparation, design, and construction management of the WaterPyramids as well as their subsequent implementation.

Pamana is home to two small villages: Pamana City, which boasts a population of 1,500 people and is situated on the slopes of one of the mountains of the island, and Genungsari, a smaller and impoverished village on flat terrain. Flores, a 2-hour wooden ferry ride from Pamana, was the primary source of drinking water for Pamana residents. Plastic tanks holding approximately 1 gal of water were ferried back and forth between the islands to be filled with water. Although this was a workable option, it was expensive and inefficient.

Therefore, the Chief of Gunungsari made land available for the construction of two WaterPyramids. Working with local partner Yayasan Dian Desa (YDD), a nongovernmental organization, all tools and materials were ensured to be available on the island through local acquisitions or by importing them from The Netherlands. Construction of the pyramids was accomplished using YDD and local labor, with technical expertise and construction guidance from MWH and AAWS. The Pamana pyramids were largely funded by Partners for Water, a government program in The Netherlands.

Not only do the water pyramids purify saline water through evaporation and condensation, they also harvest rainwater on the outside. There are currently plans for the construction of 500 water pyramids worldwide.

The WaterPyramids, including the trenches and underground water tanks, were built solely by hand—no mechanical digging tools were used. Many of the construction materials were also transported by hand because of the lack of transportation on the island. Construction was completed in September 2009, with members of the local population trained as operators so they could use and maintain the technology. Today, the WaterPyramids are fully functional for residents of Pamana and generate approximately 530 gpd (2,000 L/d). WaterPyramids have also been constructed in India.

A FINANCIALLY SUSTAINABLE SOLUTION

The WaterPyramids provide a technical, low-cost solution to the need for water in parts of the world where access to clean water is otherwise limited. Operating costs related to energy and employment are low and, in most cases, the pyramids can be built and constructed by local people with local materials. The use of solar energy reduces the use of fossil fuels and makes the technology more applicable in rural, tropical areas where access to other drinking water supply sources is also limited. By delegating the responsibility for the operation and maintenance of each pyramid to local residents, the pyramids also generate employment opportunities.

Critical to the success of the financial model of the WaterPyramids is that local residents are willing to and capable of paying approximately €0.02 for 1 L of water. In Pamana, residents are accustomed to paying for water supplied by the more expensive ferry system.

Although residents pay for the water produced by the pyramids, the fees are less than what they paid before they were constructed. The distilled water that is also produced, used for filling batteries and cleaning, is a product for which people are willing to pay 20 times more than they do for drinking water. This helps subsidize the price of the drinking water.

The funds that are generated are used to pay for the long-term maintenance of the pyramids, and this economic process is critical to their success, ensuring that enough income is generated to operate and maintain the pyramids. Because each village is made a key shareholder and the local villagers are the key stakeholders, the community is able to become self-reliant with regard to its water supply. AAWS remains involved in the operation of the pyramids in Pamana, with hopes that residents of Gunungsari will eventually take 100% responsibility for the continued, sustainable production of drinking water for the local population. After approximately nine months of operation, the income generated as a result of water sales will likely match the costs needed to operate and maintain the water plant.

MWH and AAWS plan to build 500 WaterPyramids worldwide. Their success in countries such as Indonesia demonstrates the feasibility and applicability of the technology, especially in rural areas with saline or polluted groundwater. The initial prototypes are expensive, but as the concept is shared and demand is generated, the scale of production as well as other production efficiencies can grow, and the price will be significantly reduced.

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