In the World: Clean Water for Ghana

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Several women from a village near Tamale, Ghana, test the filters that Pure Home Water will soon begin manufacturing. Photo courtesy of Susan Murcott

Nearly 1 billion people do not have access to clean drinking water. The problem is particularly dire in Ghana, where diarrhea causes 25 percent of all deaths of children below the age of five each year, according to UNICEF. The figure is even higher in northern Ghana, where about half the population get its water from wells, ponds and streams that often contain disease-causing microorganisms.

Part of the problem is that large, centralized water filtration and sanitation systems aren't designed to reach remote areas like northern Ghana, according to Susan Murcott, a senior lecturer in MIT's

Department of Civil and Environmental Engineering (CEE). Murcott has been distributing affordable ceramic water filters in the region through Pure Home Water (PHW), a nonprofit she co-founded with local partners in 2005. To date, PHW has sold and distributed the filters to more than 100,000 people, and the goal is to reach 1 million people by 2015.

Murcott has taught water and sanitation infrastructure in developing countries for more than a decade and believes that a household-scale device is crucial for fighting poverty in remote regions that aren't connected to urban water and wastewater treatment plants. "Engineering schools in the West teach students mainly how to build large, urban, centralized systems, but these systems can never reach the people most in need," she said. "This is a huge disconnect, and my work has been about making people aware that while the treatment processes are the same, they can design small systems, either household-scale or community scale, that will reach the bottom billion."

Locally branded as the "Kosim" filter, (meaning "pure water" in the local Dagbani language), the flower pot-shaped vessel has thousands of microscopic pores on the bottom that drain water while trapping parasites and bacteria. Although other small systems have been successful in other developing countries, the Kosim filter is the only one that has been embraced by northern Ghana's residents, who are willing to pay as much as $5 for a filter even though they earn less than $1 per day on average. One reason for the popularity is that PHW is the only NGO testing and monitoring the quality of the water treated by its filters. The organization also employs trained field personnel to help integrate the filter into poor households.

More than 40 MIT engineering and Sloan School of Management students, many of whom have traveled to Ghana thanks to the support of the CEE Masters of Engineering Program, the Global Entrepreneurship

Lab and the Public Service Center, have helped PHW by conducting product-research and consumer studies. They are currently helping the organization become locally and financially self-sufficient by building a factory in northern Ghana. Until now, PHW would procure, sell, distribute and monitor filters it bought from a factory located more than 12 hours away, but the filters suffered from lack of quality control and often broke. By making their own filters, Murcott is confident her team can improve their quality while also reducing their cost of production from $16 to $10.

Because the filters cost more for PHW to produce than people can typically pay for them, owning a factory is essential for PHW to become a sustainable business that does not operate at a loss or rely solely on outside grants, according to Gordon Adomdza, a Ghanaian business professor at Northeastern University who advises PHW. With its own factory and equipment, PHW can diversify its offerings to other clay products like bricks and tiles that can be sold for profit. “They can then reinvest that money to help supplement the filter deployment,” said Adomdza, who is optimistic about PHW’s future as a self-sustaining organization.

From the ground up

In January, Murcott, four students, a factory consultant and local workers spent one month building the factory, as well as the kilns and other manufacturing equipment. The construction also involved testing the production capabilities of the site to ensure that the filters could be produced through an unusual technique that Murcott learned a decade ago while researching household filters made in Nicaragua by nonprofit Potters for Peace.

Instead of the traditional method of mixing clay, forming it into a shape and heating it in a kiln, the Potters for Peace method entails breaking the

clay into small pieces that are dried in the sun for a few days. After the pieces are ground into a powder and mixed with rice husk or sawdust, the mixture is molded into a pot with a press and placed in a kiln for eight hours. During the firing process, combustible particles from the rice husk and sawdust burn off, leaving tiny pores small enough to keep out bacteria and parasites but large enough to allow one to 2.5 liters of water to flow through per hour.

The filter design and production process are constantly being evaluated to improve performance and durability. While helping with the construction, Reed Miller, a graduate student in CEE, tested how different amounts of rice husk and sawdust, as well as differently shaped pots, affected the bacterial removal and flow rates of the filters. Although his research is ongoing, Miller said his trip to Ghana was a great way to apply engineering principles he had learned in the classroom to real-world problems. “It was quite rewarding to create a finished product literally from the ground up,” he said.

Murcott and two students will return to Ghana in late May to finish construction of the factory with local Pure Home Water partners before the rainy season begins in June, and full factory production is scheduled to begin later this summer. But even that is just the tip of the iceberg for Murcott, who estimates that there are only 25 similar factories operating in 18 countries. “My dream is that there should be factories like this in all of UNICEF’s so-called ‘priority countries,’ of which there are 60,” she said. “That would be a good start.”

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