Berkeley-Darfur Stoves Improve Women's Safety And Feed Refugees

Engineers Without Borders
Lawrence Berkeley Natl Lab
University of California, Berkeley (UC Berkeley)

The humanitarian crisis in the Darfur region of western Sudan has displaced nearly 2.3 million people. While many of these individuals live within the safe confines of refugee camps, they are not always out of harm's way.

Women must venture outside camps to collect firewood to cook for their families. The sudden and drastic increase of people relying on the camps' surrounding land has taken a toll on the environment.Deforestation has left the area surrounding camps barren, and the lack of firewood causes more than 50 percent of families to miss one or more meals a week. As women spend more time outside of the camps in search of wood (a typical trip can last up to seven hours), they put themselves at risk of being raped or subjected to genital mutilation by the Janjaweed militia.

When Dr. Ashok Gadgil, Senior Scientist and Group Leader for the Environmental Energy Technologies Division at Lawrence Berkeley National Laboratory, was contacted by an officer of the United States Agency for International Development (USAID) to help refugees in Darfur, he knew little about the daily lives of refugees and wondered how a group of scientists could help better their lives.

The initial USAID proposal was to develop a compactor to turn sun-dried kitchen waste into a fuel source. On his first trip to Darfur, Gadgil concluded that there was not enough kitchen waste to provide an adequate fuel source for cooking fires. He did note that refugees cooked over three-stone fires, which transfer just five percent of heat to food.

This inefficient cooking method inspired Gadgil to develop a field test in Darfur to study the efficiency of various cooking stove designs.

Researchers assessed the factors of cooking in Darfur. They worked closely with women, taking note of what they liked and didn't like about each stove in the trial. Other factors they considered included the size and shape of the pots used, how the stove was manned and the cooking environment-either outdoors, in close proximity to neighbors, or inside refugees' small shelters.

The team also took note of the types of food cooked. One of the staple foods of Darfur is assida, a bread that is cooked in a pot and must be continuously stirred. As the assida cooks, it becomes viscous and requires the cook to use the leverage of the pot to stir-stability is crucial to ensure the pot and stove do not tip over. Mulah is a sauce served with the assida. Cooks must fry onions, a cooking technique that requires a higher heat output from the fire than other techniques such as boiling water.

Back in the United States, Gadgil and students at the University of California, Berkeley designed a stove that would address the specific needs of refugees in Darfur. The resulting Berkeley-Darfur Stove is four times more efficient than a three-stone fire and features customized engineering to benefit the refugees.

A tapered wind collar increases fuel-efficiency in the gusty Darfur environment and allows for multiple size pots. Wooden handles allow for the stove to be handled while hot. Metal tabs accommodate a flat plate to bake bread. Internal ridges create the optimum space between the stove and pot for maximum fuel efficiency. Feet provide stability, and optional rods can be pounded into the earth for more stability. Nonaligned air openings between the outer stove and inner firebox prevent too much airflow, and a small firebox opening prevents cooks from using more fuel wood than necessary.

> *Berkeley-Darfur Stoves use 25 percent of the fuel used in three-stone fires. The stoves have more combustion efficiency (how well energy is converted into heat) and better heat transfer (how heat gets to the pot).*

The design also minimizes the changes required of the refugees. It allows them to prepare the same kinds of food as before in the same amount of time, something not guaranteed by other options such as solar stoves. With the design in place, the next step was to devise a plan to produce and distribute the stoves. The Berkeley group partnered with the San Francisco Professionals Chapter of Engineers Without Borders to develop a manufacturing system with Darfur's infrastructure in mind. Led by Ken Chow, this group of engineers revisited the stove design to make it simpler to build by reducing the number of parts and streamlining the assembly without compromising the design of the stove.

The Berkeley-Darfur Stove is metal, instead of clay, because metal provided better quality control when producing mass quantities. Sheet metal is stamped and cut to the exact dimensions shown to provide the most efficiency.

These flat kits are shipped to Darfur and assembled by local workers. In cooperation with CHF International, a pilot production facility has been set up in Darfur. The facility currently produces between 200 and 500 stoves per month, not nearly enough to provide for the estimated 400,000 stoves needed. The facility is currently working to increase production by increasing days of operation and adding a second shift. The project hopes to open more facilities in the future.

The manufacturing sites will create new jobs in Darfur, just one of the economic benefits of the Darfur Stoves Project. Families who use the stove will save $250 a year on firewood. Women will spend less time looking for firewood and will be able to pursue entrepreneurial activities such as weaving mats. An influx of money to the Darfur economy will improve the living conditions of refugees. Each stove costs $25. Since this is an outrageous amount for refugees to pay, international nongovernmental agencies underwrite the stoves.

Amy Callis, Executive Director of the Darfur Stoves Project, works with organizations such as The Hunger Site to distribute the stoves and provide training to ensure the most efficient cooking. There has already been a high demand for the stoves. During a three-week trial, 50 stoves were distributed and assessed. After the study, the stoves were offered for sale, and each one was bought.

This successful program could not have been possible without the collaboration of experts from various fields—Gadgil and his scientific team, Chow and his engineers and Callis' networking and communication skills. The project was executed almost entirely by volunteers. Each had their own specialty and none worked exclusively.

"We're doing what we can to relieve them from suffering, but the humanitarian crisis is extreme," said Chow. "The stoves will improve the situation but will not be an answer to the crisis." For more information visit www.darfurstoves.org.