Berkeley Lab tests cookstoves for Haiti

September 28 2011

The developers of the fuel-efficient Berkeley-Darfur Stove for refugee camps in central Africa are at it once again, this time evaluating inexpensive metal cookstoves for the displaced survivors of last year's deadly earthquake in Haiti.

Scientists from the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) have teamed up with students from the University of California (UC), Berkeley to run a series of efficiency tests comparing the traditional Haiti cookstove with a variety of low-cost, commercially available alternatives. The long-term goal is to find the safest and most fuel-efficient stove—or to design a new one that would win favor with the cooks of Haiti—and tap the resources of nonprofit aid organizations to subsidize its manufacture in local metal shops.

"A more efficient cookstove would not only save Haitian families and aid organizations money on fuel, but could also reduce pressure to cut down trees in this already heavily deforested island nation," says Haiti Stove Project leader Ashok Gadgil, director of the Environmental Energy Technologies Division at Berkeley Lab and the driving force behind development of the Berkeley-Darfur stove. "More efficient stoves that emit less carbon monoxide and smoke could also help reduce the adverse impacts of these emissions on the health of the cooks in Haiti, who are mostly women."

The Haitian government estimates that 316,000 people were killed and more than 1 million made homeless by the January 12, 2010 magnitude

7.0 quake that left the capital city of Port-au-Prince in ruins (although some international organizations estimate the casualties to be lower). That suffering and devastation was readily apparent when Gadgil sent a team to Haiti three months after the quake on a mission to evaluate the need for cookstoves among survivors.

Their findings underscored both the promise and challenges facing any attempt to apply the Darfur cookstove experience to the Haitian situation. "The Darfur stove is a wood-burning stove. It didn't work as well in Haiti, where most people cook with charcoal," says UC Berkeley combustion engineering graduate student Katee Lask, who is supervising the stove-testing. "Since there were already so many charcoal stoves on the market, we decided to look at the ones that were already being disseminated there and provide an unbiased assessment. This is valuable information for the nongovernmental organizations, or NGOs, who do not have the technical capacity for assessment of efficiency and emissions."

The team brought back for testing a traditional Haiti stove, which is typically fabricated with perforated sheet metal, and several "improved" commercial designs also available there. In a scientific kitchen set up with a fume hood in a warehouse at Berkeley Lab, the performance of the traditional stove was compared with that of four alternatives made of metal or metal-ceramic combinations. UC Berkeley undergraduates carried out most of the combustion efficiency tests. One set of experiments matched the five charcoal stoves' performance at the simple task of boiling water; a second set of experiments involves cooking a traditional Haitian meal of beans and rice.

The four nontraditional stoves tested at Berkeley Lab included the Mirak, which was originally designed by the humanitarian organization CARE. Mirak copies are built and sold in Haiti for about $3.75, the same price as a traditional stove. Others tested were the EcoRecho, a

ceramic-lined metal stove that costs about $25 (and sold at a subsidized price of $11); the Prakti Rouj, a compact, insulated metal stove (no price available); and the StoveTec, a metal stove with clay insulation sold for $15.

These first water boiling tests did not identify a clear-cut winner. Nevertheless, they provided researchers with valuable information that helped inform subsequent cooking tests and offered insight into factors that designers of a more efficient stove for Haiti must consider. In general, the newer models outperformed the traditional stove in most categories, but fell short in some crucial ways.

In tests of "thermal efficiency," a measure of the fraction of the charcoal's energy converted into hot or evaporated water, the best-performing of the newer stoves was clearly superior to the traditional design. In a test of average efficiency (from start to boil, and then holding the water at a simmer), the Prakti model was rated at 37 percent, the traditional stove at 22 percent. The remaining three stove designs were rated near 30 percent, but the tests performed did not find significant distinctions among those three.

The testers confirmed that the newer stove designs used substantially less charcoal fuel than the traditional stove, particularly during the "simmer" phase that accounts for most of the fuel consumed. In one series of tests, the traditional stove took an average of 978 grams of fuel to bring a liter of water to boil, while fuel consumption among the newer models ranged from 479 to 591 grams.

Yet in a simple test of "time to boil" the traditional stove appeared to have a clear advantage over its fancier brethren. A pot of water was brought to a boil in 36 minutes on the traditional stove, while the four "improved" stoves were clustered between 51 minutes and one hour. This is a serious problem for the more efficient stoves. The researchers

in the field found anecdotal evidence that Haitian cooks reject stoves if they are slow to boil.

"The traditional stoves are inefficient but cook quickly, because they put out more thermal power," notes Kayje Booker, a UC Berkeley PhD student in Ecosystems Research, who was a member of the field research team. "Even some of the respondents who had tried the more efficient Mirak stoves to save charcoal had gone back to the traditional stove because it cooks quickly."

More efficient stoves were often also plagued with design problems, such as holes that would become clogged during cooking, diminishing airflow and efficiency. "The traditional stove has the benefit of simplicity," says Booker.

More information: A complete report on the results of the water-boiling tests is posted at cookstoves.lbl.gov/haiti.php . A second report on the food tests is expected to be posted this fall.

Provided by Lawrence Berkeley National Laboratory