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to conserve water in ethanol production

Winter 2010

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stoves
that
save

Ethanol brings an energy revolution to households in the developing world.

by Julie Flannery-Allen

Preheat the oven to 350 degrees. Press the popcorn button on the microwave. Turn the knob to med-high on the stovetop. A cooked meal seems simple enough. But for many people across the globe, it's anything but simple. It requires a significant part of your day while sacrificing your health, safety and even the environment.

"It sort of hits you over the head. Here in America we take for granted our ability to turn on the gas or the electric and cook," says Harry Stokes, Executive Director of Project Gaia, Inc. and a champion of the development of alcohol fuels and their stoves in Africa and South America. "We don't realize what a struggle it is just to cook a daily meal."

Project Gaia, Inc. based out of Gettysburg, Pennsylvania is a U.S. non-profit organization that is part of a global initiative promoting clean-cooking fuels, particularly alcohol cooking stoves, to the poorest part of the population. These fuels can cleanly and safely enable families to meet their daily household requirements for cooking, lighting, heating and refrigeration.

Currently, Project Gaia's first focus is on clean-burning stoves because nearly 3 billion people worldwide cook and/or heat their home using polluting fuels of wood, charcoal and dung. Burning these fuels results in a smoky and unhealthy living environment. The majority of the households in need of these stoves reside in Africa, Latin America and Asia.

Nivea Marta da Silva from Dom Orione, Brazil describes the reality. "My husband always rises around 4:00 a.m., and sometimes even earlier. He lit the wood stove to prepare the coffee, but had no outlet

for smoke. The smoke went through the house, even the clothes smelled of smoke. I had to also get up because of the smoke. After breakfast, we went to work in farming. We walk back in the late afternoon, and the house was closed and full of smoke. We always left the stove on, because it is difficult to light the wood. And always left the water bath in the fire for the return, so we would have hot water."

DAILY DANGER

Inhaling the carbon monoxide and smoke causes everything from chronic bronchitis in women, low birth weights, asthma, a variety of eye ailments and even death. The World Health Organization estimates that indoor air pollution results in 1.95 million deaths worldwide per year. That's more than malaria. Many are infants and children, and most are preventable.

Unfortunately, there are additional dangers in regards to firewood – the collection of it. Millions of refugee women risk being beaten, raped or harmed by animals as they search for the needed wood to cook for their families.

Often times, the search for wood can take anywhere from four to eight hours. Kelementina, a resident of a refugee camp, describes her experience, "When gathering fuelwood, I fear wild animals like snakes and scorpions. Also, the local people throw stones at me.



gaia

The fuelwood is not easily available. I get very tired carrying the fuelwood back home.”

THE SOLUTION

Part of the solution is the Swedish designed CleanCook stove by Dometic AB. It was selected by Project Gaia because it is easy to use, safe and affordable to run. It burns fuel alcohol without smoke and is highly efficient. The fuel tanks hold the ethanol in a special adsorptive fiber, so the opportunity for dangerous spills is virtually zero, even if the stove is turned upside down.

This is a big improvement over kerosene and LPG (Liquefied Petroleum Gas) stoves that are the alternative stove options for a wood or charcoal stove.

“Kerosene is not the fuel it used to be – it is dirty, dangerous, explosive and really more similar to jet fuel than to the kerosene of old. On top of this, kerosene, once widely subsidized by governmental authorities to promote the move from fuelwood to liquid fuels, is now being widely deregulated. African nations can no longer afford to subsidize it for their citizens,” Stokes explains. “The result of this deregulation is rapidly increasing prices, at a rate of 200 percent per year or more in many markets. All over Africa, people are moving back from kerosene to fuelwood. In Brazil, because of price deregulation

of LPG, there has also been a move back to fuelwood from LPG.”

Project Gaia started the journey toward an alcohol-

driven household energy economy in Africa by launching the pilot testing of the CleanCook stove in Ethiopia.

In the 1980s, the Nordic nations donated a distillery to Ethiopia because they were concerned that a big new sugar plantation on the headwaters of the Nile would create unwanted molasses from the sugar refining and that this molasses would be dumped into the pristine Nile waters, de-oxygenating them and killing the river. Instead, the molasses could be used to produce ethanol.

By 2003, Ethiopia’s first industrial distillery was up and running, but no really solid market for the ethanol has been developed. The Finchaa Sugar Factory put a query out about the stoves. Project Gaia, then a research study, responded.

“We saw an opportunity. The Shell Foundation funded the study and that gave us exposure to the UN agencies. They became interested in our idea and that’s really how the project got started in a big way,” explains Stokes.

The pilot study in Ethiopia began in 2004 with the introduction of 850 CleanCook stoves and ethanol for testing in various sites around Ethiopia. The testing included private households of varying income levels in Addis Ababa, institutions such as Mother Teresa’s HIV/AIDS orphanage, and far away from Addis Ababa refugee camps under UNHCR (The UN refugee agency) and Ethiopian Government management.

The trials were a success in all of the settings. In homes of all descriptions and income levels, women said the stove was their most prized possession.

“Most of the persons who cooked the food were telling me that they were really happy to use the stove,” says Firehiwot Mengesha, an Ethiopian native who worked for Project Gaia as a surveyor and later became the Assistant Director in Ethiopia.

After conducting pilot studies, CleanCook stoves are now being used by 3,400 Somali families in the Kebribeyah and Awbarre refugee camps. Trials and



distributions have also taken place in Nigeria, Brazil, South Africa and Madagascar.

PRODUCING THE FUEL

The CleanCook stove is only half of the solution. The other part of the equation is the fuel. How are the people who need it going to get it?

“Ethanol works here in the U.S. It works in Brazil. It could also work in Africa and Southeast Asia, but we can’t assume the best use is for fuel blending, because there are other pressing needs as well – such as basic household energy needs like cooking,” explains Stokes.

The CleanCook stove uses alcohol, and this means it uses fuels that can be made from things that are wasted right now. For example, in Ethiopia, Gaia uses the waste from sugar production. In Nigeria, Gaia is looking to use the gases that are otherwise flared off in oil exploration to produce methanol, another simple alcohol. The gas flared in Nigeria alone could create enough methanol for every household in Africa to cook cleanly.

Stokes adds, “We took the project to Nigeria because we wanted to see if we could get traction on the idea of building ethanol distilleries and also taking the flare gas and turning that into methanol for blending with ethanol.

As far as getting the fuel to the people, Stokes explains, “Currently we distribute the ethanol through a very simple system. It is no different than the kerosene supply chain. One liter of ethanol per day per family provides all the cooking a family needs. That displaces about 8 kilograms of wood, which is about 16 pounds. That’s pretty significant.” Gaia staff members also train families in using the stove and in proper handling of the fuel, and they follow-up in case the stove needs any repairs.

The plan is to eventually produce the fuel locally through advanced local, micro distilleries. This would give communities the opportunity to produce

sufficient ethanol for their residents and become self-reliant in generating

their own cooking fuel. As a result, the fuel would be largely unaffected by changes in world oil or commodity prices.

Nigeria and Ethiopia both are among African nations that have the highest potential to produce over one billion liters of ethanol from starchy cassava and sugarcane molasses. Cassava, with a short life of 3 days from harvest, is often wasted, so feedstocks for strategically placed micro distilleries could be cheap and plentiful.

As of 2009, Ethiopia produces around 8 million liters of ethanol annually (3.8 liters = 1 U.S. gallon), and there are plans to expand ethanol production to 130 million liters by 2012.

ENVIRONMENTAL IMPLICATIONS

Ethiopia is 95 - 98 percent deforested. Throughout Africa, the main reason for the disappearance of the forests is the taking of wood for cooking and for charcoal production for cooking.

In addition to the deforestation, the 2.5 billion smoky kitchen stoves being used worldwide are also a contributing factor to the soot believed to cause around 16 percent of global warming. It is now believed that black carbon particles in the atmosphere may be the second most significant global warming pollutant after carbon dioxide.

“Small soot particles from cooking fires all over Africa go into the atmosphere and settle out on the ice caps, the Himalayan glaciers, the arctic circle and so on. These particles absorb heat and melt the ice,” Stokes explains. “That’s the beauty of ethanol and alcohol, they burn essentially soot free - unlike petroleum. Petroleum fuels are made from really long



chains of carbon atoms, compared with an alcohol molecule that is a tiny chain of one or two carbons surrounded by hydrogen atoms and an oxygen-hydrogen tail. That's a big difference. Burning a long carbon chain produces a lot of soot compared to burning alcohol where most of the energy is as result of the hydrogen."

A MAINSTREAM NEED

The need of the stoves is not limited to the poor people in the refugee camps. Even in the city of Addis Ababa cooking a meal is a struggle.

"We've been introducing the ethanol stoves into these new high rise housing units in the city. I've been in many of the homes where the people say 'Finally, we have a stove and we can cook,'" explains Stokes. People living in the new block of flats are trying out the stove - thus, making the stoves a mainstream renewable technology.

"I am living in a small flat which needs clean air. When I used charcoal and kerosene the smoke from the stoves was bothering me and caused smoke related health problems. The house ceiling gets black from the smoke," comments Senedu Ariaya who lives in a condominium in Addis Ababa.

Since using the CleanCook stove Senedu talks about the difference in her life, "Now I'm using the stove and I'm having clean indoor air and save my time for other purposes. All the health problems that I mentioned are alleviated."

Senedu Ariaya is an HIV/AIDS sufferer, and an activist for other women with HIV/AIDS. Having a smoke-free environment is very important, indeed life-saving for her.

Yiftusera Kebede, another condominium dweller in Addis Ababa echoes the life improvements described by Senedu, "Within five months (of using the CleanCook stove) I saw some changes in my family's health. Previously, I had headache problems due to the smoke from kerosene, charcoal and firewood

stove. However, now I am feeling good and have no worries about accidents, especially with the children. The money I am spending for fuels is also reduced. Since the stove burns clean and fast, our indoor air is normal and I use my extra time to run my business."

Yiftusera may also be feeling better because the ethanol stove eliminates the high levels of carbon monoxide produced by kerosene, wood and charcoal. One of the first symptoms of carbon monoxide poisoning is headache. High levels of carbon monoxide are endemic in homes using solid fuels and inefficient stoves.





CHANGING LIVES

The benefits for women who have had access to the stove are enormous. As a result of having the CleanCook stoves, they are saving time by not having to collect wood; plus the stove cooks the food faster. The time saved is used for income generating activities, taking care of personal health, attending literacy classes, providing care to their children and engaging in fulfilling productive and creative activities.

“After the stove arrived, everything was different,” reports Nivea from Minas Gerais State, Brazil. “We no longer wake up so early to light the stove. The home environment has improved a lot, because there is no smoke. Before the stove I always had to go to the health center for inhalation medicine, and I even have a vaporizer and masks for use at home. I never had asthma attacks after I started using the stove. I also had more time for other activities, since the stove was easy and fast. No more looking for firewood, and no smoke in the house. I have more time, and began to learn to make crafts with corn husk or banana, which I have in the backyard.”



HOPE

“The Gaia Project recently received the Ashden Award for Sustainable Energy and is gaining a lot of international momentum,” says Brady Luceno, Project Manager of Project Gaia. “People see this project as a development project that offering a real, working solution. The use of ethanol for household energy is something people can get excited about. It actually has real and immediate benefits for the people who deserve it and need it the most.”

Speaking about her experience in the refugee camps, Luceno says, “I’m there to talk about cooking, to talk about stoves....but they have so many needs that it is hard. Cooking is just one small piece of the puzzle, but it’s a big one because it’s interconnected to so many different things. It’s connected to health. It’s connected to safety. It’s connected to the amount of time that people save and what else they can do with that time.”