

Keeping healthy and saving trees

Cooking with a gasifier saves fuel and time, reduces smoke and produces charcoal for other uses

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The demand for energy remains huge globally and it is rising due to population increase and most importantly, changing lifestyles that increase requirements for energy. About 2.5 billion people depend on biomass (vegetable matter) energy for cooking and heating. Of this, wood makes up 87 per cent.

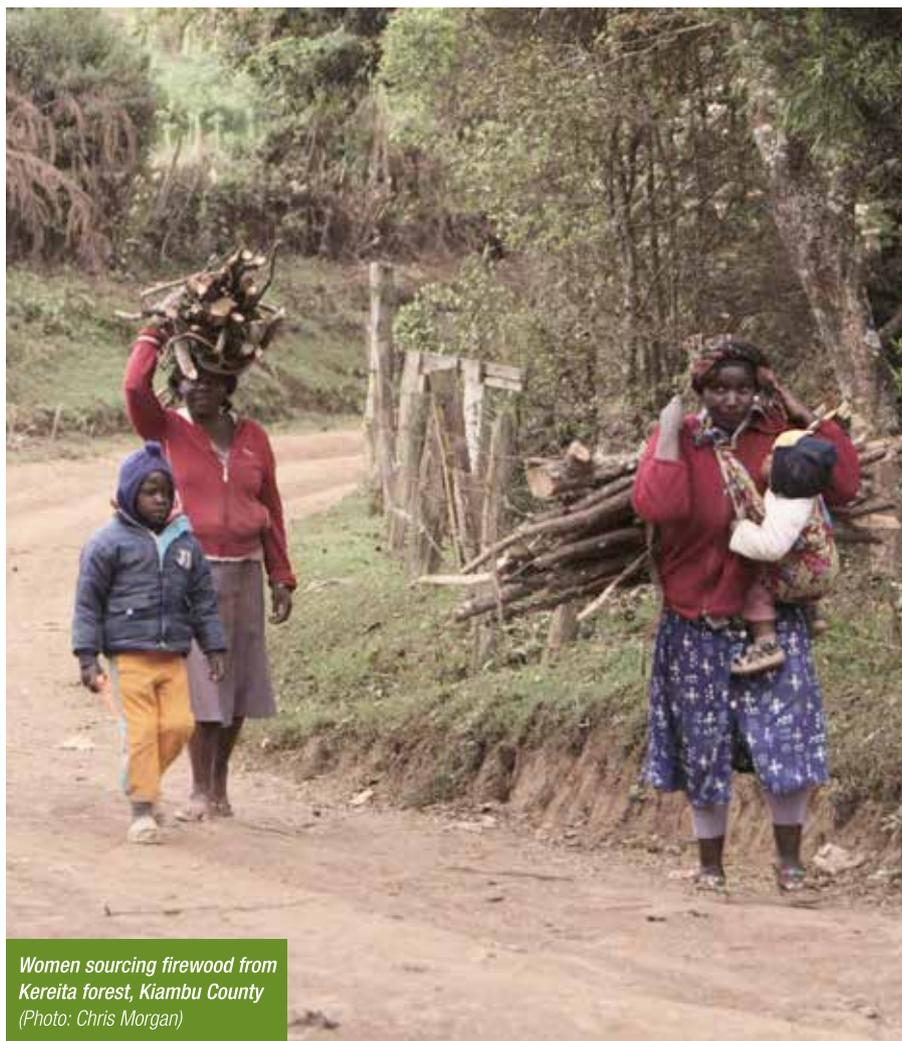
In sub-Saharan Africa, more than 90 per cent of the population relies on firewood and charcoal. Charcoal is the principal fuel used in Kenya, providing cooking and heating energy for 82 per cent of urban and 34 per cent of rural households, while firewood is used by almost all households in the rural areas.

Nutritional benefits in cooking food

“Cooking made us human,” claims Wrangham (2009). Wrangham, a professor of biological anthropology at Harvard University, associates invention of fire and cooking food to evolution of shorter intestines in man, compared to primates. This makes it difficult for human beings to process raw carbohydrates.

Cooking makes food soft, easy to break down and more digestible, allowing human beings to derive optimal energy and other nutrients from carbohydrates. Cooking also makes food safer, gives it rich and delicious tastes and reduces spoilage.

The benefits of cooking food in Africa/Kenya might be impaired by the fact that charcoal is increasingly becoming expensive, while deadwood and other forest residues that were collected for free are getting scarce. Poor households desperate to put food on the table



Women sourcing firewood from Kereita forest, Kiambu County
(Photo: Chris Morgan)

are forced to use unsafe sources of fuel such as plastic bottles, plastic basins and old shoes or else abandon traditional nutritious food that takes long to cook.

The pain of sourcing firewood

“Collecting firewood from forests is tiring and time-consuming; robbing us of time that we could spend on income generating activities and it is a risky undertaking. Our children lose many hours that would otherwise be spent in school.

“If I want to reduce the number of trips to the forest, I carry a load of firewood that is so

heavy that I am helped by two women to put it on my back,” laments Margaret, a mother of eight children.

After a long day in the forest, women are hardly able to feed themselves or their families and are forced to neglect some of their responsibilities, which results in domestic disagreements. Women also risk head, spine and leg injury from carrying heavy loads of fuel wood - no wonder many African/Kenyan women complain of backache and knee pains in their old age.

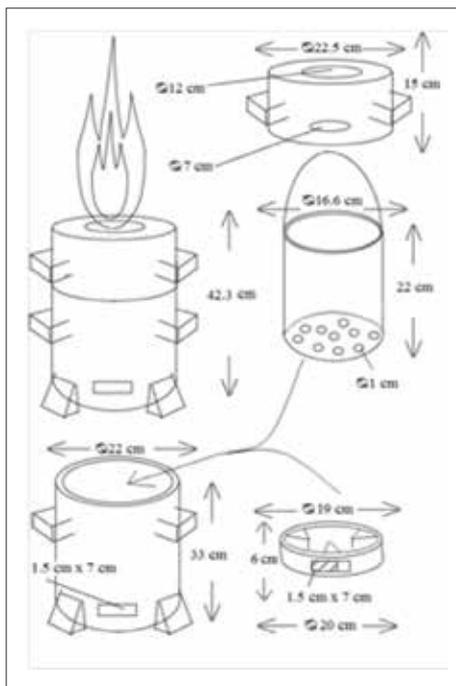
Research shows that households also buy

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Parts of gasifier. (Source: Nemer Achour)



Lighting and cooking with a gasifier. (Photos: Mary Njenga)



firewood from groups of women and young men who collect it daily for sale. A load of about 30kgs costs over Ksh 350 and lasts for about three days. At this consumption rate, firewood collectors spend two days every week collecting the commodity.

Women are care-takers and are expected to conserve mother-nature. However, when chances of putting cooked food on the table are threatened, women do whatever needs to be done. They cut down young tree samplings to use as fuel. Others cut down timber trees on their farms and domestic disagreements occur. Worse still, fruit trees that are meant to provide the family with free sources of nutritious food are also cut down.

Smoke – the killer in the kitchen

Smoke from the kitchen is associated with over 4.3 million deaths every year, making it one of the world's leading causes of death. Most of the deaths occur in developing countries and mainly affect women - because they spend a lot of time preparing food in the kitchen - and little children whose lungs and other body organs are still developing.

Using inefficient cooking technologies such as poor performing cook stoves, poor quality biomass such as wet wood, wood from tree species with low energy and/or with toxins, and cooking in kitchens with inadequate ventilation all escalate the problem. Coughing, sneezing and headaches are common among women while in smoky kitchens and bronchitis, lung cancer, asthma and tuberculosis have also been linked to smoke in the kitchen.

Cooking with a gasifier

One of the novel innovations that could reduce the burden of sourcing firewood, reduce expenditure on cooking fuel, save trees and improve kitchen environment is a domestic gasifier. Gasification of wood and coal has been known and used since 1800, with major applications of coal-based "gaslight" in London and Paris during the 1850s.

A gasifier burns biomass under controlled oxygen where the volatiles and tars are burnt and charcoal and wood gas are made. The resulting gas mixture and charcoal can be used as energy.

A domestic gasifier has three parts. The top part is a gas chamber, 15cm in height where combustion of gases take place; the middle inner part is a fuel

container that is 22cm high where gasification takes place; and a lower air inlet, 6cm in height. The gasifier is lit at the top and primary air enters at the bottom and moves up through the packed bed of fuel.

The gasifier is lit outside using dry tree prunings, leaves or papers and taken into the kitchen after the fuel has caught fire and stopped smoking. When the flame goes off, it means the charcoal is ready. One can also lift the pot to check if the charcoal is ready.

To harvest the charcoal, one removes the cooking pot and then the top part. The charcoal is in the fuel container, which is emptied in a pot and covered completely for about 30 minutes to stop oxygen supply and any further burning.



Users of the gasifier in Embu pick cooled charcoal from the ground. This is charcoal produced during cooking – it is harvested and used again. (Photos: Mary Njenga)



The hifadhi cook stove.



Three-stone cook stove.

Communities that use the gasifier prefer to empty the charcoal onto the ground and cover it with soil. This way, it takes less than five minutes to cool down.

After that, the cooled charcoal is picked carefully – avoiding soil so as not to reduce its heating value – and stored in another container, ready for use. Studies are on-going to assess the benefits of using charcoal from the gasifier cook stoves as soil amendments for increased crop productivity.

Participatory cooking tests were carried out in Embu in 2014. *Grevillea robusta* prunings or twigs of about 3cm in diameter were used for a meal of one kilogram of maize flour and 750g of sukuma wiki [(*Brassica oleracea*) kale] and 2,087ml of water. This meal was assumed to be enough for the Kenyan standard household of five people.

In the study, performance in cooking with a gasifier was compared to performance using the hifadhi and the three-stone cook stoves. Converting the tree prunings into charcoal took about 51 minutes and the cooked meal was ready in 32 minutes, leaving 19 minutes of available energy that can be used to cook or heat something else.

Below is a summary of the experience.

Comparative advantages and disadvantages of the gasifier:

- When charcoal produced during cooking is harvested and used again, cooking with the gasifier saves 40 per cent of fuel compared to three-stone cook stove and 27 per cent compared to the improved cook stove. Optimal fuel saving with a gasifier occurs when charcoal is harvested for another use.
- If the gasifier is used for cooking and the charcoal is not harvested when ready but allowed to burn into ashes, saving of fuel is only 6 per cent compared to the three-stone cook stove.
- Saving fuel helps households reduce expenditure on cooking energy, reduces the

workload and saves time spent by women and children in collecting firewood. The saved time could be spent on other productive activities as well as leisure and education for children. It would also allow households to process food types of their choice, improving nutrition.

- The gasifier uses small pieces of wood which could be sourced from prunings or twigs of trees in the farm. It could also use crop residues such as coconut husks and maize cobs and still produce useable charcoal. Use of tree prunings and crop residues as cooking fuels will save trees and forests.

- The gasifier significantly reduces concentration of carbon monoxide (CO) and fine particulate matter (PM_{2.5}).

- Reducing emissions from cooking with firewood and other biomass will save women and children from death and illnesses associated with smoke in the kitchen and also save income spent on health.

Challenges in using a gasifier

- It takes 11 minutes to light, which is longer than the four and eight minutes respectively taken in lighting the improved and the three-stone cook stoves.

- The gasifier requires chopping of wood into small pieces to fit into the fuel container. Users are being trained on this.

- The galvanized wall of the gasifier becomes very hot, posing a risk of burns. There is need to protect children from this risk.

- The gasifier costs Ksh 3,000 compared to Ksh 500 and negligible cost for the improved and three-stone cook stoves respectively. The Ksh 3,000 is subsidised through project funding and the actual price could be much higher. However, the long-term benefits of using the gasifier are worth much more.

- The gasifier does not warm the room, which the three-stone cook stove does very well.

- The gasifier does not allow roasting of such

foods as maize and potatoes, which the three-stone cook stove allows. Roasting can however be done later, using the charcoal produced from the gasifier.

Conclusions and recommendations

The gasifier cook stove reduces consumption of cooking fuel, hence reducing expenditure on fuel and saves time spent on collecting firewood. The gasifier uses tree prunings, hence saving trees that would otherwise be cut down for cooking. It cooks fast, freeing time for other activities.

The gasifier produces low emissions which could reduce premature deaths and costs of health associated with smoke in the kitchen. Low emissions also reduce release of green-house gases and particles into the air, hence mitigating against climate change. There is need for a mind-set change and awareness-raising on the benefits of improved cooking technologies for improved livelihoods, environment and ecosystems.

Acknowledgement

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References for this article can be obtained from the Miti Editor.

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