Trees on farms could satisfy household firewood needs

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In Kenya, like many other countries in sub-Saharan Africa (SSA), over 90 % of the rural population relies on firewood to provide heating and cooking energy. Currently households, and in particular, women farmers, spend precious time collecting firewood from local forests to keep their families warm and fed. At the same time, critics of firewood use would like to see the health issues associated with indoor cooking reduced. Smoke in the kitchen kills. The answer is a combination of adequate ventilation, drying firewood well and strategic use of efficient cook-stoves to reduce smoke, save fuel and decrease dangerous exposure.

Agroforestry, a better alternative: Pruning multipurpose trees on farms such as happens with timber and fruits can provide households with an affordable and convenient source of firewood. It would also reduce the time, human energy and money that now goes into collecting firewood from off-farm locations such as forests.

Firewood as a cooking and heating energy allows people to cook food, boil water and warm their houses. Lack of affordable and convenient cooking and heating energy negatively impacts on human wellbeing -nutrition, health, workload on women and the girl children and the environment. Agroforestry presents an opportunity to satisfy household needs in an affordable and environmentally sustainable way.

Agroforestry provides households with a cheap and convenient source of firewood

According to the World Agroforestry Centre (ICRAF), the basic definition of agroforestry is agriculture with trees. Agroforestry may involve planting trees along boundaries, as live fences, intercropped with crops or pasture, along water ways, along roads and paths, under a section of the farm set aside for growing trees -woodlots and around houses among other practices. Having trees on farms improves people's well-being and the environment (de Leeuw et al., 2014).

Trees provide (a) biological products including (i) food such as fruits, nuts, vegetables, (ii) livestock feed such as pods and leaves, (iii) medicine and pesticides, (iv) oils, gums, resins,

Prunings of another tree species (*Melia volkensii* **- mukau), also to be used for firewood. The importance of firewood and where it comes from, is vastly underestimated by policy makers, and even by the consumers themselves, mining their environment for ever more branches to be able to cook, degrading their livelihood in the process.** *Photo BGF.*

(v) construction material (vi) woodfuel (firewood and charcoal) and wood waste such as sawdust. Trees also provide ecosystem services such as (b) supportive services in fixing nitrogen in the air and making it available for soil fertility improvement {fertilizer trees}, leaves from the tree prunings are thrown into cow sheds to make manure which is later used in their farms, (c) regulating services, such as providing windbreaks, regulating soil erosion and (d) cultural services such as for religious purposes.

Planting trees purposefully for subsistence firewood production is only attractive to farmers if under severe firewood shortages or there is a monetary value such as selling to tea factories. However, cases exist where farmers in response to firewood scarcity plant trees on the farms. In Eastern Uganda, one percent of the households have deliberately planted trees on their own farms to ease problems of firewood shortage (Egeru at al., 2014). Growing multipurpose trees such as those used for timber and fruits and using prunings as fuel might be more feasible as established in Embu, Kenya. In Kenya 9 out of every 10 rural households use firewood for cooking (MoE, 2002).

A study was carried in 2015 and 2016 in Kibugu village Embu County about 120km Northeast of Nairobi and Kereita, Kiambu County about 60 kms West of Nairobi along Nairobi Nakuru highway. In each site 40 households were interviewed. It was found out that in Embu 40% of the farmers depended exclusively on agroforestry for firewood supply compared to 5% in Kereita . In Embu none of the farmers depended exclusively on sourcing from the forest while at Kereita 25% did. The question is how to increase the percent of farmers depending exclusively on sourcing firewood from trees on farms.

Grevillea robusta is grown for timber was the main source of firewood in both sites. In Embu agroforestry was an important source of firewood and farmers had a well-developed biannual (after every 2 years) pruning regime to enhance the quality of timber. The pruning was carried out by young boys between the ages of 10 and 17 years of age. Girls are only permitted to carry wood for relatively short distances between the base of the pruned trees and the woodshed where the wood is then dried under shelter. If a family does not have boys of the proper age, then adult men must be hired for wages which alters the economic considerations made by famers.

At Kibugu village, Embu, a household got about 750kgs of firewood from 16 mature trees which lasted for 5 months using approximately 5kg/day under normal cooking practices (Njenga et al., forthcoming). Twice as many trees are required to supply firewood for a year because pruning is carried out biannually. Considering a spacing of 2.5 m between trees, a farmer could plant the 16 trees along 40 m of a farm boundary. This means about 76 trees would be needed to supply firewood all year round, while a household would need 180m area along farm boundaries.

In an area of 40x100m, trees could be planted along the two longer sides. The farms with an average of 1 acre had between 15 and 386 trees with an average of 116. These were a mixture of indigenous and exotic species for different purposes including timber, fruits and nuts. Using improved cook stoves that reduce fuel consumption by about 40% would lengthen the period that the prunings supply cooking energy to the household. Further almost half the number of trees would be required to satisfy household firewood needs.

Firewood from trees on farm provide relief to women and children. Collecting firewood from a forest is life threatening and hard work. Firewood in the forest is considered to a greater extent a free resource costing only 100Ksh for one month. Weekends excluded this translates to 5Ksh per woman load of firewood but moving it to homes where it is needed is expensive.

Regrettably, the activities of sourcing firewood from forests also take away time that a girl child would otherwise spend in school or at leisure. With forests receding from excessive collection of deadwood near the forest edges, more time is spent and longer distances are travelled for firewood collection. Little has been done over the decades to correct this yet it should be high on the development and women empowerment agenda.

Trips to the forest could be reduced by use of improved stoves. In rural Kenya cooking with a gasifier stove saves 40% of fuel compared to three stone open fire (Njenga et al., 2016). In Dadaab refugee camp in Kenya, switching from the three-stone stove to an improved cook stove reduced the number of times women made the four-hour journey to a forest to fetch firewood from 5 to 3 per week (Bizzarri, 2010). The adoption of improved stoves is still a change and as such there is need for integration of user needs, preferences and cooking culture into the technology development.

The hard work of firewood collection from the forest on the other hand is a source of income for women. Some women chose the challenging but lucrative job of collecting firewood for sale. These women were highly skilled at selecting and trimming firewood into attractive, consistent, sizeable and saleable portions that sold for Ksh 350 (equal to $3.5) per load. Compared to the average wage for farm labor of Ksh5000 (US$50) per month, a skilled woman collecting 5 women loads per week which they pack into six sellable

***Pruning of** Grevillea robusta **(grevillea) in Central Province of Kenya. Inside the row of trees, on the left, pruned ones. On the right, unpruned. Apart from that, the top also is pollarded. The trees react well to excessive cutting of branches by resprouting of numerous twigs, and this also reduces shade and allows more light for intercropping.** Photo BGF.*

Chainsaw in action. The grevilleas are thin, though. Protective equipment is also thin. Photo BGF

portions make Ksh 8400 (or $84) per month. The women look for dead logs which they split using wooden chisels and other logs to hit the chisel. This is not only energy and time consuming but very tiring. At the same time, this is not work that anyone can plan to do forever. The physical wear and tear eventually forces women to switch to some other activity.

Nutrition and health benefits

Cooking and heating energy is an essential commodity that allows people to cook food, boil water and heat their houses. Lack of access to affordable cooking and heating energy affect peoples' livelihoods. Food and nutrition-health-energy are connected. For instance poor households abandon diets that take too long to cook, they reduce amount of food cooked and the number of cooking times, serve cold leftovers and cook food improperly. They also spend a big proportion of the household income on cooking energy at the expense of food (Sola et al., 2016). Boiling drinking water is recommended as it reduces chances of contracting water-borne diseases.

Heating space to keep people warm is critical. In the tropical highlands where temperatures are low from evenings to late morning open fires help keep houses warm, an aspect of energy use that is incredibly undervalued. Cold and damp houses can have dramatic effects on everyday life especially for the elderly, children and ill people. The World Health Organization recommends 21°C in the living room and 18°C in other occupied rooms (WHO, 2007). Cold and damp houses have been linked to illnesses including respiratory infections such as pneumonia and bronchiolitis, asthma, rheumatic fever and stress on the cardiovascular system (University of New Zealand, 2016).

Health and environmental concerns

Although cooking with firewood is endeared by billions of people, using it when wet in inefficient stoves and poorly ventilated kitchens is dangerous. The smoke in the kitchen contains gases such as carbon monoxide (CO) that causes headaches, dizziness and in high concentrations result into unconsciousness or death. This silent killer in the kitchen annually claims over 4 million lives mostly affecting women and children as they spend a lot of time processing and cooking food (Lim et al, 2012).This is scary as 2.6 billion people are without clean cooking facilities and more than 95% of these people live in SSA or developing Asia, with 84% in rural areas (IEA, 2013).The situation is even worse where poor households are desperate to put cooked food on the table and result into using unhealthy cooking fuel such as plastic waste (Gathui and Wairimu, 2010).

Firewood can be used safely in the kitchen. First, it is important to dry firewood well. There are simple and friendly ways of drying wood such as having a rafter in the kitchen, drying under direct sun or under a drying shade next to the kitchen. If firewood produces water bubbles as it burns, it is an indication that it is not dry enough and will produce a lot of smoke.

Secondly having sizeable windows and doors for adequate air flow is critical. Thirdly it is very important to use efficient stoves so as to burn the firewood in a cleaner way with less smoke. All these factors need to be addressed collectively.

There is evidence that using improved stoves is beneficial. In the mid-hill region of Nepal, indoor concentrations of $PM_{2.5}$ and CO were found to be reduced by 63.2% and 60.0% respectively, after 1 year of using the improved stove (Singh et al., 2012). In rural Kenya, CO and PM2.5 were reduced by 45% and 89% respectively when using a gasifier cook stove instead of the traditional three-stone fire (Njenga et al., 2016). In south-western Bangladesh, 98% of women had

health and lifestyle improvements after using an improved earthen stove (Alam et al., 2006).

Negative environmental impacts. Collecting deadwood from natural forest, withdraws organic material that would otherwise decompose and enhance soil fertility. Collecting firewood in form of tree residues from official commercial logging of plantation forests is beneficial in land preparation for next use. Taking away the deadwood also may affect the soil quality consequently affecting seedling regeneration (Kilian, 1998).

Scarcity of firewood results into households utilizing agricultural residues as cooking fuel instead of them being left in the farms to improve soil fertility. Cooking with firewood emits particles and gases that contribute to air pollution some of which may have implications on climate change such as carbon dioxide.

A balance must be found between human needs and the impact on the environment. Agroforestry, and use of efficient cooking stoves can help ensure that firewood is efficiently burned while maximum benefits are achieved with the lowest possible harm to the users and the environment.

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Not an easy job: women do suffer for collecting firewood

By MARY NJENGA

Improved cooking stoves exist in various forms. This one, as photographed from a household in Tharaka-Nithi, economizes on the use of firewood, and has a chimney to guide all smoke outside of the kitchen. *Photo BGF.*

Margaret is a woman in her late-fifties who lives and farms in a small village in Kereita on the Nairobi Nakuru highway in Kenya. Like her peers she has regularly carried one "woman load" of firewood from Kereita National Forest for decades. The informal measurement of a "woman load" is about 52 kg, an astonishing burden given that many of these women weigh about 55 kg.

In the study area, the distance travelled ranged between 4 to 10 km, averaging 6km often over rough or hilly terrain. National forests in Kenya are surrounded by fences to prevent unauthorized lorries from entering. This means that when Margaret and her friends walk to the forest they must enter through a gate that is frequently controlled by a ranger from the Kenya Forest Service who checks that the women have paid the monthly fee that authorizes one to collect downed wood. The women carry only machetes because they are forbidden from cutting down trees. They also must search for locations where wood is lying on the ground or residues left from authorized timbering operations. This means too that the distance from a gate into the forest to the actual location where adequate wood can be found varies. As wood becomes scarce, women must walk further.

Accidents and encounters with wildlife, especially elephants present a clear danger to women in the forests. Some women, Margaret among them, are motivated to carry extra heavy loads, sometimes as heavy as 67kg, to ensure that they will have enough fuel and to avoid having to make another trip in a given week. In Margaret's case, a broken arm kept her both from collecting firewood and working for a wage on the farm. For an average farm labourer, the wage earned in a day is two hundred and fifty shillings (equal to US$2.5) which one forgoes on the day when one sources firewood.

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