Sustainably Feeding Africa: Wood-burning Technologies in the Food-Energy Nexus (FEN)

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Abstract: Can woodlands co-exist sustainably with the ever food- and energy-hungry human species? Are improved woodstoves a sustainable energy option for the kitchen and fireplace of rural and suburban Africa? There are many questions that surround ideas around woodfuel as an energy source. Many studies have been done to indicate how unsustainable reliance on woodfuel is to the forests, savannas and woodlands. It should be borne in mind that > 90% of rural/ suburban households in sub-Saharan Africa depend on biomass-based energy sources. Biomass-based technologies that base on sustainability concepts may point to a better and healthier future for many families especially in sub-Saharan Africa. The objective of this study (this presentation) is to stimulate some discussion on the sustainable pathways in the bio-energy economy and how this relates to food security and environmental conservation. In this study, a total of 26 stove users, non-users and promoters in Tanzania were interviewed using semi-structured, unstructured and focused interview methods. Results indicated that, at the farmer's level, proper application of improved woodstoves faces the following challenges: lack of techniques to evaluate stove's efficiency; farmers are not involved woodburning projects' evaluation; lack of technical capacity to make or repair woodstoves; and inherent woodstoves problems e.g. faults and non-versatility. In practice, women who are the primary users of stoves for cooking and heating are either passively or partially involved in decision-making related to the production and maintenance of woodstoves. At the policy-making level; the government is yet to make stove programs a priority and has settled for the NGO-led dissemination efforts. Results from this study will be a useful contribution for researchers, policy makers, NGOs and groups involved in promoting the sustainable adoption and use of improved woodstoves.

Keywords: Sustainable futures; woodfuel economy; rural food-energy systems; Tanzania.

Introduction

The global climatic changes have brought to the forefront important discussions on whether it is sustainable to continue harvesting forest resources for use in the kitchens of the developing world [1]. Woodlands are dwindling at unprecedented rates. For poor families in rural Africa there are not many options when it comes to choosing sustainable energy sources for cooking and indoor heating. It has been approximated that 275 million people live in the forest

depletion hotspots of East Africa and South Asia and that the demand for woodfuel in these regions is unsustainable [2]. Renewable energy sources e.g. solar, wind, mini-hydro, etc. are not affordable. In many sub-Saharan countries, the government-tariffed electricity is too expensive. Woodfuel, therefore, is left as the only cost-effective, howbeit environmental unfriendly, option for many rural families of sub-Saharan Africa.

Traditionally, sub-Saharan Africans have used the three-stone fires [3]. The problem with this traditional technology is that it consumes a lot of biomass resources. Furthermore, the traditional three-stone kitchen emits huge amounts of smoke, particulate matter, and black carbon. These issues have caused the global scientific community, researchers, and environmental engineers to come up with solutions related to the use of the traditional cookstoves. However, the proposed technological solutions have met many challenges.

Some end-users improved cookstoves have argued that the proposed solutions are useful, the food cooked on 'modern' stoves is not as tasteful as the food cooked on the traditional stove [4]. Traditionalists argue that encouraging village people to make roti in a solar cooker is synonymous to telling an Italian that risotto cooked in a microwave oven tastes just as fine. Other end-users of improved cookstoves have complained about technical configurations of the improved stoves e.g. the stoves only being able accommodate only certain pot sizes [5].

The objective of this study was to investigate behaviors and product-user attributes that may be contributing to low adoption of improved biomass stoves in Tanzania.

Materials and methods

In the present study, semi-structured, unstructured, and focused interviews were employed whereby a total of twenty-six (26) respondents were interviewed. Categories of respondents were randomly constituted to include former improved stove users (2), current improved stove users (17), non-users of improved stoves (3), and improved stove promoters (4). Respondents came from different geographical locations of Tanzania characterized by different socio-economic and educational status.

In the Kilimanjaro region of Tanzania, respondents were located in Moshi (urban area), Sanya Juu (peri-urban area), and Magadini (rural area). In Tanga region of Tanzania, respondents were located in Kuze-Kibago village, a rural setting with some patches of peri-urbanism. These two Tanzanian regions, although neighboring each other, their dwellers have significant cultural differences that may be influencing their perception about and their adoption of improved woodstoves.

Results and discussion

In rural sub-Saharan Africa, the individual's decision to adopt an improved wood-burning stove may not be as a direct result of health, economic or environmental benefits. The decision to adopt an improved wood-burning technology may be influenced by one's kitchen space, level of education, culture, food taste, type and availability of biomass, and the word of mouth from other users. The efficiency and cost-effectiveness of the stove are even more desirable to the end-user of the stove than human health and conserving the natural environment.

In the present study, end-users of improved wood-burning stoves pointed out that the technology lacked multifunctional features – the stoves are designed, mainly, for cooking. Users of improved stoves in rural Africa,

however, prefer a kitchen stove that can accomplish many functions at the same time e.g. crop drying, food smoking, indoor heating, and space lighting. Also, in the present study, end-users complained that most wood-burning stoves are designed to accommodate only one pot, although most rural stove users in sub-Saharan Africa would want to operate a multi-pot (2 to 3 'plates') stove (Figure 1). This indicates a separation between technological innovators on one end, and end-users of the improved products on the other end – innovation in isolation. Sustainability would require that woodstove designers should be inspired by stove users – in this case women who, in most of the cases, use the improved wood-burning stove. Most women who were interviewed in the present study said that stoves were either made or bought by men. None of the technical experts (technology promoters) who were interviewed in the present study was a woman. Women involvement in the design and propagation of improved wood-burning stoves would probably improve the technical design as well as the technology uptake.

When commercial, institutional (schools and health centers), and urban users were interviewed, another design-deficiency aspect was unveiled. These 'advanced' users said that designers of improved wood-burning stoves need to consider the users' posture during cooking. Respondents remarked that most cookstoves are of 'sit-or-squat' design. However, these end-users would prefer a cookstove that allows a standing posture of the cook. Other design- or technical-related challenges that were pointed out in the interviews included chimney clogging cases, chimneyless stoves, lack of expertise to repair broken stoves, materials e.g. cement used is expensive and make stoves not easy to repair. This raises a point for designers and promotors of improved wood-burning stoves: (1) design with the user [in mind], (2) design clean, and (3) design simple.

Conclusions: It is known that improved biomass woodstoves can reduce the degradation rates of wood resources in sub-Saharan Africa. It is also known that improved woodstoves have human health benefits including reduction in smoke emissions. Other benefits of using improved biomass stove include reductions in black carbon (BC) emissions to the atmosphere that has been linked to global warming. However, designers of improved wood-burning stoves need to consider the key design and technical issues (Figure 1).

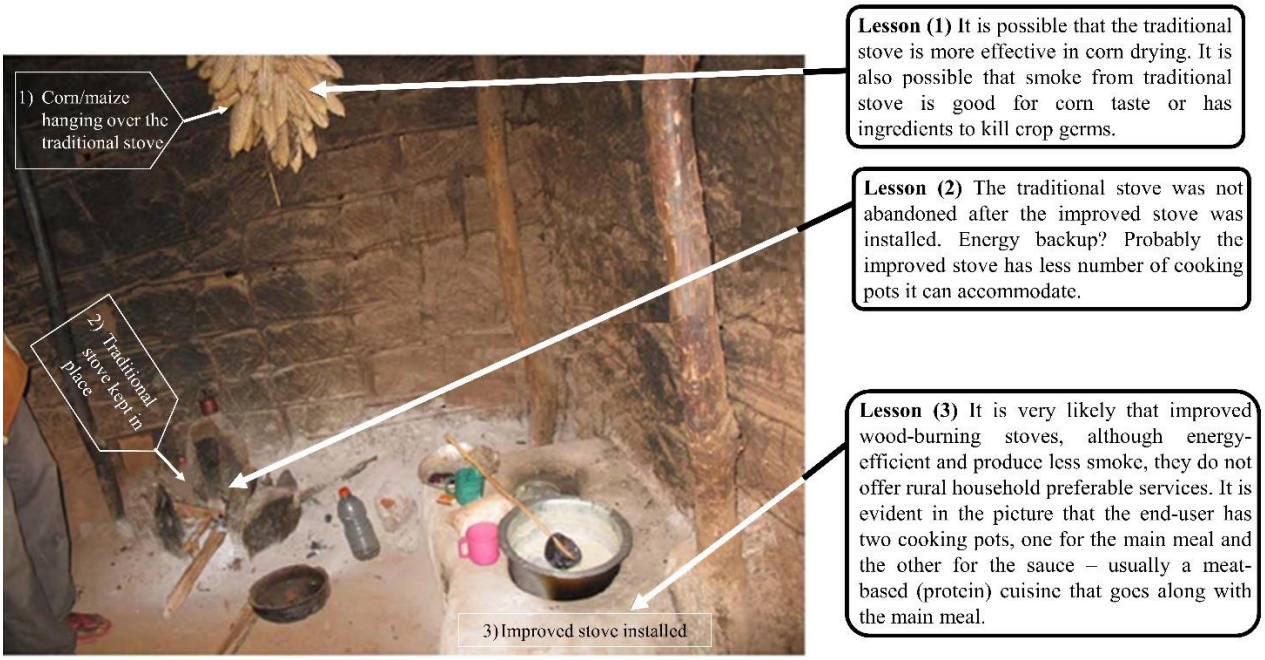

Figure 1 The food-energy nexus (FEN) portrayed in a typical rural sub-Saharan Africa kitchen. Relationships between energy, food cooking, and food storage must be considered when designing improved woodstoves for rural Africa. The photo was taken during the present study at Kuze-Kibago village, Muheza district, Tanzania.

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