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Household Fuel Consumption Based on Multiple Fuel Use Strategies: A Case Study in Kibera Slums

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Abstract

Recently, it has been argued that, contrary to earlier energy ladder thinking, households in developing countries do not switch to modern energy sources but instead tend to consume a combination of fuels. This article aimed to gather a better understanding of the relative importance of fuel substitution and fuel complementation, especially among charcoal, fuel briquettes and kerosene, and the factors associated with these choices. In this paper we present results of a household survey conducted during October 2010 in Kibera slums in Nairobi, Kenya. The results revealed that widely various household characteristics influence demand for charcoal and briquettes for cooking. In addition to these factors, the household income level affects the use of kerosene for cooking. At the same time, we found the fact households tend to switch to multiple fuels strategy as their increasing in income instead of completely switching from the consumption of traditional fuels to modern energy sources.

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1. Introduction

Woody biomass, especially charcoal, is well known to be an important energy source in Kenya. Urban households in informal settlements are almost entirely reliant on charcoal for their basic cooking energy needs

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[1]-[4]. Charcoal is preferred because it produces little smoke and its calorific value is twice as that of wood and lasts longer, especially when used with improved cook stoves. Charcoal is regarded as affordable, economical, and convenient. Moreover, its extensive distribution network ensures its availability in informal settlements, makes it into one option of cooking fuels among many poor residents. A previous study has found that the annual charcoal world production in 2004 was 1.6 million tons [4]. Population increase in addition to urbanization, has led to the increasing charcoal demand in sub-Saharan Africa. This trend, coupled with inefficient charcoal production and consumption technologies, and inaccessibility to other modern energy sources, is not likely to change in near future [5].

Charcoal production is considered the major cause of deforestation, mostly due to unsustainable harvesting and inefficient production techniques [6], [7]. Charcoal is usually produced by using inefficient kilns. That means the production process of charcoal must be wasteful. For instance only 10-20% of the raw wood is converted to charcoal during its production process [4], and about 10-15% of charcoal is wasted along the supply chain as charcoal dust [8]. It is also well known that indoor air pollution from burning charcoal cause threats to health. There are severe health risks from polluted smokes especially to women and children, who spend the most time by the fire around the kitchen [9]. Substituting charcoal with electricity or liquid petroleum gas (LPG) should be one of the solutions to reduce pressures on deforestation and to reduce health risks from indoor air pollution [1]. Even though it has now become obvious that access to cleaner energy is essential, only about 30% of the population has access to electricity while 90% relies on traditional fuels for cooking and heating [10]. Regarding relations between household economic growth and energy consumption, some empirical and micro-level studies have revealed an “energy ladder” hypothesis, which states that an increase in income helps households to shift their energy source from traditional biomass to modern fuels [11]-[13]. Income is a strong key factor in explaining the substitution from private fuels to commercial energy sources [14], [15]. Additionally, market access and the distance to the forest as well as the price of modern fuel are important factors for adopting modern fuels [16].

Recently, it has been argued that, contrary to earlier energy ladder thinking, households in developing countries do not switch to modern energy sources, but instead tend to consume a combination of fuels. The study in Ethiopia has shown that households do not switch completely from biomass to modern fuels but rather increase the number of fuels used as their total expenditures rise [17], [18]. In Kenya, the adoption of fuel briquette is spreading among urban and rural area, with a huge potential to supply affordable and good quality cooking fuel, and it can also create employment and income generation. The dust produced in charcoal production processes, which still has considerable energy value, can be recycled as fuel briquette. At the same instant, however, kerosene is the most important modern energy option for the poor in Nairobi, in terms of its share in total energy expenditure. They consider it quick and easy to use, although the cost of kerosene is high [19]. Thus, they may choose among a variety of fuels, depending on their budgets, preferences, and needs [20]. This led to the concept of fuel stacking, as opposed to fuel switching on energy ladder hypothesis [21], [22].

Understanding the interfuel substitution and diversification are crucially important for policy planning aimed at facilitating sustainable development, given the multiple connections between woody biomass use and environment, health and social impacts [23]. Carefully developed and maintained data and implications on household fuel consumption should be crucially required by policymakers in order to identify, quantify, and address key issues related to household energy usage. So as to produce effective policy interventions for sustainable biomass energy development pathways it is necessary to enhance the understanding of factors affecting urban energy demand and the estimation of impacts related to that demand on rural resources [24]. It is critical to understand the factors affecting cooking energy consumption patterns, i.e., substitution and diversification of energy sources by lower-income urban households in sub-Saharan Africa (SSA), rather than simply assuming the energy ladder hypothesis. A more policy relevant and realistic theory of household energy demand is necessary, because the benefit of policies that ignore fuel stacking may be lesser than