Energy Policy 92 (2016) 409–419

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Stoves or sugar? Willingness to adopt improved cookstoves in Malawi

Pamela Jagger [a,*], Charles Jumbe [b]

[a] Department of Public Policy and Carolina Population Center, University of North Carolina at Chapel Hill, CB#8120, 211 West Cameron Avenue, Chapel Hill, NC, USA

[b] Center for Agricultural Research and Development, Lilongwe University of Agriculture and Natural Resources, P.O. Box 219, Lilongwe, Malawi

HIGHLIGHTS

- There is demand for locally produced improved cookstoves in rural Malawi.
- Environmental awareness, labor availability, and peer effects influence adoption.
- Sustained and exclusive use of improved cookstoves requires training and follow-up.

ARTICLE INFO

Article history:
Received 2 July 2015
Received in revised form
29 January 2016
Accepted 17 February 2016

Keywords:
Adoption
Biomass
Cookstoves
Fuelwood
Malawi
Sub-Saharan Africa

ABSTRACT

Malawi has set a target of adoption of two million improved cookstoves (ICS) by 2020. Meeting this objective requires knowledge about determinants of adoption, particularly in rural areas where the cost of traditional cooking technologies and fuels are non-monetary, and where people have limited capacity to purchase an ICS. We conducted a discrete choice experiment with 383 households in rural Malawi asking them if they would chose a locally made ICS or a package of sugar and salt of roughly equal value. Six months later, we assessed adoption and stove use patterns. Sixty-six percent of households chose the ICS. We find that having a larger share of crop residues in household fuel supply, awareness of the environmental impacts of woodfuel reliance, time the primary cook devotes to collecting fuelwood, and peer effects at the village-level increase the odds of choosing the ICS. Having a large labor supply for fuelwood collection and experience with a non-traditional cooking technology decreased the odds of choosing the ICS. In a rapid assessment six months after stoves were distributed, we found 80% of households were still using the ICS, but not exclusively. Our findings suggest considerable potential for wide-scale adoption of low cost ICS in Malawi.

1. Introduction

Approximately 3 billion people or 40% of the global population rely on solid fuels including fuelwood, charcoal, crop residues, and dung for cooking and heating (Pachauri et al., 2012). While several countries have made considerable gains with respect to access to modern fuels and improved cooking technologies (e.g., Brazil and China), transitions to modern energy systems remain elusive throughout much of the developing world. Nowhere is this more pronounced than in sub-Saharan Africa, where the absolute number of people reliant on woodfuels (fuelwood and charcoal) to meet basic household energy needs will increase in coming decades (Riahi et al., 2012). Heavy reliance on woodfuels has implications for human and terrestrial systems. Fuelwood is the most important subsistence forest product (in value terms) that rural households in sub-Saharan Africa harvest (Angelsen et al., 2014; Dewees et al., 2010; Fisher, 2004; Jagger, 2012). While the region is urbanizing, this does not necessarily reduce woodfuel dependence; city dwellers rely heavily on charcoal for their daily cooking needs (Bailis et al., 2015). In sub-Saharan Africa woodfuels account for 75% of total wood harvest, contributing to deforestation (in hotspot areas, for example Ethiopia) and more commonly forest degradation (Ibid). Obtaining energy from wood is a massive mobilization of resources, carried out by millions of people every day, resulting in large burdens on both people and environment (Masera et al., 2015).

Despite persistent efforts by the energy and natural resource management communities, transformations in the domestic household energy sector have proven elusive over the past several decades (Arnold et al., 2006). Policy frameworks for reducing woodfuel consumption include regulations governing fuelwood

* Corresponding author.
E-mail address: pjagger@unc.edu (P. Jagger).

http://dx.doi.org/10.1016/j.enpol.2016.02.034
0301-4215/

harvesting and charcoal production (Schure et al., 2015), introduction of modern fuels (e.g., electricity and liquid petroleum gas), and promotion of energy saving cooking technologies (Schure et al., 2014). Our study focuses on adoption and sustained use of improved cookstoves (ICS) as a policy that is being widely promoted in the region to reduce environmental impacts and improve the well-being of rural people, but which to date has had limited traction in rural African settings.

Two streams of new knowledge have rekindled the interest of the international development community and brought new attention to addressing household energy issues. First, there is a growing body of evidence on the role of household air pollution (HAP) from cooking with solid fuels and traditional cooking technologies as a risk factor for a variety of health outcomes including acute respiratory infection (ARI) among children under five years old, chronic obstructive pulmonary disease (COPD) and chronic obstructive lung disease for women, low birth weight and a host of other acute and chronic illnesses (Ezzati, 2005; Ezzati et al., 2002; Smith, 2000; Smith-Sivertsen et al., 2009). The 2010 Global Burden of Disease Study reports that household air pollution (HAP) and ambient particulate matter (PM) accounted for 3.5 million and 3.1 million deaths respectively, and 4.5% and 3.1% of global disability adjusted life years (DALYs). While HAP decreased from 2nd to 4th in the global ranking of DALY risk factors between 1990 and 2010, it remains the second most important risk factor globally for women (who do most of the cooking in developing countries), and the 2nd most important risk factor, after childhood underweight, in sub-Saharan Africa (Lim et al., 2012).

Second, the role of incomplete combustion from burning solid fuels and reliance on traditional cooking technologies in regional climate change has been documented (Hicks and Demkine, 2011; Ramanathan and Carmichael, 2008). Black carbon or 'soot' from burning biomass fuels has been identified as the second largest contributor to anthropogenic climate change after carbon dioxide emissions. Net emissions from unsustainable harvesting of woodfuels are estimated to contribute 2–8% of global anthropogenic climate forcing, and 20% of black carbon emissions globally (Masera et al., 2015). Moderating chronic disease and mitigating climate change are viewed as a 'double-dividend' public investment; actions relating to energy use and behavior choices could have large and immediate impacts on both local health and greenhouse gas emissions (Kandlikar et al., 2009; Smith and Balakrishnan, 2009; Smith et al., 2010).

This paper focuses on willingness to adopt improved cookstoves (ICS) in Malawi where household air pollution from traditional cooking is the most important risk factor for burden of disease (IHME, 2013), and regional climate change is a pressing issue (Ahmed et al., 2009; Fullerton et al., 2009; Martin et al., 2014). Malawi is also an important case as it has relatively high rates of deforestation, suggesting that some parts of the country will experience fuel scarcity in the coming years (Bandyopadhyay et al., 2011; Hansen et al., 2013; Kamanga et al., 2009). Woodfuels primarily sourced from natural forests account for more than 90% of energy consumption (Jumbe and Angelsen, 2011). Only five percent of the population has access to electricity which is delivered at relatively high cost and with unreliable service (MARGE, 2009). Biomass burning from domestic cooking, small-scale industry, agricultural processing, and clearing of forests for agriculture contributes to regional climate change; the Government of Malawi estimates that forest-based emissions account for nearly 80% of the nation's overall carbon-footprint (GoM, 2015).

In January 2013, the Government of Malawi announced a target of distributing two million clean and efficient cookstoves throughout the country by 2020. This is a particularly ambitious policy objective given that over 90% of households currently burn solid fuels using traditional three-stone stoves. By 2020 there will be an estimated four million households in Malawi. If successful, half of all households in Malawi will have adopted improved cookstoves. As part of a study on linkages between forests, energy and livelihoods we conducted an experiment on ICS adoption in two field sites in rural Malawi. To understand underlying preferences for improved cooking technologies, we carried out a discrete choice experiment in which survey respondents were asked to choose between a low cost locally produced ICS (locally referred to as the *'chitetezo mbaula'* meaning *'protecting stove'*), and a package of dry goods including sugar and salt, common kitchen staples, of equal cash value to the ICS. After all surveys were completed in a village, respondents were given their choice, along with a brief tutorial for those who chose stoves. We quantitatively test a comprehensive set of hypotheses related to cookstove adoption. Six months after the ICS were distributed we conducted a rapid assessment to evaluate levels of adoption and the extent of utilization. Our approach is to comprehensively test several factors hypothesized to motivate cookstove adoption.

In anticipation of high levels of public investment in interventions aimed at providing incentives for households to transition to cleaner fuels and technologies, there is a need to strengthen the relatively weak theoretical and empirical evidence base on determinants of adoption. Several recent meta-analyses have reviewed the literature on improved cookstove adoption including Lewis and Pattanayak (2012), Puzzolo et al. (2013), and Rehfuess et al. (2013). Much of the research on ICS adoption is focused on household-level determinants including income, household size and education levels (Chen et al., 2005; Duflo et al., 2008; Gupta and Kohlin, 2006; Heltberg, 2005; Kavi Kumar and Viswanathan, 2007; Khushk et al., 2005). Several factors are known to increase the likelihood of ICS adoption including household income, education (especially for females), household size, and access to credit (Edwards and Langpap, 2005). Female-headed households tend to adopt cleaner fuels and technologies (Lewis and Pattanayak, 2012). Factors such as house ownership and presence of a kitchen also influence households to adopt stoves (Rehfuess et al., 2013). Information or level of awareness is generally associated with adoption: perceptions of reduction in smoke-related health effects, risk of burns and house fires; and increase in cleanliness (i.e. cleaner homes and vessels) have been identified as enablers of stove adoption and utilization (Barnes et al., 2012; El Tayeb Muneer and Mukhtar Mohamed, 2003).

Several factors are known to reduce the likelihood of ICS adoption. Prioritization of other basic needs relative to improved stoves, and reliance on free traditional stoves may deter households from purchasing improved stoves (Mobarak et al., 2012). Rural households and marginalized social groups are less likely to adopt ICS (Lewis and Pattanayak, 2012). Other barriers to ICS adoption include capital costs and poor stove designs that are not complementary to traditional cooking practices (Pandey and Yadama, 1992; Troncoso et al., 2007). For example, Barnes et al. (1994) found that stoves that are similar to a traditional stove, designed according to consumer preference, easy to light, use different wood sizes, and are produced by local artisans using local materials have the highest adoption rates.

The issue of free, subsidized or full cost stoves has gained a lot of attention in light of recent ICS interventions and programs. Stove cost, stove subsidies, flexible pricing schemes, and access to credit are factors that determine stove adoption (Rehfuess et al., 2013). Stove demonstrations and 'word-of-mouth' are important for stove demand creation, while strength of production, dissemination and maintenance of stoves determine a business model's sustainability in the long-run. Miller and Mobarak (2011) found that women preferred improved stoves when offered free of cost, but other evidence (Barnes et al., 1994) suggests that stove