

Authors

Mushfiq Mobarak
Yale University

Grant Miller
Stanford University

Puneet Dwivedi
University of Georgia

Robert Bailis
Stockholm Environment Institute

Lynn Hildemann
Stanford University

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Low demand for nontraditional cookstove technologies

Ahmed Mushfiq Mobarak^{1,2}, Puneet Dwivedi³, Robert Bailis⁴, Lynn Hildemann⁵, and Grant Miller⁶

¹School of Management, Yale University, New Haven, CT 06511; ²School of Forestry & Environmental Studies, Yale University, New Haven, CT 06511; ³Department of Civil and Environmental Engineering, Stanford University, Stanford, CA 94305; and ⁴School of Medicine, Stanford University, Stanford, CA 94305

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Biomass combustion with traditional cookstoves causes substantial environmental and health harm. Nontraditional cookstove technologies can be efficacious in reducing this adverse impact, but they are adopted and used at puzzlingly low rates. This study analyzes the determinants of low demand for nontraditional cookstoves in rural Bangladesh by using both stratified random and nationally representative survey of rural women and revealed preferences (derived by conducting a choice-experimental trial of cookstove pilot approaches). We find consistent evidence across both analyses suggesting that the women in rural Bangladesh do not perceive biomass air pollution as a significant health hazard, prioritize other basic developmental needs over nontraditional cookstoves, and overwhelmingly rely on a free traditional cookstove technology and are therefore not willing to pay much for a new nontraditional cookstove. Efforts to improve health and climate environmental harm by promoting nontraditional cookstoves may be more successful by designing and disseminating nontraditional cookstoves with features valued more highly by users, such as reduction of operating costs, even when those features are not directly related to the cookstove's health and environmental impacts.

consumer demand experiment | technology adoption | development economics

Biomass combustion with traditional cookstoves is the primary source in developing countries of indoor air pollution (1), a major global health hazard (1–4). A conservative estimate suggests that exposure to indoor smoke from unimproved household fuel combustion is responsible for nearly 3% of the global disease burden and 4% of the disease burden in the high-mortality developing regions of the world (5, 6). Beyond health impact, traditional cookstoves have substantial environmental consequences as well. Traditional cookstoves are inefficient, burning only 5–15% of biomass energy (7). As a result, users collect large quantities of fuel from surrounding fields and forests, potentially decreasing agricultural productivity and contributing to forest degradation (8, 9). Traditional cookstoves also contribute to global warming (10). Incomplete combustion releases heat-trapping pollutants, including methane and black carbon, which have a greater global warming impact than carbon dioxide does per unit of carbon emitted (11, 12). Unsustainable harvesting of biomass fuel compounds this problem because carbon dioxide emitted during combustion is not sequestered by subsequent plant growth. Despite these negative effects, half of the world's population and 75% of South Asians continue to burn solid fuel in inefficient traditional cookstoves for cooking and heating (13, 14). Many governments and development organizations have attempted to reduce indoor air pollution by disseminating cleaner-burning cookstoves (15), but the adoption and use of these nontraditional cookstoves in the developing world has, with few exceptions, remained disappointingly low (16). The primary exception is China (17, 18). Low rates of adoption may be attributable to different ideas of what constitutes improvement over traditional cookstove technologies. Cookstove developers typically focus on fuel savings, health improvements, or, increasingly, greenhouse gas emission reduction. However, depending on the technology, the so-called “improved” cookstoves may not bring improvements in all of these dimensions.¹ Moreover, as our study demonstrates, health improvements and emission reductions may not be

prioritized by cookstove users. In fact, across rural Bangladesh, 96% of the population continues to cook with biomass in traditional cookstoves (20) despite years of efforts to promote nontraditional cookstove technologies (21), and 92% of rural Bangladeshi households surveyed in this study had never seen a nontraditional cookstove. In contrast to the vast body of literature on the health and environmental effects of nontraditional cookstoves,² there is a paucity of evidence on the determinants of demand for nontraditional cookstoves. Only a few studies address the determinants of clean cookstove adoption mostly by using qualitative approaches and nonexperimental evidence. Specific factors suggested to explain low adoption rates include expense (24–26), difficulty using cookstoves correctly (26), low levels of formal education (27), lack of knowledge about the benefits of nontraditional cookstoves (26, 28), mismatch between cookstove characteristics and local needs (28), and gender dynamics in household decision-making (29). With the launch of several major international efforts to disseminate cleaner cookstoves—including the United Nations Foundation's Global Alliance for Clean Cookstoves to coordinate cookstove dissemination efforts across more than a dozen UN government agencies, European government and private sector donors (30), and the government of India's National Biomass Cookstoves Initiative—the need for rigorous research on the demand for new varieties of cookstoves and effective distribution strategies has become more urgent.

This paper presents two analyses of underlying preferences for cookstove technologies in the context of rural Bangladesh. First, we report survey evidence on women's stated preferences for cookstove technologies that probes their perceptions about the harm of indoor air pollution, what attributes of cookstoves they value most highly (including health and non-health factors), and how they prioritize cookstoves relative to other basic developmental needs. Second, we present experimental evidence on households' revealed preferences for two types of nontraditional cookstove designs, one that substitutes fuel-efficiency gains and

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To whom correspondence should be addressed. E-mail: ahmed@mohob.com.

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¹Values of some cookstoves may reduce fuel consumption by increasing fuel transfer efficiency relative to traditional cookstoves but at the expense of additional efficiency, causing greater emissions of harmful pollutants and greenhouse gases. The overall effect challenged the “improved” label placed on many cookstoves and suggested that it is always to either settle upon or among the other two improvements, an objective and their own requirements in combination may result in the superior of reduced greenhouse gas emissions in other areas (16). In this paper, we use the label “nontraditional cookstove” to distinguish these new cookstove designs from the “improved” traditional cookstoves commonly used in rural Bangladesh. We intend to contribute to the literature efforts to better define and market healthier, efficient, and/or more sustainable technologies that do not simply outperform conventional technologies in the near future.

²For a review of the health impact of biomass combustion, see Smith (2) on India, Grant and Hildemann (3) on Bangladesh, and Pandey et al. (22) on China and on Smith et al. (23) on South and West Africa. In addition, Pandey et al. (17) found health and climate (18) issues the critical determinants of biomass combustion and stove design.

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stated preference (from a nationally representative survey of rural women) and revealed preference (assessed by conducting a cluster-randomized trial of cookstove prices) approaches. We find consistent evidence across both analyses suggesting that the women in rural Bangladesh do not perceive indoor air pollution as a significant health hazard, prioritize other basic developmental needs over nontraditional cookstoves, and overwhelmingly rely on a free traditional cookstove technology and are therefore not willing to pay much for a new nontraditional cookstove. Efforts to improve health and abate environmental harm by promoting nontraditional cookstoves may be more successful by designing and disseminating nontraditional cookstoves with features valued more highly by users, such as reduction of operating costs, even when those features are not directly related to the cookstoves' health and environmental impacts.

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