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Low demand for nontraditional cookstove technologies

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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 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.

consumer demand experiments | technology adoption | development economics

Biomass combustion with traditional cookstoves is the primary cause in developing countries of indoor air pollution (1), a major global health hazard (1–4). A conservative estimate suggests that exposure to indoor smoke produced by household solid-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, harnessing only 5–15% of biomass energy (7). As a result, users collect large quantities of fuel from surrounding fields and forestlands, 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 suppressed by subsequent plant growth.

Despite these negative effects, half of the world's population and 75% of South Asians continue to burn solid fuels in inefficient traditional cookstoves for cooking and heating (13, 14). Many governments and development organizations have attempted to combat 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 reductions. However, depending on the technology, the so-called "improved" cookstoves may not bring improvements in all of these dimensions.* Moreover, in our study communities, health improvements and emission reductions may not be prioritized by cookstove users. In fact, across rural Bangladesh, 90% 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,† 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 (24), 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 US 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 advertises fuel-efficiency gains and

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*Indeed, some cookstoves may reduce fuel consumption by increasing heat transfer efficiency relative to traditional cookstoves but at the expense of combustion efficiency, causing greater emissions of harmful pollutants and greenhouse gases. One recent editorial challenged the "improved" label placed on many cookstoves and suggested that it always be written with quotes to stress the idea that improvements are subjective and that some improvements in performance may come at the expense of reduced performance in other areas (98). In this paper, we use the label "nontraditional cookstoves" to distinguish these new cookstove designs from the "business-as-usual" traditional clay cookstoves universally used in rural Bangladesh. We intend no contribution to the discussion efforts to best define and market healthier, efficient, and low-emission cookstove technologies that the scientific and policy communities hope to disseminate in the near future.

†For reviews of the health impact of biomass combustion, see Smith (2) on India, Ezzati and Kammen (3) on Africa, and Pandey et al. (22) on China as well as Ezzati et al. (1) and Smith and Mehta (23). In addition, Bruce et al. (1) and Smith and Haigler (99) review the relationship between biomass combustion and climate change.

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