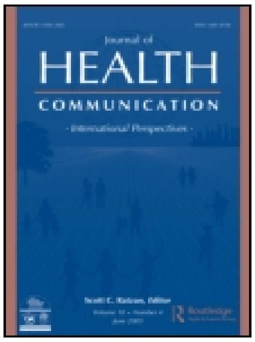

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Piloting Improved Cookstoves in India

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Despite the potential of improved cookstoves to reduce the adverse environmental and health impacts of solid fuel use, their adoption and use remains low. Social marketing—with its focus on the marketing mix of *promotion, product, price*, and *place*—offers a useful way to understand household behaviors and design campaigns to change biomass fuel use. We report on a series of pilots across 3 Indian states that use different combinations of the marketing mix. We find sales varying from 0% to 60%. Behavior change promotion that combined door-to-door personalized demonstrations with information pamphlets was effective. When given a choice amongst products, households strongly preferred an electric stove over improved biomass-burning options. Among different stove attributes, reduced cooking time was considered most valuable by those adopting a new stove. Households clearly identified price as a significant barrier to adoption, while provision of discounts (e.g., rebates given if households used the stove) or payments in installments were related to higher purchase. Place-based factors such as remoteness and nongovernmental organization operations significantly affected the ability to supply and convince households to buy and use improved cookstoves. Collectively, these pilots point to the importance of continued and extensive testing of messages, pricing models, and different stove types before scale-up. Thus, we caution that a one-size-fits-all approach will not boost improved cookstove adoption.

Almost half the world relies on solid biomass fuel for cooking purposes (Bonjour & Adair-Rohani, 2013); in India this proportion reaches almost 70%, and 90% in rural areas (Venkataraman, Sagar, Habib, Lam, & Smith, 2010). Biomass burning—especially in inefficient traditional stoves—releases high concentrations of particulate matter and other household air pollutants that are harmful to health (Smith et al., 2014). The use of solid fuels negatively affects households' well-being in other ways, because time spent gathering fuel and cooking is diverted from other productive activities (Pattanayak, Sills, & Kramer, 2004). Burning biomass also harms the environment by contributing to unsustainable harvesting of fuelwood (Bensch & Peters, 2013; Pattanayak et al., 2004), regional air pollution (Rehman, Ahmed, Praveen, Kar, & Ramanathan, 2011), and black carbon emissions (Bond et al., 2013).

One potential solution to this complex set of problems is use of cleaner-burning stoves, known as improved cookstoves (ICSs; Anenberg et al., 2013). Compared with traditional stoves, ICSs burn less fuel and decrease time spent cooking. They also emit less smoke and improve air quality and, therefore, potentially improve the health of children and cooks (e.g., Pant, Pattanayak, & Thakuri, 2014). Thus, a diverse set of interests have coalesced into a global community that is motivated toward dissemination of ICSs (Simon, Bailis, Baumgartner, Hyman, & Laurent, 2014). There is limited empirical evidence, however, of programs that have achieved the desired behavior change—ICS adoption and use—let alone the environmental and health benefits of ICSs (e.g., Hanna et al., 2012; Lewis & Pattanayak, 2012).

How should we move beyond these low levels of adoption and use of ICS? We argue that stove intervention programs can be viewed through a social marketing lens, specifically the 4Ps of "marketing mix": *promotion, product, price*, and *place* (Borden, 1964; Lee & Kotler, 2011). This perspective has previously been successfully applied in the environmental health domain, for example in the use of social mobilization, subsidies, and on-site provision to promote household latrine use in rural India (Pattanayak et al., 2009). Recently, Evans and colleagues (2014) showed how social marketing can be used to promote water, sanitation, and hygiene products and services, as well as to change behaviors. As such, social marketing is one of the tools in the behavior change communication (BCC) toolkit (Devine, 2009). These ideas behind social marketing are also consistent with a more conventional

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economic argument that households will adopt new products such as improved stoves if interventions change household constraints, for example through promotion campaigns that pay attention to consumer preferences for product attributes and price discounts (Pattanayak & Pfaff, 2009).

We apply the social marketing lens to consider elements of a BCC campaign to encourage household purchase and use of ICSs, although we give equal attention to the noncommunication aspects of social marketing such as price and place. To statistically test whether a particular behavior change campaign would work in the field, ideally we should conduct a large *n* quantitative study in the field and address the many complexities inherent in the causal chain. However, a logical precursor to large evaluations is the careful design and piloting of intervention strategies—for example, the testing of different attributes and combinations of the marketing mix—using smaller samples, case studies, qualitative appraisals or semi-quantitative approaches (Arriagada, Sills, Pattanayak, & Ferraro, 2009; Vreugdenhil, Slinger, Thissen, & Rault, 2010). Such mixed-methods or iterative field research approaches are especially critical when the questions are relatively clear, but understanding of the socioeconomic-institutional context for the behaviors in question is lacking (Kanbur, 2003). They also allow better interpretation and contextualization of results from large *n* evaluations.

On the basis of a thorough literature review, focus group (see Bhojvaid et al., 2014), and previous quantitative surveys in communities in our study regions (see Jeuland et al., 2014), we field-tested different combinations of social marketing intervention features in eight pilot villages in rural India. These pilots built on previous findings that argue in particular that (a) promotion/communication alone may be insufficient to affect behavior change (Barnes 2014; Jin et al., 2006; Pattanayak et al., 2009); and (b) limited focus on the design and/or sale of specific products (e.g., ICS prototypes that achieve emissions reduction targets) may not lead to long-term gains. Rather, behavioral outcomes (i.e., sustained ICS use and generation of benefits), which themselves moderate environmental and health impacts, define the success of social marketing campaigns (Lefebvre, 2011).

India is a pertinent location for testing ideas for accelerating ICS dissemination because it has high-level policy directives related to ICS that nonetheless face great implementation challenges. For example, the country's National Biomass Cookstoves Initiative seeks to provide 160 million ICSs to households currently using solid biomass fuel, a goal that is at least as ambitious as the Global Alliance for Clean Cookstoves global target (Venkataraman et al., 2010). However, households in our study area however appear to have very limited understanding of the adverse effects of traditional cooking practices, strong entrenched preferences for traditional stoves, and somewhat limited but highly variable willingness to pay for ICS attributes (Jeuland et al., 2014). ICS adoption studies from India also find that awareness of health benefits alone is often insufficient to motivate ICS adoption (Thurber et al., 2013; Thurber et al., 2014).

Our pilot program varied in four dimensions: location and institutional context (*place*), ICS technology (*product*), the information and demonstration strategies (*promotion*) and the price and payment plans (*price*). It was conducted in cooperation with three nongovernmental organizations (NGOs) each of which focused in one of three biophysically and socio-politically different rural settings of India, namely Uttar Pradesh, Odisha, and Uttarakhand. We explored demand for three different ICS technologies, two of which burn solid fuels more efficiently (natural and forced-draft stoves), and one that runs on electricity. Information and demonstrations were provided at community or individual household levels with varying intensity. The pilots varied in allowing households to pay for stoves over time or upfront, and in delivery of price discounts.

Our results offer a set of lessons on household behavior change related to adoption and use of ICS. First, successful BCC campaigns directly engaged households while providing information and conducting personalized demonstrations. Second, we must test diverse ICS products to identify an appropriate and desirable model for the cultural setting. Third, price is a significant barrier, but offering households the possibility of paying in installments might enable purchases by cash-strapped households. Fourth, understanding context—road and transport infrastructure, supply chains and local micro-institutions— is paramount for penetrating into remote, rural locations.

Can Social Marketing Help Us Understand the Challenges of Disseminating ICS?

Despite the promise of ICS, adoption and use rates remain low in much of the world, including in India (Bhojvaid et al., 2014). Some have contended that stoves are a "push" rather than a "pull" product (unlike a technology such as cell phones), suggesting that innovative methods are required for delivering stoves to households and convincing households of their utility (Shell Foundation, 2013). Others have categorized the challenges into demand and supply side factors (Lewis & Pattanayak, 2012; Rehfuess, Puzzolo, Stanistreet, Pope, & Bruce, 2014). Here we discuss if the low rates can be understood using a social marketing framework.

Information, Education, Communication

There is a small but growing literature in economics that shows how information, education and communication can influence the adoption and use of environmental health technologies such as taps, toilets, bednets and ICSs (Pattanayak & Pfaff, 2009). The underlying premise is that poor households who would most benefit from such technologies may not know or are unable to learn about their benefits (Madajewicz et al., 2007; Opar et al., 2006). Information provision may also help overcome household reluctance to invest in new and costly goods such as ICS technologies if these reduce the perceived riskiness of these investments (Conley & Udry, 2010; Hazra, Lewis, Das, & Singha, 2014).

This evidence is partly corroborated by the ICS practitioner literature that suggests that BCC, promotion, user demonstrations, and social networks can lead to more consistent behavior change (Dalberg Advisors, 2012; Ramirez, Dwivedi, Bailis, & Ghilardi, 2012; Shell Foundation, 2013). Health communication and/or BCC that combines rational appeals (such as to decrease fuelwood use) with emotional messaging (such as improving health and improving household livelihood) would thus appear to be an important component of ICS dissemination campaigns.

Types and Attributes of Stoves

ICSs such as liquefied petroleum gas (LPG) and electric stoves have long been available in developing countries, yet the supply of electricity and LPG fuels is not always dependable. Other improved stove technologies, most notably a variety of more efficient biomass stoves, are therefore being developed to reduce the health and environmental harms caused by traditional stoves. Unfortunately, the challenges of appropriate technology persist because a health-protective emission level is likely only possible with the cleanest of stoves such as gas, electric or advanced combustion (Simon et al., 2014). Furthermore, there is often a disconnect between the ICS that may be most accepted by users (e.g., similar to their traditional stoves in design and fuel type) and those that can meet efficiency and manufacturing standards (Beyene & Koch, 2012; Jeuland et al., 2014; Shell Foundation, 2013). Thus, it is imperative to test different stoves before scaling up, as documented in several recent field programs (Derby, Rosenbaum, & Dutta, 2015; Singh, 2014).

Stove Price and Payment Collection

Prices are usually set by market forces of demand (reflecting willingness to pay) and supply (reflecting opportunity costs of resources), with the market clearing price reflecting the equality of willingness to pay and marginal cost. On the supply side, the market for most ICSs is currently too thin to have confidence that stove prices represent marginal costs that are relevant for scaled up promotion programs. There is a small literature on household demand and willingness to pay for ICS. Miller and Mobarak (2011) found very low willingness to pay for two types of ICS. Jeuland et al. (2014) find that average demand for stove attributes in rural Indian communities may reach levels comparable to some cheaper natural-draft ICS options, but that this average masks considerable heterogeneity across households. Cost would thus seem to be an important barrier to adoption, particularly for the poor.

Three other features of ICS use make it hard to decide how market price does and or should influence household demand. First, many of the effects of ICS adoption and use may be external to households (Jeuland & Pattanayak, 2012; Pattanayak & Pfaff, 2009). This raises the case for subsidizing stove purchase. Yet, programs providing ICSs to households at highly subsidized rates or free of charge (as is often done in field studies) have faced their own problems, particularly with regards to achieving sustained use (Adrianzen, 2010; Hanna, Duflo, & Greenstone, 2012). This suggests that household preferences—encompassing cultural or aesthetic preferences—and ICS proponents' expectations may not be fully aligned (Mitchell et al., 2010; Ruiz-Mercado, Canuz, Walker, & Smith, 2013).

Second, programs might want to change how they collect payments because poor rural households typically face serious credit and liquidity constraints (Adler, 2010; Pant et al., 2014). Last, programs that allow households to spread payments over time may increase ICS adoption because households may heavily discount the long-term benefits of ICS, or suffer from self-control problems (Beltramo, Levine, & Blalock, 2014).

Local Context

In social marketing, place refers to the distribution channels and outlets through which tangible products are made available to consumers (Evans et al., 2014). For example, Pattanayak et al. (2009) argued that bringing masons and materials to households so that they could have an improved toilet next to their house radically alters sanitation options in remote rural villages. A similar challenge exists for ICSs because of the remoteness of target markets. Local infrastructure (e.g., roads and the supply chain for alternative fuels) often remains underdeveloped in such locations, making transport of bulky ICSs to remote rural regions difficult (Shell Foundation, 2013).

The failure of previous ICS dissemination programs likely stemmed from insufficient attention to developing stable and accessible supply, although most evidence on this question is anecdotal (Bruce, Rehfuess, Mehta, Hutton, & Smith, 2006; Ezzati & Kammen, 2002; Shrimali, Slaski, Thurber, & Zerriffi, 2011). Therefore, there is growing recognition that ICS supply chains remain insufficient; experiences in India with clean stoves and fuels are no exception (Dalberg Advisors, 2012; Martin, Glass, Balbus, & Collins, 2011; Rehfuess, Briggs, Joffe, & Best, 2010). In contrast with the failure in India, strong government supply chain strengthening is hailed as a critical component of China's National Improved Stove Program (Smith, Shuhua, Kun, & Daxiong, 1993). Thus, it is no surprise that the Global Alliance for Clean Cookstoves prioritizes the strengthening of ICS supply chains (Global Alliance for Clean Cookstoves, 2011).

In remote settings such as ours, micro-institutions such as effective NGOs, creditors, and retailers can also be vital for delivering environmental health technologies (Pattanayak et al., 2009; Pattanayak et al., 2012). When locals are unsure about a new and costly technology, NGOs can also serve as a major channel for trust and social capital (e.g., Krishna, 2007). More generally, micro-institutions connect households to local collective action, determine flows of external support, and link local populations to national and international interventions (Agrawal & Perrin, 2009).

Designing the Pilots

Eight pilots were conducted in rural villages in three states in succession, Uttar Pradesh (three villages), Orissa (two villages), and Uttarakhand (three villages). These pilots tested various aspects of the marketing mix related to (a) BCC, (b) stove types, (c) purchase options (payment plan and risk-free trials) and use incentives, and (d) access and institutional delivery. The specific configuration of features that were tested were identified on the basis of literature reviews and extensive data collection from focus group discussions (March 2012) and a large cross-sectional survey (June through August 2012), both of which took place in communities in Uttar Pradesh and Uttarakhand similar to those where we conducted these pilots; those results are reported elsewhere (Bhojvaid et al., 2013; Jeuland et al., 2014). Collectively, these data collection activities provided valuable information on consumer perceptions and impressions of traditional and improved cookstoves, and on prevailing cooking behaviors.

The pilots were implemented over a 4-month period (March through August 2013) with iterative updates to the design based on lessons learned from earlier pilots. For example, drawing on experiences in the first two sites that revealed the importance of prior institutional presence in a target community, pilots in Uttarakhand were only implemented in villages where the partner NGO had previously worked.

All households in the pilot villages were given the opportunity to purchase a stove. In addition, in each pilot village, approximately 25 (Uttar Pradesh and Odisha) or 15 (Uttarakhand) households were randomly selected for interview.[1] Households were selected by dividing the total number of households in the village by the desired sample size and sampling every *n*th household. Those who refused to participate or could not be located on the day of the pilot visits were replaced with a neighboring household. We implemented this procedure for random selection of survey households to obtain a representative picture of the adoption process that is most relevant for efforts to scale-up ICS promotion, rather than simply talking to those households most interested in demonstrations, stoves, or visits from outsiders. The survey was used to collect information on household characteristics (demographics and socioeconomic status), perceptions of traditional and the offered improved stoves, cooking behaviors, as well as to gather real-time feedback on the effectiveness of the intervention program.

Promotion: Behavior Change Communication

Among the households participating in our initial data collection activities in Uttar Pradesh and Uttarakhand, we found that a minority (39%) were aware of stoves that produce less smoke than traditional ones, and that only 41% believed that some fuels produce less smoke than others when burned (Jeuland et al., 2014). Most of these households knew about LPG stoves but had very limited exposure to other improved cooking technologies. In addition, among households that were aware of adverse health effects from traditional cooking (68%), only 14% believed adopting a clean stove could help alleviate those effects (Pattanayak et al., 2013). Knowledge and belief that improved stoves could also improve environmental outcomes such as forest preservation and protection of regional air quality was even lower. Last, the weight placed on ICS benefits was influenced by prior exposure to technological products and experience with similar NGO environmental interventions (Bhojvaid et al., 2013).

To address these knowledge gaps and the need for additional education around the benefits of ICS, we piloted different promotional and social marketing campaigns. All pilots contained messaging around three key features: (a) time savings from reduced time spent cooking and gathering wood, (b) fuel savings, and (c) health benefits. During our preparatory work, nearly all households who knew of improved stoves had identified the first two as important benefits, while the latter was primarily mentioned by women who were the primary cooks in their particular households (Bhojvaid et al., 2014). The messages were included in various combinations of promotional materials and subsequently explained as part of the BCC strategy.

Informational pamphlets were used in each pilot to compare various attributes of traditional and improved stoves, although the specific content of the pamphlet varied by pilot location. The information sheet contained both Hindi text and visual icons for illiterate households. The promotional material compared the stoves on the basis of their differential fuel requirements, cooking times, smoke emissions, and prices. For example, in Pilot F (Figure 1), the fuel requirement of the natural-draft stove is shown as 70% of the traditional stove requirement with written percentages, as well as a photo of a woman carrying a smaller pile of wood and symbols representing proportionately less wood; the electric coil stove is shown with a crossed out symbol for wood. In pilots where an electric stove was offered, households were informed about the anticipated effect of the electric stove on their monthly electricity bill.

Household visits were included in all pilots. During the household visits, the stove sales staff carefully explained the benefits of the ICS depicted in the promotional pamphlet. Health communication included a discussion of the adverse effects of smoke inhalation for respiratory health and eye problems, particularly for the cook and nearby children. BCC also included description of general livelihood benefits, such as the ability to carry the biomass stoves to cook in different locations in or outside the house. Visits at each household ranged from 15 minutes (in the basic variety subsequently detailed) to 1 hour (in the more intense option below). The sales staff pointed to the informational sheet (which was left with the household) as they described the benefits of the stove.

We attempted three levels of intensity for our BCC strategy:

- At the most basic level (“Basic”), households received informational pamphlets and private stove demonstrations

[1]Actual sample sizes were slightly different (Pilots A, B, C, D, and E: 25 households, Pilot F: 16, Pilot G: 15, Pilot H: 14) as a result of households not being at home during repeated visits or enumerator error.

(A)

	BUY AN IMPROVED STOVE. SAVE YOUR FAMILY AND YOUR FORESTS.		
STOVES TYPES	Traditional *angithi* stove	Improved wood stove	Improved electric stove
FUEL REQUIREMENT	Most firewood use (100%)	Compared to traditional stove, uses 70% of the firewood	Uses electricity. Does not use firewood
COOKING TIME REQUIREMENT	Takes the most time to cook	Takes less time (compared with traditional stoves)	Takes the least time (compared with traditional stove)
SMOKE AND POLLUTION	Most smoke released (100%)	Less smoke (65% compared with traditional stove)	No smoke
ELECTRICAL FEATURES	None	None	As with all electrical products in rural India, use care. Ground your outlets and, during rainy season, wear rubber soled shoes.
PRICE OF STOVE	0 Rs.	1,300 Rs.	900 Rs. Monthly electricity bill will increase with use of the electric stove. For example, daily 1-hr stove use will lead to a bill of approximately Rs. 260 over 2 months and daily 2-hr stove use will lead to a 2-month bill of approximately Rs.525
INSTALLMENTS	0	675 Rs. in two installments biweekly	470 Rs. in two installments monthly
	Less fuel. Less time. Less smoke. Healthy family.		

(B)

Fig. 1. (A) Promotional pamphlet in Hindi for Pilots F and G showing the traditional stove, natural-draft stove, and an electric stove, with (B) English translations.

during single-day visits conducted by trained ICS sales teams. Also, to allow users to become more familiar with the ICS, a few demonstration stoves were left overnight before taking final orders in Pilots A and B in Uttar Pradesh.

- At a more intensive level (“Basic Plus”), an extended promotional campaign was conducted over a week. This included hanging informational posters throughout the targeted community, delivering flyers to every household in advance of ICS demonstrations, and multiple community demonstrations during which ICS benefits were described at length. Sales teams collected names of interested households and returned the following day to complete sales. If randomly selected households had not seen the demonstration, they were given a private one. This strategy was used in Pilots C (Uttar Pradesh), D, and E (Odisha).
- At the most intensive level (“Intensive”), used in Pilots E, F and G (Uttarakhand), households received a personal stove demonstration and informational meeting lasting 1 hour at which they had the opportunity to purchase the stove (see Table 1).

Table 1. Summary of pilot intervention features

	Product			Pricing plan				Place					
Pilot	Forced draft	Natural draft	Electric	Full upfront payment	Installments	Rebates conditional on use	Optional stove return	State	NGO	Near highway?	Promotion: Social marketing/ behavior change communication[a]	Total sales (sales in random sample)	% HH purchase (% purchase in random sample)
A	✓	✓		✓		✓		Uttar Pradesh			Basic	0 (0)	0 (0)
B	✓	✓			✓				✓		Basic	2 (2)	8 (8)
C		✓			✓	✓			✓		Basic Plus	3 (0)	1 (0)
D		✓			✓	✓		Odisha	✓		Basic Plus	14 (6)	23 (46)
E		✓			✓					✓	Basic Plus	4 (1)	4 (8)
F		✓	✓		✓	✓		Uttarakhand	✓		Intensive	19 (6)	40 (38)
G		✓	✓		✓		✓		✓		Intensive	17 (9)	31 (60)
H		✓			✓	✓			✓		Intensive	2 (2)	7 (14)

Note. NGO = nongovernmental organization.
[a]Basic: pamphlets and household demonstration; Basic Plus: pamphlets (in advance), village posters, community and household demonstration; Intensive: new pamphlets and extended household visit (in advance), community and household demonstration.

The "messengers," or sales staff, differed by region. In Uttar Pradesh, young men, some of whom already sold energy products, were trained in ICS sales. An experienced stove salesman from the stove manufacturer also helped with the demonstrations for Pilot C. In Odisha, NGO village workers accompanied and provided support to a team of experienced male ICS salespeople from a local sales organization. The most extensive recruiting and training of male and female stove sales staff was conducted in Uttarakhand.

Product: Stove Type

Households were found during preparatory work to have varying preferences for ICS features and fuel requirements, but only had substantial experience with LPG (which was owned by about 20% of households in our preparatory survey; Jeuland et al., 2014). We therefore offered three distinct stove technologies in our pilots, which were not available in these locations but were manufactured and could be purchased in India. We did not attempt to test emissions or modify the designs of these improved stoves in the field. Instead, the stoves—a natural-draft biomass ICS, a forced-draft biomass ICS and an electric coil stove—were selected to offer varying characteristics (relative emissions and fuel requirements, prices, and operation and maintenance costs). We only selected stoves that are on the list of "approved" ICS published by the Indian Ministry for New and Renewable Energy (2014) or, in the case of the electric stove, that had zero household emissions (the Ministry for New and Renewable Energy does not test electric stoves). And while the preparatory focus groups had indicated that women would prefer a double-pot stove that would reduce the time required for cooking (Bhojvaid et al., 2014), no double-pot stove that passed the government criteria for smoke and fuel reductions existed in the market at the time of the study.

The forced-draft ICS (the TERI SPT-0610, sold for 2,700 rupees [Rs. 2,700]) has a thermal efficiency of 37%, carbon monoxide emissions of $2.25\,g/MJ_d$, and total particulate matter emissions of $147.40\,mg/MJ_d$ (Ministry for New and Renewable Energy, 2014), and gains efficiency because it uses a fan powered by a battery. This stove requires wood to be chopped into small pieces and inserted from the top. The natural-draft ICS (Greenway Smart Stove) has a thermal efficiency of 24%, carbon monoxide emissions of $3.0\,g/MJ_d$, and total particulate matter emissions of $315.38\,mg/MJ_d$ (Ministry for New and Renewable Energy, 2014); it was sold for Rs. 1,300. Wood is inserted into the front of this stove. The electric stove uses a heated coil and emits zero household air pollution; it cost households Rs. 900 and was only piloted only in Uttarakhand. In some pilot villages, households were only offered a single stove, whereas in others, households had a choice of purchasing one or more different types. Ultimately, piloting several ICS also allowed us to observe the penetration of their supply and distribution networks.

Pricing and Payment Plan

The natural-draft and electric stoves were sold at the manufacturer suggested retail price, whereas the more expensive forced-draft stove was partially discounted (the manufacturer suggested retail price is Rs. 4,000). All three come with a one year warranty provided through the retailer, which covers the buyer in the event of serious defects in the ICS (the warranty only covered the coil element in the electric stove). In pilots where the electric stove was offered, households were informed about the anticipated effect of the electric stove on their monthly electricity bill (Figure 1).

The stoves described above have costs equivalent to about 25% to 77% of monthly expenditures among households in our sample (Rs. 3,500 [US$60] on average across all pilots). They therefore represent significant investments, and we expected based on our preparatory surveys that many potential purchasers—especially the poor and women—would have difficulty producing the cash required to pay for an ICS upfront even if they wanted it (Jeuland et al., 2014). These survey data also strongly suggested that liquidity constraints would be an important obstacle to stove purchase; access to credit was limited to 34% of households (ranging from 9% in Uttar Pradesh to 64% in Uttarakhand). Further, a minority of households were members of microfinance or credit groups (ranging from 9% in Uttar Pradesh to 62% in Uttarakhand). We therefore piloted several plans that allowed households to pay for the stove in installments (Pilots B–H). Participation in these installment plans was optional; any household could still choose to purchase a stove with a single upfront payment. The number of installments varied from three to four depending on the pilot, the fee associated with the installment plans was equivalent to 2% of total stove cost added on to each installment. The interval between payments varied from 2 to 3 weeks.

Households might also be wary of paying a large amount for a product with which they had limited experience. So we also piloted an optional return policy (Pilot G), which allowed households to return a stove at any time if they were unsatisfied with it. In such cases, the household would forfeit any payments already made toward the purchase of the stove, but would not be responsible for additional installment payments.

The benefits of adopting an ICS can only be realized if their use is sustained over time, and adjustment or learning costs may discourage uptake (Jeuland & Pattanayak, 2012; Ruiz-Mercado, Masera, Zamora, & Smith, 2011). Thus, to incentivize both adoption and short-term learning about these technologies, we included rebates in some of the pilot villages (Pilots A, C, D, F, and G). These rebates were only delivered if the household continued to use its purchased ICS over the entire installment collection period. During this period, household stove use (for all stoves owned) was recorded by the sales teams every 2–3 weeks (via household self-reports with verification of signs of stove use by enumerators) in conjunction with the visits to collect installments. During each visit that households were found to be using their purchased stove, they received a Rs. 50–100 rebate that would count against the payment of the installment that was due.

Place: Context, Institution, and Access

We conducted our pilots in three Indian states that differed in extent of economic development and market access. The sites were selected to allow for variation in the presence and nature of local NGOs and infrastructure, and therefore in the geography and connectivity of the sites (Table 2).

The pilots required development of a new supply network for ICS because there were no retailers located near our study sites. Indian regulation prohibits shipments across state boundaries by organizations without a tax identification number such as NGOs (compared with registered businesses that have tax identification numbers). In addition, although the three ICS are sold with a 1-year manufacturers' warranty, it is usually not practical for a household to act on this warranty because it would have to travel 1–2 days to reach the retailer. Last, local suppliers were unwilling to order large numbers of ICS without a payment guarantee, which could not be provided in advance. Thus, our partners collaborated with local wholesalers to order and transport ICS to our sites, purchasing 20–50 ICS at a time to minimize financial risks.[2]

Given these challenges, it was thus critical to partner with NGOs who were among a small number of micro-institutions working or interested in working to disseminate clean energy products (and ICS) in our pilot regions. These NGO partners had varying degrees of knowledge of and relationships with local communities, all of which affected the supply chain in our pilots. Our Uttar Pradesh partner was a research organization headquartered in New Delhi and working in policy research, rural livelihoods, energy needs and sustainable development. Pilot villages (A–C) were chosen to vary according to the NGO's prior presence in the community from a set of villages situated near to this organization's local office and accessible by paved roads. Our Odisha NGO partner was headquartered in a rural setting; they focus on water, sanitation, education, livelihood and energy programs throughout the state. Pilot locations there—one from a tribal area (D) relatively near to the NGO office; the other from farther away near a highway (E)—were selected from villages where this partner had previously worked. In Uttarakhand, we worked with a rural NGO whose programs emphasize improved livelihoods, health, education, and natural resource management across several districts. The Uttarakhand pilot villages (F–H) consisted of dispersed and isolated communities located in the Himalayan foothills where our partner had also previously worked; the intensity of NGO livelihood programs was greater in Pilots F and G than in Pilot H.

Given the fact that no point of sale existed for these ICS in the study areas before these programs, the improved stove sales offer was delivered by the sales teams at the dwelling of all randomly selected households. In some pilots (C–H),

[2]In Uttar Pradesh, this problem was somewhat reduced; a small network of energy entrepreneurs were beginning to sell ICS but only had the capital to stock a few stoves at a time.

Table 2. Characteristics of pilot villages, by village (Pilots C–H)

	Uttar Pradesh	Odisha		Uttarakhand			Full sample
	C	D	E	F	G	H	
Household characteristics							
Total number of households	23	25	24	16	15	14	117
Below poverty line (%)	48	56	29	81	80	50	55
Open/general caste (%)	4	0	0	75	93	93	34
Household size	6.1	5.0	4.7	6.7	6.3	6.0	5.7
Female-headed household (%)	13	8	13	6	20	7	11
Head of household years of education	5.3	3.4	6.9	8.1	5.0	6.8	5.7
Head cook years of education	1.4	1.9	4.9	5.8	2.9	6.7	3.6
Self help group membership (%)	9	44	71	69	53	64	50
Number of hours of electricity per day	5.0	20.0	17.5	19.6	20.1	20.9	16.6
Average monthly expenditures (rupees)	3,370	1,776	2,492	5,250	3,900	6,143	3,506
Latrine access (%)	9	96	92	100	93	100	79
Fuelwood used for heat (%)	100	96	54	94	100	100	89
With savings (%)	52	48	63	31	40	86	53
Taken out a loan (%)	9	20	17	69	73	50	34
Stove/fuel use							
Traditional stove ownership (%)	100	96	96	94	100	100	97
Improved stove ownership (%)	9	0	29	75	27	79	31
LPG stove ownership (%)	9	0	25	60	27	64	26
Average time spent gathering fuel (all traditional fuels) in hours per week	16.3	5.2	3.7	20.1	23.7	12.1	12.3
Average rupees spent on traditional fuels per week	43.7	0.0	29.0	0.0	0.0	0.0	14.5
Average rupees spent on clean fuels per week	11.1	0.0	107.2	237.8	62.2	145.1	82.0
Preferences for stove attributes (%)							
ICS top 2 attribute: reduced smoke	74	40	0	38	7	57	42
ICS top 2 attribute: cooking time	11	47	1	56	67	14	42
ICS top 2 attribute: fuel requirement	21	93	1	44	40	64	54
ICS bottom 2 attribute: cost	42	100	95	33	33	77	63
ICS bottom 2 attribute: maintenance	0	10	0	75	0	15	14

Note. LPG = liquid petroleum gas; ICS = improved cookstove; 55 Rs. = US$1.

households were also able to purchase the stove at community demonstrations.

Differences in connectivity, geography, and the local economy of our pilot sites also translated into a range of different fuel and stove use situations; this was intentional given our objective. Prior to our pilots, although virtually all households owned traditional stoves, rates of ICS (LPG, biogas, or kerosene) ownership varied widely (Table 1); they were greatest in Uttarakhand (>60% of households owned improved stoves in two pilot villages), but much lower in Uttar Pradesh (9%) and Odisha (0% in D and 25% in E). Rates were slightly lower for LPG. Average time spent gathering traditional fuels also varied by pilot location: households in Uttarakhand and Uttar Pradesh spent the most time (all village averages were more than 12 hours per week) compared with 5 hours per week or less in Odisha. Households in Uttarakhand did not pay for traditional fuels, unlike households in Uttar Pradesh and Odisha. Conversely, Uttarakhand and Odisha households spent the most money on clean fuels.

With respect to household characteristics, Uttarakhand households were much more likely to be in the open or general caste designation, and were wealthier and more educated than their counterparts in Uttar Pradesh or Odisha. Electricity supply in the Uttar Pradesh communities was much lower (ranging from 0 to 10 hours per day) than in those in Odisha (0 to 21 hours) and Uttarakhand (15 to 22 hours). Uttarakhand and Odisha villages were more remote compared with Uttar Pradesh villages. The fraction of households that have taken out a loan was far higher in Uttarakhand than in the other states where pilots were conducted.

Several differences are also notable at the level of individual pilot villages. The Pilot C village, for example, stands out for the very low percentage of households in open or general caste categories, few years of education for primary cooks, low latrine coverage, and low access to credit compared with the other villages. This village also has the greatest percentage of households that value the reduced smoke from ICS. Pilot E (Odisha) had the highest SHG membership, the lowest percentage of households that use fuelwood for heat, and the lowest time spent gathering traditional fuels. In the Pilot F village (Uttarakhand) education levels were higher; this village also had fairly high baseline ownership of improved stoves and spending on clean fuels. Approximately

20% of the households in the Pilot G village (Uttarakhand) had female heads, which stands out from the other villages; households in this village spend the most time gathering wood and also expressed the lowest preference for reduced smoke from ICS. Pilot H (Uttarakhand) had substantially higher average monthly expenditures than any of the other villages, as well as noticeably greater access to savings and credit. This village also had by far the highest baseline level of improved stove ownership.

Pilot Findings

Stove sales varied widely in these pilot programs: within the random sample of households selected for targeted demonstrations and surveys, sales varied from 0 (Pilot A, Uttar Pradesh) to 60% (Pilot G, Uttarakhand; Table 3 and Figure 2). Across all pilots, 18% of randomly selected survey households (26 out of 146 households) purchased an ICS. Stove sales varied substantially by state. In Uttar Pradesh, Odisha, and Uttarakhand villages, 3%, 27%, and 38%, respectively, of randomly selected households purchased ICS, with one household purchasing two stoves in Uttarakhand. The total rate of stoves sold to any households in these three states were 2% in Uttar Pradesh, 11% in Odisha, and 29% in Uttarakhand. While our design precludes us from conducting rigorous causal analysis or controlling for village-level differences, we present t tests results for differences in means that suggest some noteworthy differences between households that bought and those that did not (Table 3). Overall, households that adopted ICS were significantly more likely to have access to a latrine (27%, $p = .00$), own cell phones (22%, $p = .00$), and to have taken out a loan (36%, $p = .00$) than nonpurchasers.

Promotion

In Uttarakhand, only 7% (3 of 45) randomly selected households indicated they had heard of ICS before observing a stove demonstration. After the demonstrations, households indicated that the ICS attributes they found most desirable were amount of fuel required (54%), reduced smoke emissions (42%) and reduced time spent cooking (42%; Table 1 and Figure 3). This is in keeping with consumer aspirations that emerged from prior work (focus group discussions and baseline). These stove attributes were explicitly highlighted in the information campaign, suggesting that the informational materials and stove demonstrations likely influenced households' thinking about the ICS. The majority (63%) of randomly selected households cited cost as the least desirable aspect of the ICS. Purchasers were significantly more likely to value a reduction in cooking time, whereas nonpurchasers were much less likely to value smoke reduction ($p = .000$). Purchasers may have also highly valued smoke reduction, but it fell below their desire for reduced cooking time and fuel requirement. Purchasers spent on average 5 hours or more collecting fuel than nonpurchasers, and though they spent less money on fuel, the numbers of households paying for fuel and amounts involved were very small (Table 3).

Table 3. Test for differences in means between purchases and nonpurchasers for randomly selected households (Pilots C–H)

Variable	Purchasers ($n = 24$)	Nonpurchasers ($n = 93$)	p
Promotion			
Household received pamphlet	92%	76%	.036**
Household attended demonstration	88%	73%	.084*
Household characteristics			
Female-headed household (%)	13%	11%	.817
Head of household years of education	5.6	5.8	.912
Head cook years of education	3.2	3.8	.5
Below poverty line	71%	51%	.061*
Open/general caste	63%	27%	.002***
Self help group membership	67%	45%	.053*
Latrine access	100%	73%	.000***
With cell phone	91%	69%	.004***
With cattle	88%	74%	.108
With savings	46%	55%	.435
Taken out a loan	63%	27%	.002***
Fuelwood used for heat	96%	87%	.109
Household size	6.5	5.5	.118
Number of cooks in household	2.1	1.8	.302
Average monthly expenditures (rupees)	3563	3491	.86
Number of hours of electricity per day	20	16	.000***
Stove/fuel use			
Traditional stove ownership	100%	97%	.0836*
Improved stove ownership	29%	31%	.849
LPG stove ownership	17%	28%	.256
Average rupees spent on traditional fuels per week	3	18	.008***
Average rupees spent on clean fuels per week	68	85	.592
Average rupees spent on LPG per week	133	91	.447
Average time spent gathering fuel (all traditional fuels) in hours per week	16	11	.062*
Preferences			
ICS top 2 attribute: reduced smoke	9%	53%	.000***
ICS top 2 attribute: cooking time	66%	33%	.007***
ICS top 2 attribute: fuel requirement	62%	53%	.447

Note. LPG = liquid petroleum gas; ICS = improved cookstove; 55 Rs. = US $ 1.
*** $p < .01$. ** $p < .05$. * $p < .1$.

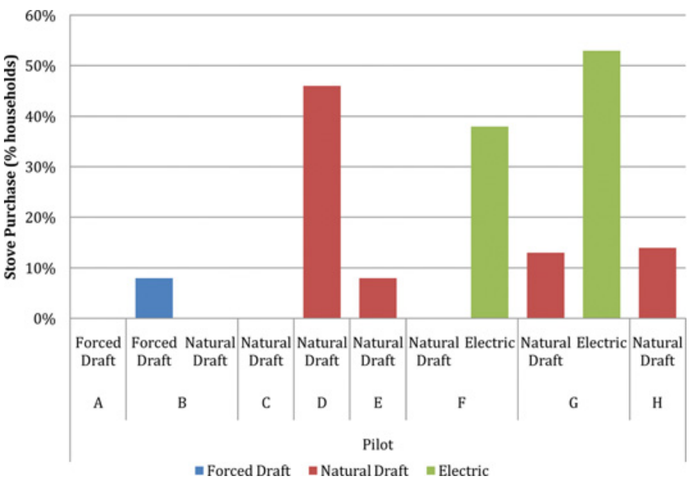

Fig. 2. Stove purchase, by randomly selected households. One household in Pilot G that purchased an electric stove also purchased a natural-draft stove.

As shown in Table 3, the BCC campaign appears to have influenced sales. Purchasers were 15% ($p = .08$) more likely to have attended a demonstration and 16% more likely to have remembered receiving a pamphlet ($p = .03$). Stove sales were also greatest in the villages with more intense marketing: in villages with the basic BCC campaign (A and B), only 4% of survey households purchased stoves, compared with 38% in villages with more extensive social marketing (C through H; Figure 4A).

Product

When households were given a choice between the natural and forced-draft biomass ICS (Pilots A and B), households that purchased ICS strictly preferred the more expensive forced-draft stove. Also, nearly all households selected the electric ICS when given the choice between the latter and the natural-draft stove (Pilots F and G). In villages where both the electric and natural-draft stove were offered, 45% ($n = 14$) of randomly selected households purchased the electric stove, only 3% ($n = 1$) purchased the natural-draft stove, and 3% ($n = 1$) purchased both types. In contrast, when only offered the natural draft, households did make purchases: 3 such stoves were purchased in Pilot C (although none by survey households); 46% ($n = 6$) of randomly selected households purchased in Pilot D; 8% ($n = 1$) in Pilot E; and 14% ($n = 2$) in Pilot H. These results suggest that households may be less interested in the natural draft stove when they observe it alongside other ICS. More critically, it shows that

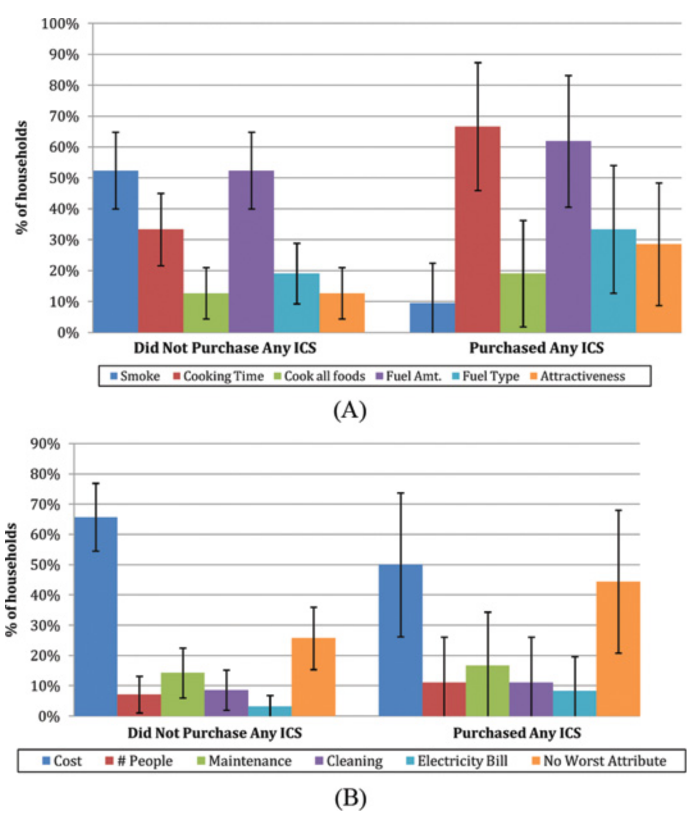

Fig. 3. Two attributes considered best (A; $n = 84$) and worst (B; $n = 88$) about the improved cookstoves (ICS), by randomly selected households (Pilots C–H) on average (with 95% confidence intervals).

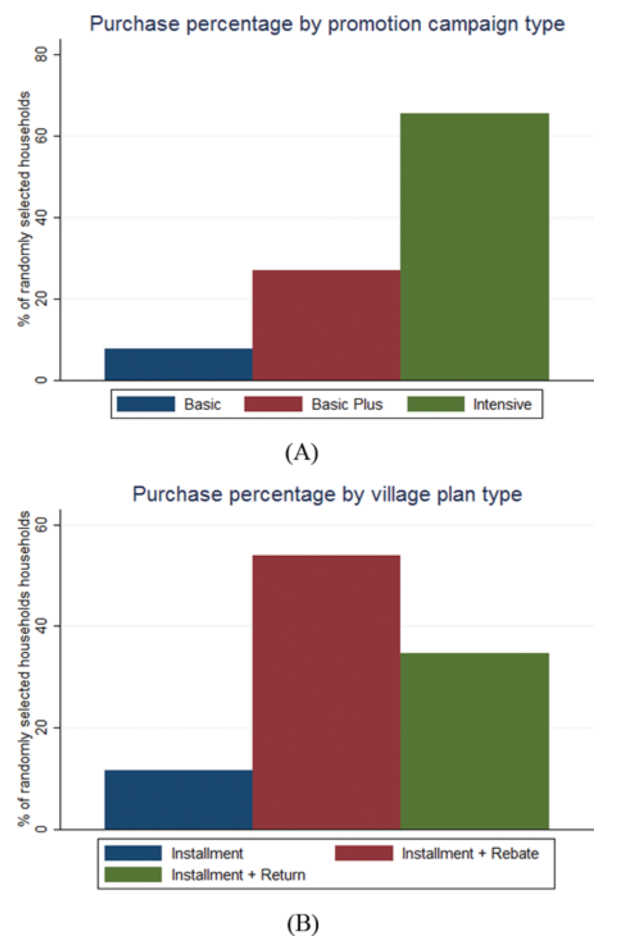

Fig. 4. Purchases among randomly selected households grouped by (A) intensity of promotion campaign and (B) payment plan in the village; ($n = 26$ purchasers) across all pilots.

households have heterogeneous preferences, and suggest that giving multiple stove choices may increase adoption.

Results from the pilots indicate that once households purchased an ICS, the stove was used regularly. In Pilots F and H, stove use was monitored every 2 weeks for 1 month after initial purchase, while in Pilot D use was recorded over eight visits for 2 months. All households reported using the purchased stove during all visits, with the exception of one household on the second monitoring visit and one household on the sixth monitoring visit. Enumerator observations for signs of use (e.g., presence of ash or food residue) confirmed these household reports. Even so, households also continued to use traditional stoves. On average, households reported approximately equal time of stove use for ICS and traditional stoves (Figure 5). This pattern is consistent regardless of the type of stove purchased, although electric stove buyers generally reported greater use.

Price

Responses under different payment schemes were also different (Figure 4B). Where rebates alone were offered (Pilot A), no households purchased stoves. In pilots where the installment plan was offered alone (Pilots B and E), purchase rates were 8% (Pilot B) and 8% (Pilot E) to randomly selected households. Where rebates were added to the installment plan, adoption rates were 0% (Pilot C), 46% (Pilot D), 8% (Pilot E), and 38% (Pilot F) for adoption in randomly selected households. Last, where the stove return option was instead added to the installment plan, the greatest sales rate was achieved: 60% (Pilot G) of randomly selected households made purchases, and no households chose to return their stove.

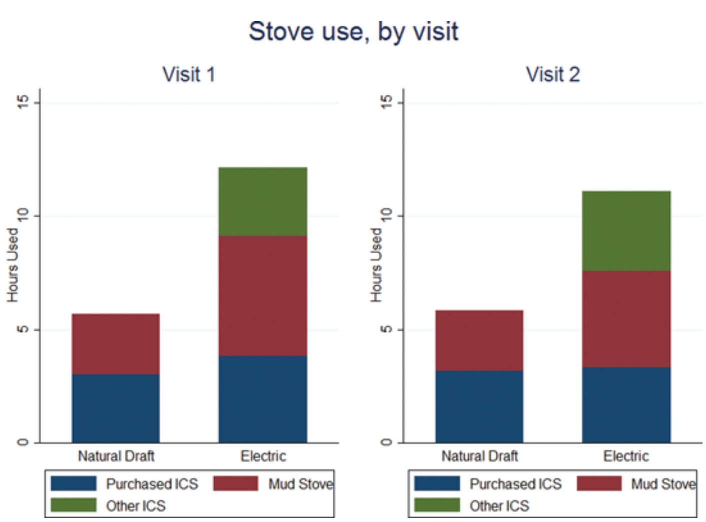

Fig. 5. Stove use in the past 24 hours checked at visit 1 (2 weeks after purchase) and visit 2 (1 month after purchase). Visit 1 and 2, $n = 35$; data from Pilots D–H. If households responded that both traditional and improved cookstoves (ICSs) were used, the time was divided between the two stoves as estimated by the household.

Almost all households that had the opportunity to pay in installments took advantage of this option, with only 8% of survey households electing to pay full price (and 33% households overall), whereas the rest used the installment plan. In Uttarakhand, of the 15 randomly selected households that opted for the installment plan, installment payments were recovered from 87%. Installments were recovered from all households in Uttar Pradesh.

We also note that the timing of the pilot programs relative to the harvest season may have translated into households having different amounts of cash on hand in different pilots. Some of the difference in sales between Uttar Pradesh, on the one hand, and Odisha and Uttarakhand, on the other, may have been due to the fact that programs in the former location preceded the harvest, which is the major source of income for rural households in these pilot communities.

Although households responded in the survey that cost was the most negative attribute they perceived about the improved cookstoves, we observed that households preferred the more expensive forced-draft stove over the biomass stove, suggesting that other factors such as modernity and novelty also play an important role in consumer interactions with these technologies. Nonetheless, the majority of these households still proved unwilling to purchase the more expensive stove they preferred.

Place

Consistent with the challenges we faced in procuring stoves, households told us that ICS technologies were not locally available in or near these villages. In supplying stoves to these communities, we frequently experienced significant delays in procurement and transport of several weeks to months. Routes to some villages in Uttarkhand in particular were inaccessible to vehicles of any kind and it was necessary to carry stoves to households. ICS adopters also appeared satisfied with their purchases; no households sought to return stoves after purchase. Nonetheless, 31% of households in pilots featuring the electric ICS listed stove maintenance as one of their main concerns about ICS purchase, compared with very few households expressing this concern in the biomass-stove only pilots. Given the lack of a realistic warranty scheme, maintenance concerns were reported to our NGO partners, who, in turn, organized the return of nonfunctional ICS to the retail partners and bore the coordination costs for repairs.

We are unable to separate the role of specific NGO characteristics from contextual variables across states, because partner organization is perfectly correlated with state. Despite greater remoteness and other supply chain problem in the Orissa and Uttarakhand sites, ICS sales were higher in these regions. As discussed in the next section, we attribute this to two interrelated place-based features of Uttar Pradesh: the sociopolitical climate and the rootedness of the community-based organizations with whom we partnered. Three pilots have markedly higher sales among randomly selected households: Pilot G (Uttarakhand), in which 60% purchased a stove, and Pilot D (Odisha), with 46%, and Pilot F (Uttarakhand), with 38%.

How Promotion, Product, Price, and Place Attributes Influence ICS Adoption

We conducted eight ICS promotion pilots across three states in India to (a) highlight some of the challenges related to ICS promotion, and (b) design a BCC strategy. Following the social marketing mix of the 4 Ps (promotion, product, price, and place), our pilots tested various levels and designs based around:

- Behavior change communication strategies for ICS promotion and sales team composition;
- Stove type;
- Stove payment plans, rebate incentives, and risk-free trials; and
- Geographical context, access, and local institutional environments

Overall, approximately 18% of a randomly selected group of households (26 out of 146 households) purchased an ICS at the full retail price, although the most successful pilot (G) had an adoption rate reaching 60% (Figure 2). While our small *n* design limits any definitive endorsements, we believe the pilots offer several lessons relevant to ICS promotion efforts.

Promotion

Much has already been written about the role of promotion for behavior change (e.g., Pattanayak et al., 2009; Shell Foundation, 2013; Thurber, Phadke, Nagavarapu, Shrimali, & Zerriffi, 2014); we therefore limit our discussion to a few important observations. First, as indicated in previous surveys and through interviews in these specific pilot communities, potential beneficiaries have little knowledge of ICS benefits (Bhojvaid et al., 2014; Jeuland et al., 2014). Given this low baseline awareness, a combination of promotional efforts are likely to be crucial for increasing purchase and use of ICS. The promotional efforts in the pilots focused on discussing the merits of ICS in terms of reduced wood use, cooking times, and health benefits because households identified these to be key features. In addition, significantly more households that purchased an ICS reported receiving one of our informational brochures and explanations, or witnessed an ICS demonstration (as part of the BCC campaign). Last, our pilots show sales that increase with the intensity of the promotional campaign.

Product

These small-scale promotion efforts reveal the importance of the ICS technology itself and the effect of presenting households with multiple stove options. Different combinations of three stove types were offered to households in the pilots. Sales of the electric stoves were greatest (45% in randomly selected households; 34% overall), followed by the natural-draft biomass stove (9%; 4%) and the forced-draft biomass stove (4%; 4%). Somewhat unexpectedly, the electric stove clearly emerged as the most attractive option when it was offered to households (in Pilots F and G), both in terms of interest and purchase. Attempts were not made to market this product before the Uttarakhand pilots, mainly because we initially thought that the cost and lack of reliable electricity supply to rural Indian villages would preclude the use of this ICS. It is clear that potential beneficiaries thought differently, however, perhaps because they did receive electricity for roughly 20 hours per day on average. Therefore, future ICS promotion efforts should consider the potential of electric stoves even where electrification rates are low and supplies are not fully reliable.

Impressions of the relative value of ICS compared with traditional cooking technologies varied considerably across sites. In Uttar Pradesh, households expressed limited interest in either ICS (these pilots involved the biomass stoves). These households' curiosity about the forced-draft stove was greatest, but that stove was ultimately judged to be too expensive by most, even when these were given the opportunity to purchase it in installments. These households expressed concern about the time required to chop wood into small pieces for this stove. In addition, households observing demonstrations of this stove generally responded negatively to the natural-draft stove, which was deemed to be an inferior technology by comparison. It is interesting to note that when the natural draft was the only stove offered (Pilots C, D, E, and G), households did express interest in it, particularly in Odisha, where the sales team that was employed had the most prior experience marketing it. The effects of product comparisons on consumer choice have been the subject of extensive prior research in the field of marketing (Choplin & Hummel, 2005; Heath & Chatterjee, 1995).

Impressions of ICS also varied across households within specific pilot villages, variation that highlights the importance of acknowledging heterogeneity in consumer preferences (Jeuland, Pattanayak, & Soo, 2014). Households that value the time savings from an ICS were much more likely to adopt than households who valued smoke reduction. Also, adopters generally had higher asset ownership (cell phones), which may indicate that their budget constraints are somewhat looser than nonpurchasers.

We found that all households whose use was monitored during collection of installment payments (admittedly a short time horizon) continued to use the stove throughout this period of follow-up. Even so, none of these households ever completely stopped using their traditional stoves. Households therefore appear to see advantages in having multiple stoves, either because they allow for more efficient cooking or because some are better tailored to specific cooking needs. This could be due to household preference for cooking bread on the traditional stove, the need to cook multiple dishes simultaneously, or as backup in the event of electricity of fuelwood supply problems. Significant challenges remain if the goal is to induce a complete switch to ICS technologies, and future studies should include long-term follow-up to monitor sustained use.

Price

Cost was clearly not the only factor influencing household purchase decisions: when given the choice between a more expensive forced-draft or less expensive natural-draft stove, households strictly preferred the more expensive (but more novel) forced-draft stove. The pilots also provide evidence that liquidity constraints are a significant barrier to adoption, and that installment payment schemes may help overcome it. This finding is consistent with recent evidence from Uganda that offering a lower risk, rent-to-own experience leads to higher initial adoption rates (Beltramo et al., 2014). The majority of households reported that cost was the single most important negative attribute of the ICS options, and the varying degree to which households had cash on hand (perhaps related to the timing of the pilots relative to the harvest season) may have played a role in their adoption decisions. Only 8% of the survey households that purchased ICS in the pilot programs in installments paid the full price upfront, with all others opting for the installment plan. In the only village where no installment plan was offered, no households purchased an ICS. We offered rebates to incentivize ICS use, and the resulting positive health and environmental externalities. By comparing sales in Pilot D and E, we see that offering rebates seems to promote demand. For the installment and rebate results, we caution that there were likely other factors contributing to the sales differential.

Place

We experienced a variety of challenges in procuring stoves for dissemination in rural areas that reveal real gaps in the supply chain for such technologies. The lack of existing ICS markets and supply networks outside of large urban centers in India implies that any scaled-up stove dissemination programs targeted to rural households will face major obstacles. The lack of ICS distribution networks also presents problems for stove maintenance, since finding retailers to honor manufacturer warranties or facilitate stove repairs will be difficult. Proper maintenance of ICS is crucial for delivering benefits, but without support from a local supply chain it may be difficult for households to maintain stoves, particularly electric ones. To a large extent, there was an enthusiasm gap in Pilots A–C (compared with the other five pilots), potentially because of a variety of sociopolitical and cultural factors in the Indo-Gangetic plains of Uttar Pradesh that make them different from communities in the Uttarakhand mountains and coastal Orissa.

To some extent the capacity of implementing NGOs helped us overcome some of the formidable place-based barriers. Given low baseline awareness of ICS and lack of a local supply chain, it was crucial for local NGOs to have a strong grassroots presence that engendered trust. For example, the NGO in Uttar Pradesh was primarily a research organization, without a substantive community presence and little or no experience in social marketing. The opposite was true in Orissa and Uttarakhand, where NGOs had long been working intimately with communities in their respective areas. We attribute much of the greater success in these villages to the role played by these micro-institutions. Critically, these institutions provided capable management of local field logistics and were also viewed by households as a trustworthy source of information.

Conclusion

Use of biomass fuels affects household health, local forests, and global climate. Despite the potential of ICS to reduce these adverse environment and health impacts, their adoption and use remains low. Social marketing—with its focus on the marketing mix of *promotion, product, price*, and *place*—offers a potentially useful way to understand household behaviors and design campaigns to address biomass fuel use. We report on a series of pilots across three Indian states where we varied this marketing mix. We find ICS sales ranging from 0% to 60%. Behavior change promotion that combined door-to-door personalized demonstrations with information pamphlets was effective. When given a choice among products, households strongly preferred an electric stove over improved biomass-burning options. Time savings emerged as particularly critical: ICS purchasers spent significantly more time gathering traditional fuels than nonpurchasers, and adopters considered reduced cooking time most valuable among different stove attributes. Households clearly identified price as a significant barrier to adoption, while provision of discounts or payments in installment payments boosted demand. Place based factors such as remoteness and NGO operations significantly affected the ability to supply and convince households to buy and use ICS. Collectively, these pilots point to the importance of continued and extensive testing of messages, pricing models, and responses to different stove types before scale-up.

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