



The role of social relations in the adoption of improved cookstoves

Gregor Vulturius and Hannah Wanjiru

Stockholm Environment Institute
Linnégatan 87D
115 23 Stockholm,
Sweden

Tel: +46 8 30 80 44
Web: www.sei-international.org

Author contact:
Gregor Vulturius
gregor.vulturius@sei-international.org

Acting Director of Communications: Tom Gill
Editor: Caspar Trimmer

Cover photo: To market, to market © collectmoments / flickr

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes, without special permission from the copyright holder(s) provided acknowledgement of the source is made. No use of this publication may be made for resale or other commercial purpose, without the written permission of the copyright holder(s).

About SEI Working Papers:

The SEI working paper series aims to expand and accelerate the availability of our research, stimulate discussion, and elicit feedback. SEI working papers are work in progress and typically contain preliminary research, analysis, findings, and recommendations. Many SEI working papers are drafts that will be subsequently revised for a refereed journal or book. Other papers share timely and innovative knowledge that we consider valuable and policy-relevant, but which may not be intended for later publication.

Copyright © January 2017 by Stockholm Environment Institute



STOCKHOLM ENVIRONMENT INSTITUTE

WORKING PAPER NO. 2017-01

The role of social relations in the adoption of improved cookstoves

Gregor Vulturius and Hannah Wanjiru

Stockholm Environment Institute

ABSTRACT

Improved cookstoves promise benefits for human health, deforestation, climate change mitigation and gender equality. In order to exploit the potential of improved cookstoves for sustainable development, various governmental and non-governmental initiatives have for decades tried to convince households in the developing world to change their behaviour and adopt the new technology. These have had very limited success. This study turns to the often overlooked but important role of social relations for individual behavioural change and examines the question of how, and how far, behaviour change techniques (BCTs) can promote adoption of improved cookstoves. Based on previous theoretical and empirical insights, the study assumes that social relations have great influence on the diffusion and adoption of new innovations. To answer the research question, the study compared improved cookstove users who acquired improved biomass-powered stoves from two different implementers, using a survey that included an egocentric social network analysis. The study findings suggest that the implementer who provided ongoing post-sales contact and support, and who marketed the stoves to existing social groups with a high level of shared identity, achieved much higher levels of adoption. The results also suggest that BCTs can be used to create a social multiplier effect, with improved cookstove users recruiting new users. The findings could be of great value for researchers and clean technology implementers alike.

CONTENTS

| | |
|--|-----------|
| 1. Introduction | 1 |
| 1.1 Background | 1 |
| 1.2 The study | 1 |
| 1.3 Improved cookstove implementers in Kenya | 2 |
| 2. Theoretical approach | 3 |
| 2.1 Social relations in diffusion and adoption of improved cookstoves | 3 |
| 2.2 Behaviour change techniques using social relations | 4 |
| 3. Method and data analysis | 5 |
| 3.1 Social network analysis | 5 |
| 3.2 Data collection and analysis | 5 |
| 3.3 Research ethics | 6 |
| 4. Results | 6 |
| 4.1 Interaction between users and implementers | 8 |
| 4.2 Interactions between cookstove users and between users and their peers | 10 |
| 5. Discussion | 10 |
| 6. References | 13 |
| Appendix: survey questionnaire | 17 |

ACKNOWLEDGEMENTS

This working paper is a contribution to the SEI Initiative on Behaviour and Choice, which is funded by the Swedish International Development Cooperation Agency (Sida). The authors would like to thank all research participants as well as the representatives of the two improved cookstove providers for their support and collaboration during the field work. We would also like to thank Rob Bailis, Rasmus Kløcker Larsen, Marie Jürisoo, Fiona Lambe and Caspar Trimmer of SEI for their valuable comments and suggestions.

1. INTRODUCTION

1.1 Background

The dependence of 2.6 billion people in developing countries on traditional biomass fuels – such as firewood, charcoal and dung – for cooking and heating has significant negative impacts on health, causing more than 4 million premature deaths annually (Ezzati 2005; WHO 2014). The collection, production and burning of these types of fuels can also be linked to severe environmental impacts, such as deforestation and the emission of short-lived climate pollutants (Miah et al. 2009; Ramanathan and Carmichael 2008). Improved cookstoves have been developed to reduce the health and environmental risks associated with traditional cooking technologies (Jeuland and Pattanayak 2012) even though recent research has not found evidence that cleaner biomass-fuelled cook stoves reduce the risk of pneumonia (Mortimer et al. 2016). Efforts to promote improved cookstoves are also expected to help progress towards the Sustainable Development Goals for affordable and cleaner energy and gender equality, along with the Paris agreement climate mitigation targets.

Previous research on this subject has largely borrowed from rational choice models of decision-making, arguing that the decision to adopt improved cookstoves is driven by self-interest, specifically the user's desire to access the technology's economic, environmental and health benefits (Bailis et al. 2009; Barnes et al. 1994). However, this cannot explain the persistently low rate of adoption of improved cookstoves in developing countries (Bielecki and Wingenbach 2014). Experience has shown that simply making available more efficient and healthy stoves is not enough to achieve widespread adoption (Hanna et al. 2012; Mobarak et al. 2012).

Instead, studies have shown that neighbours, opinion leaders and community networks can influence opinions about improved cookstoves (Beltramo et al. 2015) and in some cases even rates of adoption (Miller and Mobarak 2015; Ramirez et al. 2014). A better understanding of the influence of social relations is critical for formulating effective strategies to promote the dissemination and adoption of improved cookstoves. Such a behaviouristic approach acknowledges the importance of societal values, culture and social relations for development work and research (World Bank 2014).

1.2 The study

This study proceeds from social cognitive theory. It assumes that individuals learn and change their behaviour as a result of observing and emulating the actions of others (Bandura 1977; Bandura 1986). Based on this understanding of human behaviour and decision-making, the study applies an analytical framework of behaviour change techniques (BCTs) in improved cookstove interventions (Goodwin et al. 2015). It focuses on four BCTs that rely on social relations: shaping knowledge, social support, reward and threat, and identity and self-belief.

The study examines the central question of how and to what effect these BCTs can promote adoption of improved cookstoves. *Adoption* generally refers to the uptake and sustained use of a technology (Pine et al. 2011). However, for this study it was decided to look for evidence of what might be termed “strong” adoption. All of the respondents were using an improved cookstove. Adoption was considered strong if users reported being satisfied with the stove and implementer, if they interacted with implementers and other users regarding the stove, and if they subsequently recommended the improved cookstoves to their peers. This last phenomenon should be particularly interesting to implementers of improved cookstove and other clean technology programmes. The survey also asked whether the peers had gone on to purchase a stove following the recommendation, which would confirm the value of social relations for stove marketing.

Table 1. Claimed specifications and benefits of the improved biomass cookstoves marketed by the two implementers

| Marketed by | Fuel | Lifespan | Thermal efficiency | High output power | Fuel savings ^a | CO ₂ emission reduction ^a |
|---------------|----------|-----------|--------------------|-------------------|---------------------------|---|
| Implementer A | Charcoal | 2–4 years | 34.3 % | 2.7 kW | 57% | 50% |
| Implementer A | Firewood | 2–4 years | 30.2% | 3.0 kW | 68% | 50% |
| Implementer B | Charcoal | 2–5 years | 42% | N.A. | 54% | 57% |
| Implementer B | Firewood | 2–5 years | 38% | 3.7 kW | 53% | 72% |

^a Compared to conventional stove.

The survey was carried out around in Kenya and involved a sample of 40 individuals using improved biomass-driven cookstoves. These were divided into two groups (referred to here as Group A and Group B) who had received their stoves from two different implementers (referred to as Implementer A and Implementer B, respectively). The survey was conducted during four meetings of users in April 2016. Social network analysis was used to develop the survey and analyse its results.

The study findings improve scientific understanding of the potential of BCTs to promote improved cookstoves in developing countries. They also point to the potential of social network analysis for future studies that want to develop a more comprehensive understanding of how peer relations can affect adoption of improved cookstoves. Moreover, the study also offers valuable insights for practitioners and policy-makers who want to make greater use of social relations in improved cookstove interventions.

1.3 Improved cookstove implementers in Kenya

Following the UN Conference on New and Renewable Sources of Energy, held in Nairobi in 1981, improved cookstoves have been promoted in Kenya by a large variety of government agencies, development partners, and non-governmental and community organizations (Ipsos Ltd 2014). Despite their country's role as a pioneer, the majority of low- and middle-income Kenyans continue to rely on traditional three-stone stoves, charcoal and firewood for their daily cooking needs (GVEP International 2012). It has been estimated that traditional cooking technologies and fuels are responsible for around 67% of dangerous household air pollution in Kenya (GACC 2013).

Over the last five years, the improved cookstove sector in Kenya has seen exponential growth in terms of investment, new stoves designs, and number of actors involved; new financing approaches like carbon credits and results-based financing, expansion of geographical coverage and notable uptake levels (Ipsos Ltd. 2014). With increased innovation and continuing reliance on biomass, the desire for fuel-saving and less polluting stoves has seen the introduction of more efficient biomass-burning stoves for both urban and rural populations (GACC 2014).

Different stakeholders are making concerted efforts to improve adoption rates. For example, the Kenya Action Plan of the Global Alliance for Clean Cookstoves (GACC) has the target of promoting the adoption of clean cookstoves by up to 7 million households in 2020 (GACC 2013). And Kenya's National Climate Change Action Plan has improved cookstoves as one of its six priority low-carbon actions, expecting to abate 5.6 Mt CO₂e a year by 2030. Increasingly, efforts to promote improved cookstoves include incentives for adoption, end-user financing, public awareness on benefits, door-to-door direct marketing and social marketing through peers (Ipsos Ltd. 2014).

This study compares cookstove adoption among users who acquired improved cookstoves from two different implementers (A and B) – organizations that market improved cookstoves. The implementers between them marketed four biomass-fuelled stove models: one charcoal stove and one firewood stove per implementer), which did not otherwise differ significantly in their claimed technical specifications and benefits (Table1).

The two implementers did, however, use markedly different marketing strategies. Implementer A was an international social enterprise established to develop and sell high-quality and affordable, products, including improved cookstoves, that yield health, environmental and economic benefits in developing countries. Implementer A used trained sales agents – whom it referred to as technology field officers – to market improved cookstoves in institutions such as schools. Customers could either purchase improved cookstoves directly from the sales agents, paying the full price upfront, or on credit through a partner of the implementer providing mobile financial services, paying an initial deposit and monthly instalments.

Implementer B was a local non-governmental organization that aimed to reduce poverty through community empowerment and through financial services and developing entrepreneurial skills. The implementer focuses primarily on counties north-east of the Kenyan capital, Nairobi. Its strategy for marketing improved cookstoves and other products is to encourage individuals to set up microfinance self-help groups (see above). The implementer currently has several thousand members, organized in several hundred self-help groups. The groups can loan money from the self-help Group And repay it with monthly or weekly payments. Individual group members can also directly apply to the implementer for loans, provided that they have a good record of repaying the previous loans and/or a good saving record. Groups meet monthly with a representative of the implementer for loan payment collection. During these meetings, group members may also be given the opportunity to receive training on new products and to apply for new loans.

2. THEORETICAL APPROACH

2.1 Social relations in diffusion and adoption of improved cookstoves

The relevance of social relations for individual behaviour and decision-making has been highlighted in social cognitive theory developed by Bandura (1977; 2001). Social cognitive theory argues that individuals acquire new knowledge and change behaviour by observing and emulating the actions of others in the context of social interactions, education and media (Bandura 1986). Research on the subject of cultural cognition has shown that individuals form their opinions about new knowledge and experiences based on the values and beliefs they share with their peers about what is socially beneficial or detrimental (Kahan et al. 2011). The same research also points out that individuals take significant risks when they think and act differently to members of the social group they wish to belong to (Kahan et al. 2007). This indicates that social relations not only influence the way in which individuals make decisions, but also can motivate or penalize behavioural change. Social relations are also considered to be of central importance for the diffusion and adoption of innovations such as such as improved cookstoves. Rogers (2003) defines diffusion as “the process in which an innovation is communicated through certain channels over time among the members of a social system”. Moreover, “[d]iffusion is a kind of social change, defined as the process by which alteration occurs in the structure and function of a social system. When new ideas are invented, diffused, and are adopted or rejected, leading to certain consequences, social change occurs” (Rogers 2003). Studies from the developing world have highlighted the importance of social relations for the diffusion and adoption of agricultural practices such as composting (Beaman and Dillon 2014), adoption of new crops (Bandiera and Rasul 2006), and microfinance (Banerjee et al. 2013).

In this study, we test the hypothesis that social relations have an important role to play in the adoption of improved cookstoves. A recent study in rural Uganda found that knowing buyers of improved cookstoves may lead individuals to have more favourable opinions about the cookstoves (Beltramo et al. 2015). However, the same study also found that neighbours of improved cookstove users were not detectably more likely to purchase a stove than neighbours of buyers who had not yet received their stove. In this study, we focus on whether implementers of improved cookstoves had managed to achieve “strong” adoption by their users. Early adopters such as those surveyed are often “opinion leaders”, and can influence others attitudes and behaviours, including towards adoption of a new technology (Rogers 2003; Pine et al. 2011).

2.2 Behaviour change techniques using social relations

This study builds on ongoing efforts to develop an extensive and consensually agreed structured taxonomy of BCTs used in improved cookstove interventions (Michie et al. 2013). Based on this work, Goodwin et al. (2015) found eight BCTs had been used to promote the uptake of improved cookstoves. A BCT in this context is defined as the active component within an improved cookstove intervention that catalyses behaviour change (Goodwin et al. 2015) that can take place during the design, production, finance, distribution or maintenance phase of the improved cookstove value chain (Hart and Smith 2013). In this study we focus on four of these techniques that rely on social relations, as outlined below.

Shaping knowledge is a BCT that encompasses efforts to raise awareness about improved cookstoves, how to use and maintain them and where to acquire them. It is the most prevalent form of BCT and generally involves advertisement and marketing campaigns, along with practical demonstrations (Goodwin et al. 2015). Research has highlighted the importance of targeted marketing, point-of-purchase consumer education, personalized demonstration and maintenance services as effective tools to ensure lasting adoption of improved cookstoves (Rosenbaum et al. 2015; Lewis et al. 2015). Previous experience has also shown that raising awareness about health-related or environmental benefits of improved cookstoves can be a significant driver of adoption (van der Kroon et al. 2014). It has also been argued that advanced technology will not have the desired benefits unless users know how to use it sustainably (The World Bank 2011; Clark et al. 2015). All of this can be considered shaping knowledge.

Social support is the second BCT of interest in this study. This technique uses peers to influence opinions and behaviour (Goodwin et al. 2015). For example, organizations promoting improved cookstoves might use trusted individuals or groups to make the stoves more desirable and encourage people to follow their example. Strategies to promote social support for improved cookstove adoption include using local entrepreneurship (Shankar et al. 2015), community engagement, and building communities of practice (Prasodjo et al. 2015). For these strategies to be successful, implementers of improved cookstoves can draw on existing social networks (Shankar et al. 2015).

Identity and self-belief is another BCT that relies on peer relations. Efforts that use this technique target potential users according to their actual or aspirational roles in life (Goodwin et al. 2015). Drawing from social cognitive theory, the objective is to increase people’s sense of empowerment to change their behaviour in favour of clean cooking practices and adopt improved cookstoves. Experiences from India have shown that initiatives that targeted women’s self-help groups have been successful in promoting the adoption of improved cookstoves (Rajakutty and Kojima 2002; Sudhakara Reddy and Nathan 2013).

Reward and threat is the final BCT analysed in this study. In general this BCT tries to incentivize the uptake of improved cookstoves, or make failure to adopt improved cookstoves seem threatening (Goodwin et al. 2015). It is well established that the comparatively high perceived and actual acquisition costs of improved cookstoves is a key barrier to their uptake

(Rehfuess et al. 2013). Thus, efforts to reward individuals in developing countries for the adoption of new technologies typically involve direct or indirect subsidies or microfinance solutions (GIZ 2016). One example of a microfinance solution that is of particular relevance for this study is self-help groups: self-selected groups of individuals that save together and provide loans to members when needed (Rao et al. 2009).

This study is limited to assessing peer relations and the four BCTs mentioned above. Some other factors that are not explicitly treated in this study are of high importance for the adoption of improved cookstoves. For example, research has found that many improved cookstove implementers over-emphasize technical factors such as fuel-efficiency and emissions reductions and pay little attention to users' needs and cultural contexts (Lambe and Atteridge 2012). There is also considerable debate about the respective pros and cons of promoting industrially produced stoves and artisanal stoves produced locally. While some research suggests that artisanal stoves can support local entrepreneurship, employment and livelihoods options, others argue that industrially produced stoves are generally more fuel-efficient and better in achieving health and environmental benefits (Simon et al. 2014). However, all the stoves marketed by implementers in this study were industrially manufactured elsewhere.

3. METHOD AND DATA ANALYSIS

3.1 Social network analysis

This study uses social network analysis (Borgatti et al. 2013) to answer the question of how and to what effect BCTs can be used to promote the adoption of improved cookstoves. The method was chosen because of its capability to detect and explain how social relations affect perceptions, beliefs, and behaviour of individuals (Knoke and Yang 2008). Social network analysis has also been used in a few previous studies on the diffusion and adoption of improved cookstoves. It has been used to map the social networks of active community members that drove the diffusion of improved cookstoves in Honduras (Ramirez et al. 2014) and how stove adoption by opinion leaders and other social network members influenced the diffusion of non-traditional cookstoves in Bangladesh (Miller and Mobarak 2015).

Social network analysis offers a portfolio of quantitative and qualitative methods for the analysis of social structures that specifically allow the investigation of the relation aspects of these structures (Scott 2013). This study used an egocentric social network analysis of improved cookstove users to better understand the role of peer-to-peer interaction in household decisions relating to improved cookstoves. Egocentric social network analysis is ideally suited to understand these peer-to-peer relations because it offers a comprehensive analytical framework. Social network analysis builds on the understanding that social structures and individual behaviour result from relations between peers.

3.2 Data collection and analysis

The empirical data was collected using a questionnaire survey. The questionnaires were distributed in four sessions with 10 improved cookstove users each, and users were assisted by one of the researchers in filling it out. Deliberate sampling was chosen to recruit 20 stove users for each of the two implementers. Selection criteria included whether users resided in urban, peri-urban and rural areas how long it was since users had acquired their stove and whether they used charcoal or firewood as fuel. All participants had used their improved stove for at least three weeks. The average usage time across the whole sample was six months. The meetings were conducted in different towns and villages around Nairobi.

The questionnaire consisted of 14 open and 8 multiple-choice questions (see Appendix) designed to capture aspect of all four BCTs of interest in this study. The first set of questions (questions 1–8) concerned users' socio-economic and demographic status (education, marital

status) and their household (income, number of household members). The second section of the questionnaire (questions 9–17) explored users' initial contact with the implementer, their decision-making regarding the stove, how they paid for it, and their satisfaction with the stove and the implementer.

The third section (questions 18–22) included questions for an ego-centric social network analysis, asking users about their interactions with the implementer, and with other users who had acquired their stove from the same implementer. Question 21 asked whether respondents had recommended the stove and the implementer to a peer and whether the peer had gone on to purchase a stove from the implementer. The data was analysed using frequencies and descriptive statistics.

3.3 Research ethics

The research forms part of a larger research project on improved cookstoves in Kenya (Lambe 2014), which received ethical approval from the Kenyan Government in 2015. The names of the improved cookstove users, and other individual information gathered through the survey, are kept confidential, as are the names of the implementers. Participation in the survey was voluntary, and participants were informed about the survey's purpose, that their data would be anonymous, and how the survey results would be used. Representatives of the two implementers were involved in the recruitment of improved cookstove users, but did not take part in the survey itself.

4. RESULTS

This section presents results from a survey of two groups of improved cookstove users. Group A had received their stoves from a social enterprise (Implementer A), while Group B had obtained their stoves from a local NGO (Implementer B). The empirical data shows whether and how BCTs promoted adoption of improved cookstoves among the two different groups of users and their peers.

The two user groups differed to some extent in their socio-demographic and economic characteristics (Figures 1–4). More than half of Group A lived in towns, while Group B was mostly rural. Consequently, almost half of Group B named farming as their primary occupation. In comparison, those belonging to Group A were mostly business owners or teachers or had another type of non-farming employment. The groups also differed in their average level of education. More users in Group A than B had completed secondary education or university. Group B reported higher average household income, but lower per capita income, mainly due to larger average household size. A quarter of the respondents in Group A were men. Only one of the users of Implementer B was male. Members of Group A were on average 12 years younger than those in Group B (average ages 35 years and 48 years, respectively).

In this study, satisfaction with the stove and the implementer is seen as a key indicator for improved cookstoves adoption. We assume that the higher the satisfaction with either stove or implementer, the stronger the adoption. Reported levels of satisfaction differed between the two groups of users. While 85% of respondents in Group B said they were very satisfied with their implementer, the same was true of only 67% in Group A (Figure 5).

The difference in the level of satisfaction with the stove was even greater: there was 100% satisfaction among Group B compared with only 65% in Group A (Figure 6). Given that the stoves marketed by the two implementers had very similar technical and operational specifications (see Table 1), this suggests that there must be other reasons for the difference in user satisfaction.

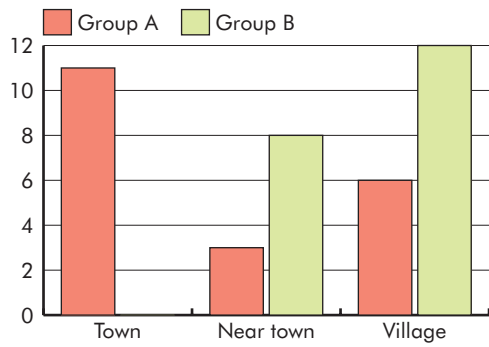


Figure 1. Residence

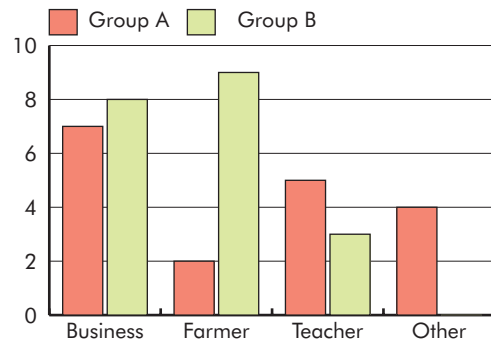


Figure 2. Occupation

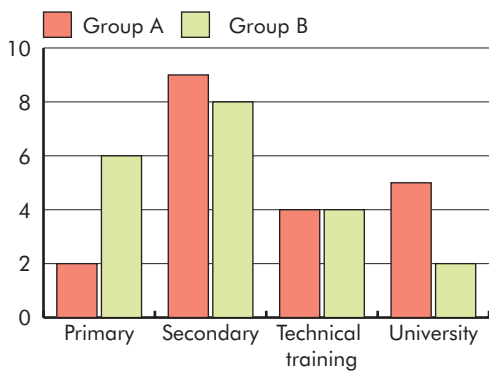


Figure 3. Educational level

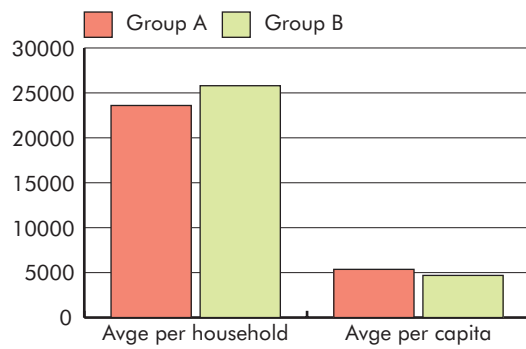


Figure 4. Average income

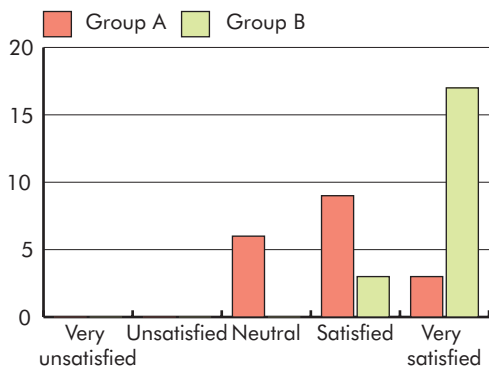


Figure 5. Satisfaction with implementer

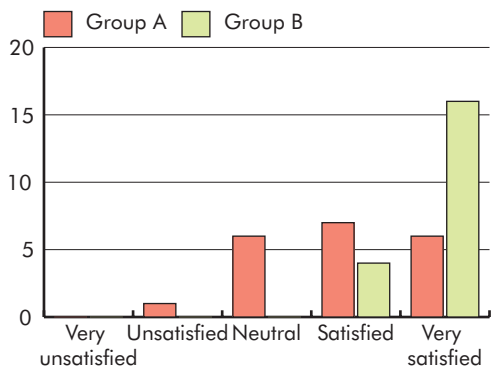


Figure 6. Satisfaction with stove

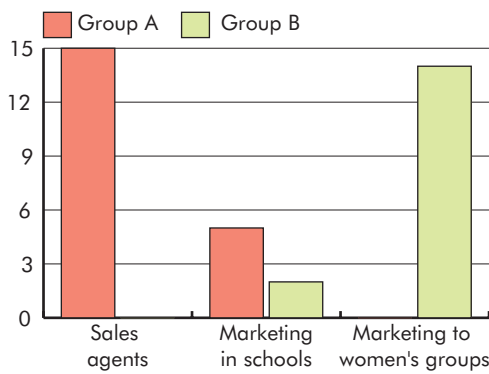


Figure 7. Marketing strategies

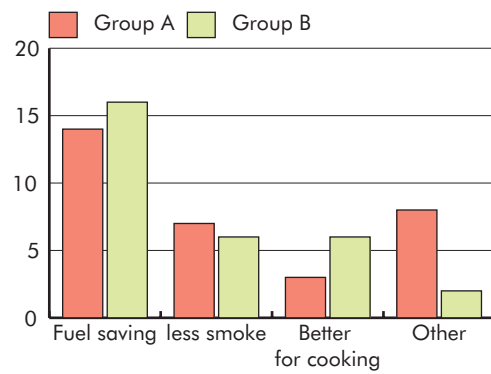


Figure 8. Reasons for purchase

4.1 Interaction between users and implementers

This section presents the findings from the first part of the egocentric social network analyses. Data about interactions between improved cookstove users and implementers offers insights into how implementers use different BCTs to promote their product and help to understand differences in the level of satisfaction with and adoption of improved cookstoves.

Firstly, implementers used different marketing channels to shape knowledge about their products (Figure 7). Most users in Group A reported that they got in touch with Implementer A as a result of direct marketing through sales agents. These sales agents were either employed by the implementer or were representatives of a sales partner that also offered financial services. In contrast, most users in Group B came into contact with the implementer through local women's groups. Both implementers went to schools to market their products to teachers. Also, both implementers used pre-sale demonstration to shape knowledge about improved cookstoves. Almost all users in both groups reported that they had received instruction in how to use the stove from representatives of the implementers or their sales partners when they decided to purchase the product.

Reasons for purchasing improved cookstoves did not differ significantly between the two groups of users (Figure 8). Both groups mentioned that they had expected the stoves to be more fuel-efficient and emit less smoke than their old stoves. Some users also cited the stoves' ability to cook faster, durability and aesthetic appeal as reasons why they purchased the stove. It should be noted that only very few users mentioned the environmental benefits directly as a reason for purchase.

The results strongly suggest that a key reason for the differences in satisfaction and adoption between the two groups was the after-sales support users received from their respective implementers. When asked if they had experienced problems with their stove, responses between the two user groups differed little, except for complaints about how much time the stove took to cook food (far more common in Group A; see Figure 9). However, 15 users in Group A reported that they had not had contact with the Implementer After they purchased the stove. In 13 of those cases this was due to the fact that users had not been given contact information or that they had lost that information. In contrast, all users in Group B reported that they were still in regular contact with representatives of Implementer B (whose agents make regular visits to the women's self-help groups, as noted above).

Another key factor in differences in user satisfaction and adoption is how the two implementers used reward and threat as a BCT to promote improved cookstoves. According to the survey, Implementer B relied largely on loan payments that are collected monthly or weekly, whereas almost all users of Implementer A had paid for their stoves in cash (Figure 11). Members of Group B reported that they paid their loan instalments with their salary or other type of income. Results from the survey suggest that Implementer B used the same visits to collect loan payments, take applications for new loans, provide technical support on stove use and market other clean energy products such as solar powered lamps.

The results also show that Implementer B deliberately marketed through women's groups whose members have greater financial independence (Figure 7 and Figure 12). The survey data suggests that female respondents in Group B – including 14 members of self-help groups – were substantially less reliant on financial assistance from their husband than their counterparts in Group A.

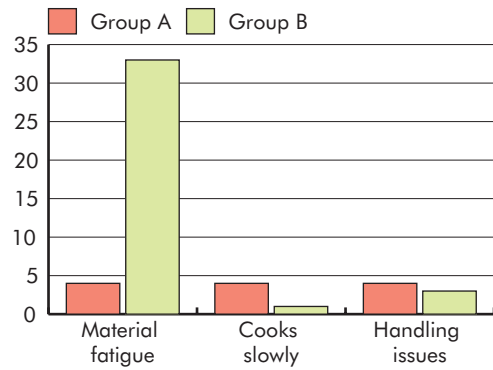


Figure 9. Reported problems with stove

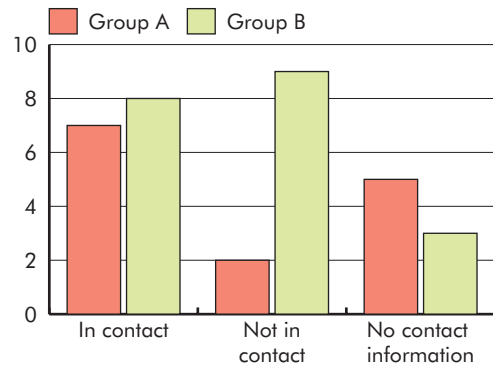


Figure 10. Post-sale contact with implementer

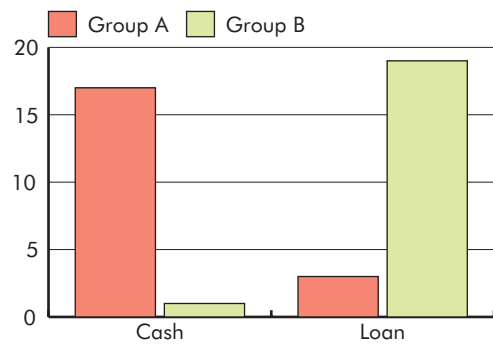


Figure 11. Mode of payment

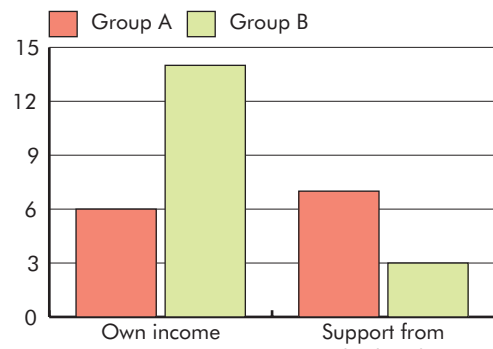


Figure 12. Female users' financial independence

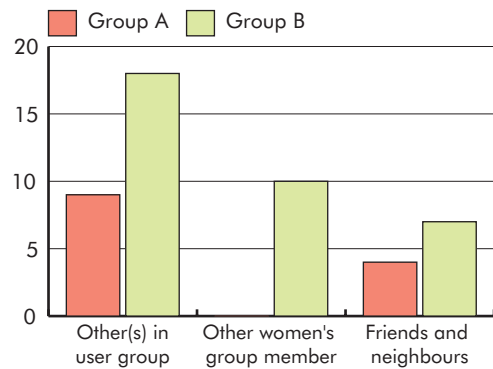


Figure 13. Who user has interacted with regarding improved cookstove

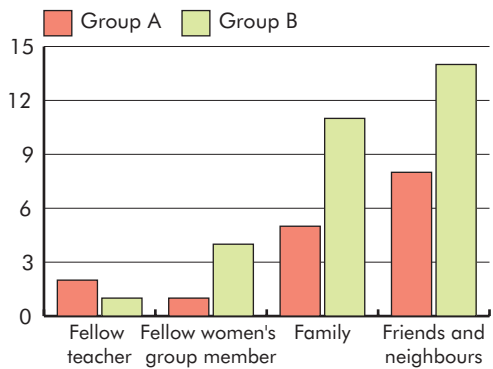


Figure 14. Who user has recommended stove to

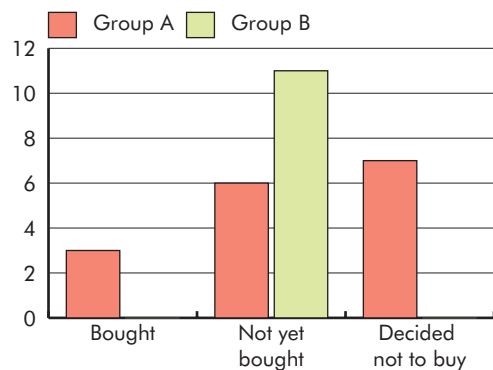


Figure 15. Purchasing decision by user's peer

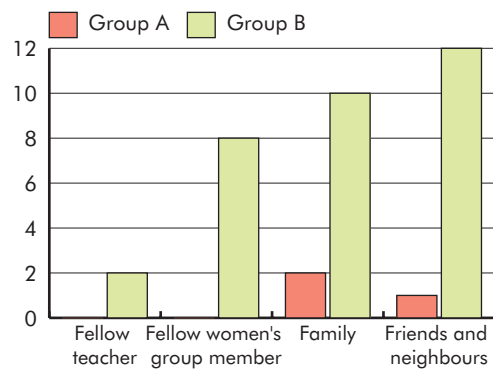


Figure 16. Purchase by peer in category

4.2 Interactions between cookstove users and between users and their peers

In this section we present the findings from the second part of the social network analysis. Insights into the interactions between improved cookstove users, and between users and their non-using peers, can show how BCTs work to promote the adoption of the technology. Findings from this analysis strongly suggest that social interaction between stove users was much stronger in Group B: twice as many respondents in Group B reported interacting with at least one other person who used a stove from Implementer B as Group A had with other users of stoves from Implementer A (Figure 13). Of the 18 members of Group B, 10 were in touch with other members of their women's group. This suggests that gender-related identity and self-belief can work to build social support and promote the adoption of improved cookstoves among women.

The nature of interactions between improved cookstove users also differed between the two groups. Members of Group B reported that their interactions with other users usually involved exchange of experiences with handling the stove, and sharing opinions about the economic and health benefits of the technology and advice on how best to realize them. Some of Group B also reported that they talked with other users about new stoves and other products marketed by the implementer. Group A reported less frequent interactions with other users, mostly regarding problems and advantages regarding fuel efficiency.

Improved cookstove users were also asked if they had recommended the stove and the implementer to their peers (Figure 14). Users in Group B were more likely to report recommending their peers to adopt improved cookstoves than their counterparts in Group A. Both groups least often recommended the stove and implementer to their fellow teachers and member of women's groups, the two groups that implementers had targeted in their marketing. Instead, improved cookstove users from both groups mostly recommended the stoves and the implementer to their friends, neighbours or family members.

Users in Group B reported that 32 of their peers have adopted improved cookstoves offered by Implementer B, compared to only three peers of Group A (Figure 15). Furthermore, many other peers of Group B were reportedly saving money or waiting for financial support from women's groups in order to buy a stove. Also notable is that most of those who purchased improved cookstoves after recommendations from Group B members were outside the two user groups that Implementer B actively marketed to (Figure 16). Five users in Group B even purchased the stove as a gift or on behalf of a close family member, friend or colleague. Taken together, this suggests that Implementer B had achieved a high level of "strong" adoption leading to a social multiplier effect: word-of-mouth promotion and sales beyond the primary marketing targets.

5. DISCUSSION

This study started from the hypothesis that peer relations and social networks have central importance for the initial uptake and sustained adoption of new innovations, such as improved cookstoves (Rogers 2003; Beltramo et al. 2015; Bielecki and Wingenbach 2014). It asked the question how and to what effect behaviour change techniques that exploit peer relations can promote adoption of improved cookstoves. The study focused on four BCTs with a large social component: shaping knowledge, social support, identity and self-belief, and reward and threat as techniques (Goodwin et al. 2015). The study compared user groups of two implementers by means of a survey that included an egocentric social network analysis (Borgatti et al. 2013). The study shows the value of this method to gain a comprehensive understanding of how BCT based on peer relations can promote the adoption of improved cookstoves.

Satisfaction with an improved cookstove and its implementers, the first measure of improved cookstoves adoption used in this study, substantially varied between the two groups of users.

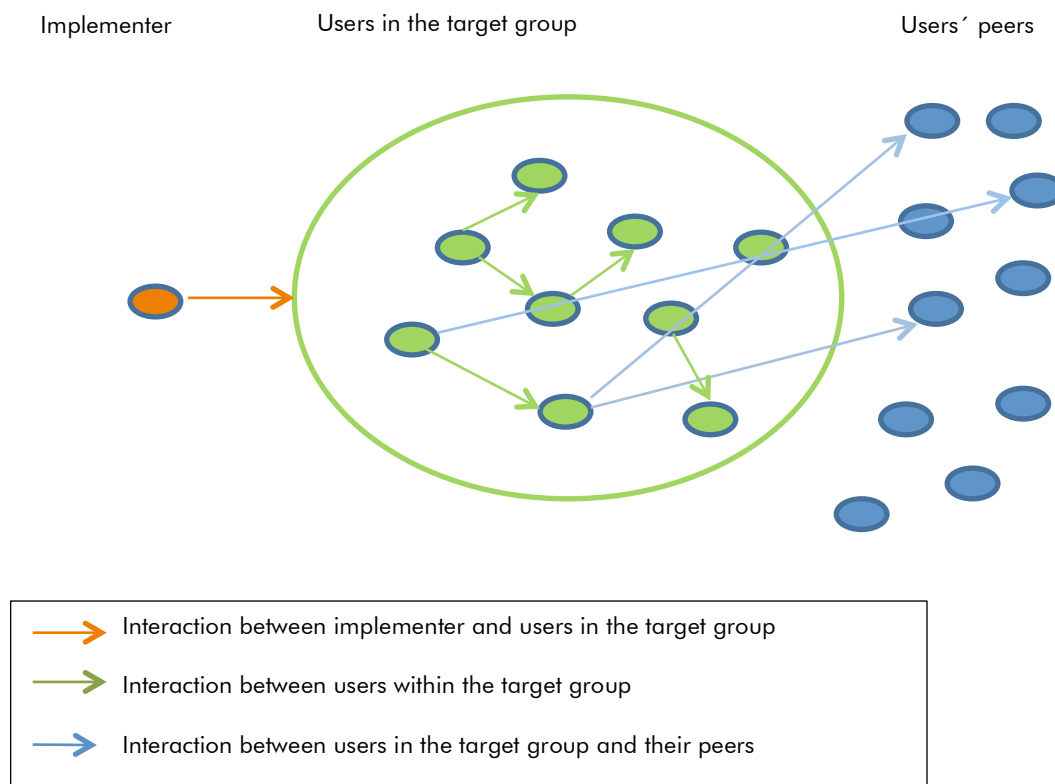


Figure 17. Social interactions and improved cookstove marketing

Satisfaction with both the stove and the implementer was much stronger among users of Implementer B than Implementer A. The fact that the technical properties of the stove models that the two implementers promotes were very similar suggests that differences in adoption are, at least in part, due to differences in how the two implementers used BCTs.

Analysis suggest that the differences in satisfaction and adoption can at least in part be attributed to the strategies implementers used to shape knowledge about improved cookstoves, in terms of how they market their product and offer support to their users. The data suggests that adoption of improved cookstoves was stronger when the implementer had directly targeted specific user groups_(women's self-help groups and teachers). The results also suggest that user satisfaction depended strongly on the availability of after-sale support. These results support previous findings (Sinha 2002; Shrimali et al. 2011). The findings also show that Implementer B's decision to use loan repayment visits to offer technical support further strenghtened adoption among users. Taken together, this suggests implementers are most succesful in promoting improved cookstoves when they develop and implement a comprehensive strategy that combines all four BCTs.

Besides user satisfaction, the study also examined the social aspects of improved cookstoves adoption (Figure 13). Adoption was considered strong if improved cookstove users interacted more frequently with other improved cookstove users about the stoves, and if they encouraged their peers to adopt improved cookstoves too. The results suggest that the choice of marketing strategy has a strong influence on social support for improved cookstoves adoption. By targeting women's groups, Implementer B was able to draw from an already established social network that could offer peer support to users if they had a problem with their stove.

The results also suggest that Implementer B was able to capitalize on user group members' shared sense of identity and self-belief to promote the adoption of improved cookstoves among women. These findings support the findings of an earlier study that found that engaging women's groups can be a powerful way to scale up the adoption of improved cookstoves in the developing world (Hart and Smith 2013). Taken together, these findings suggest that social support for improved cookstoves adoption can benefit from a marketing strategy that focuses on existing communities with a strong sense of shared identity and mutual dependence.

Finally, the results suggest that BCTs can have a social multiplier effect, as depicted in Figure 17. In the figure, implementers promote improved cookstoves to a specific market segment by tapping into existing social networks, shown with the orange arrow. The green arrows represent users promoting improved cookstoves to their peers within the original target group; for example to members of a women's group. The blue arrows indicate the social multiplier effect: users are recruiting new users outside the original target group chosen by the implementer.

Future research should further develop and test theoretical and methodological approaches to explore the importance of social relations in the promotion of improved cookstoves. Both researchers and implementers should shift their attention to looking for opportunities, and identifying the potential limits, of exploiting social relations for this purpose. This work should involve further investigation into the social multiplier effect of user-peer recruitment and what actions can be taken to promote improved cookstove adoption, including novel financing options such as micro-credit (Rao et al. 2009). This type of study may also help refocus attention in research on improved cookstove adoption from poverty eradication to reducing the health and environmental risks associated with traditional cookstoves (Mortimer et al. 2016).

6. REFERENCES

- Bandiera, O. and Rasul, I. (2006). Social Networks and Technology Adoption in Northern Mozambique. *Economic Journal*, 116(514). 869–902. DOI:10.1111/j.1468-0297.2006.01115.x.
- Bandura, A. (1977). *Social Learning Theory*. Prentice Hall, Englewoods Cliffs, NJ
- Bandura, A. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory*. Prentice-Hall series in Social Learning Theory. Prentice Hall, Englewood Cliffs, NJ.
- Bandura, A. (2001). Social cognitive theory: an agentic perspective. *Annual Review of Psychology*, 52(1). 1–26. DOI:10.1146/annurev.psych.52.1.1.
- Banerjee, A., Chandrasekhar, A. G., Duflo, E. and Jackson, M. O. (2013). The diffusion of microfinance. *Science*, 341(6144). 1236498–1236498. DOI:10.1126/science.1236498.
- Beaman, L. and Dillon, A. (2014). *The Diffusion of Agricultural Technologies within Social Networks: Evidence from Composting in Mali*. Policy note. September 2014. International Food Policy Research Institute (IFPRI), Washington, DC.
- Beltramo, T., Blalock, G., Levine, D. I. and Simons, A. M. (2015). Does peer use influence adoption of efficient cookstoves? evidence from a randomized controlled trial in Uganda. *Journal of Health Communication*, 20(sup1). 55–66. DOI:10.1080/10810730.2014.994244.
- Bielecki, C. and Wingenbach, G. (2014). Rethinking improved cookstove diffusion programs: A case study of social perceptions and cooking choices in rural Guatemala. *Energy Policy*, 66. 350–58. DOI:10.1016/j.enpol.2013.10.082.
- Borgatti, S. P., Everett, M. G. and Johnson, J. C. (2013). *Analyzing Social Networks*. Sage, Los Angeles, CA.
- Clark, M. L., Heiderscheidt, J. M. and Peel, J. L. (2015). Integrating Behavior change theory and measures into health-based cookstove interventions: a proposed epidemiologic research agenda. *Journal of Health Communication*, 20(sup1). 94–97. DOI:10.1080/10810730.2014.989346.
- Ezzati, M. (2005). Indoor air pollution and health in developing countries. *The Lancet*, 366(9480). 104–6. DOI:10.1016/S0140-6736(05)66845-6.
- GACC (2014). *2013 Results Report: Sharing Progress on the Path to Adoption of Cleaner and MOre Efficient Cooking Solutions*: Global Alliance for Clean Cookstoves, Washington, DC. <http://cleancookstoves.org/resources/285.html>.
- GACC (2013). *Kenya Country Action Plan (CAP)*. Global Alliance for Clean Cookstoves. <http://cleancookstoves.org/binary-data/RESOURCE/file/000/000/236-1.pdf>.
- GIZ (2016). *GIZ HERA Cooking Energy Compendium: A Practical Guidebook for Implementers of Energy Cooking Interventions*. Gesellschaft für Internationale Zusammenarbeit. https://energypedia.info/wiki/GIZ_HERA_Cooking_Energy_Compendium.
- Goodwin, N. J., O’Farrell, S. E., Jagoe, K., Rouse, J., Roma, E., Biran, A. and Finkelstein, E. A. (2015). Use of behavior change techniques in clean cooking interventions: a review of the evidence and scorecard of effectiveness. *Journal of Health Communication*, 20 Suppl 1. 43–54. DOI:10.1080/10810730.2014.1002958.

- GVEP International (2012). *Kenya Market Assessment – Sector Mapping*. GVEP International. http://cleancookstoves.org/resources_files/kenya-market-assessment-mapping.pdf.
- Hanna, R., Duflo, E. and Greenstone, M. (2012). *Up in Smoke: The Influence of Household Behavior on the Long-Run Impact of Improved Cooking Stoves*. NBER Working Paper 18033. National Bureau of Economic Research, Cambridge, MA. <http://www.nber.org/papers/w18033>.
- Hart, C. and Smith, G. (2013). *Scaling Adoption of Clean Cooking Solutions through Women's Empowerment: A Resource Guide*. Global Alliance for Clean Cookstoves, Washington, DC. <http://cleancookstoves.org/resources/223.html>.
- Ipsos Ltd. (2014). *Kenya Consumer Segmentation Study – Phase 2 – Final Report*. Global Alliance for Clean Cookstoves. <http://cleancookstoves.org/binary-data/RESOURCE/file/000/000/339-1.pdf>.
- Jeuland, M. A. and Pattanayak, S. K. (2012). Benefits and costs of improved cookstoves: assessing the implications of variability in health, forest and climate impacts. *PLoS ONE*, 7(2). e30338. DOI:10.1371/journal.pone.0030338.
- Kahan, D. M., Braman, D., Gastil, J., Slovic, P. and Mertz, C. K. (2007). Culture and identity – protective cognition: explaining the white male effect in risk perception. *Journal of Empirical Legal Studies*, 4(3). 465–505.
- Kahan, D. M., Jenkins-Smith, H. and Braman, D. (2011). Cultural cognition of scientific consensus. *Journal of Risk Research*, 14(2). 147–74. DOI:10.1080/13669877.2010.511246.
- Knoke, D. and Yang, S. (2008). *Social Network Analysis*. 2nd ed. Sage Publications, London and Thousand Oaks, CA.
- Lambe, F. (2014). *The SEI Initiative on Behaviour and Choice*. SEI Initiative Brief. Stockholm Environment Institute, Stockholm. <https://www.sei-international.org/mediamanager/documents/Publications/SEI-initiative-brief-behaviour-choice-rvsvd.pdf>.
- Lambe, F. and Atteridge, A. (2012). *Putting the Cook Before the Stove: A User-centred Approach to Understanding Household Energy Decision-Making – A Case Study of Haryana State, Northern India*. Working Paper. Stockholm Environment Institute, Stockholm.
- Lewis, J. J., Bhojvaid, V., Brooks, N., Das, I., Jeuland, M. A., Patange, O. and Pattanayak, S. K. (2015). Piloting improved cookstoves in India. *Journal of Health Communication*, 20(sup1). 28–42. DOI:10.1080/10810730.2014.994243.
- Miah, M. D., Al Rashid, H. and Shin, M. Y. (2009). Wood fuel use in the traditional cooking stoves in the rural floodplain areas of Bangladesh: A socio-environmental perspective. *Biomass and Bioenergy*, 33(1). 70–78. DOI:10.1016/j.biombioe.2008.04.015.
- Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M. P., Cane, J. and Wood, C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*, 46(1). 81–95. DOI:10.1007/s12160-013-9486-6.
- Miller, G. and Mobarak, A. M. (2015). Learning about new technologies through social networks: experimental evidence on nontraditional stoves in Bangladesh. *Marketing Science*, 34(4). 480–99. DOI:10.1287/mksc.2014.0845.

- Mobarak, A. M., Dwivedi, P., Bailis, R., Hildemann, L. and Miller, G. (2012). Low demand for non-traditional cookstove technologies. *Proceedings of the National Academy of Sciences*, 109(27). 10815–20. DOI:10.1073/pnas.1115571109.
- Mortimer, K., Ndamala, C. B., Naunje, A. W., Malava, J., Katundu, C., et al. (2016). A cleaner burning biomass-fuelled cookstove intervention to prevent pneumonia in children under 5 years old in rural Malawi (the Cooking and Pneumonia Study): a cluster randomised controlled trial. *The Lancet*, . DOI:10.1016/S0140-6736(16)32507-7.
- Pine, K., Edwards, R., Masera, O., Schilman, A., Marrón-Mares, A. and Riojas-Rodríguez, H. (2011). Adoption and use of improved biomass stoves in Rural Mexico. *Energy for Sustainable Development*, 15(2). 176–83. DOI:10.1016/j.esd.2011.04.001.
- Prasodjo, R., Musadad, D. A., Muhidin, S., Pardosi, J. and Silalahi, M. (2015). Advocate program for healthy traditional houses, Ume Kbbubu, in a Timor community: preserving traditional behavior and promoting improved health outcomes. *Journal of Health Communication*, 20(sup1). 10–19. DOI:10.1080/10810730.2015.1013390.
- Rajakutty, S. and Kojima, M. (2002). *Promoting Clean Household Fuels Among the Rural Poor: Evaluation of the Deepam Scheme in Andhra Pradesh*. IDP-183. World Bank, Washington, DC. http://siteresources.worldbank.org/INTOGMC/Resources/promoting_clean_household_fuels.pdf.
- Ramanathan, V. and Carmichael, G. (2008). Global and regional climate changes due to black carbon. *Nature Geoscience*, 1(4). 221–27. DOI:10.1038/ngeo156.
- Ramirez, S., Dwivedi, P., Ghilardi, A. and Bailis, R. (2014). Diffusion of non-traditional cookstoves across western Honduras: A social network analysis. *Energy Policy*, 66. 379–89. DOI:10.1016/j.enpol.2013.11.008.
- Rao, P. S. C., Miller, J. B., Wang, Y. D. and Byrne, J. B. (2009). Energy-microfinance intervention for below poverty line households in India. *Energy Policy*, 37(5). 1694–1712. DOI:10.1016/j.enpol.2008.12.039.
- Rehfuss, E. A., Puzzolo, E., Stanistreet, D., Pope, D. and Bruce, N. G. (2013). Enablers and barriers to large-scale uptake of improved solid fuel stoves: a systematic review. *Environmental Health Perspectives*, 122.120–130. DOI:10.1289/ehp.1306639.
- Rogers, E. M. (2003). *Diffusion of Innovations*. 5th ed. Free Press, NY.
- Rosenbaum, J., Derby, E. and Dutta, K. (2015). Understanding consumer preference and willingness to pay for improved cookstoves in Bangladesh. *Journal of Health Communication*, 20(sup1). 20–27. DOI:10.1080/10810730.2014.989345.
- Scott, J. (2013). *Social Network Analysis*. Third edn. Sage, Los Angeles, CA.
- Shankar, A. V., Onyura, M. and Alderman, J. (2015). Agency-based empowerment training enhances sales capacity of female energy entrepreneurs in Kenya. *Journal of Health Communication*, 20(sup1). 67–75. DOI:10.1080/10810730.2014.1002959.
- Shrimali, G., Slaski, X., Thurber, M. C. and Zerriffi, H. (2011). Improved stoves in India: A study of sustainable business models. *Energy Policy*, 39(12). 7543–56. DOI:10.1016/j.enpol.2011.07.031.
- Simon, G. L., Bailis, R., Baumgartner, J., Hyman, J. and Laurent, A. (2014). Current debates and future research needs in the clean cookstove sector. *Energy for Sustainable Development*, 20. 49–57. DOI:10.1016/j.esd.2014.02.006.

Sinha, B. (2002). *The Indian Stove Programme: An Insider's View – the Role of Society, Politics, Economics and Education*. Boiling Point, 48. National Institute of Science, technology and Development Studies, CSIR, New Delhi.

Sudhakara Reddy, B. and Nathan, H. S. K. (2013). Energy in the development strategy of Indian households—the missing half. *Renewable and Sustainable Energy Reviews*, 18. 203–10. DOI:10.1016/j.rser.2012.10.023.

World Bank (2011). World development indicators. Washington, DC. <http://data.worldbank.org/data-catalog/world-development-indicators>.

van der Kroon, B., Brouwer, R. and van Beukering, P. J. H. (2014). The impact of the household decision environment on fuel choice behavior. *Energy Economics*, 44. 236–47. DOI:10.1016/j.eneco.2014.04.008.

WHO (2014). *Burden of Disease from Household Air Pollution for 2012*. World Health Organization, Geneva. <http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/>.

World Bank (2014). *World Development Report 2015: Mind, Society, and Behavior*. World Bank, Washington, DC. <http://elibrary.worldbank.org/doi/book/10.1596/978-1-4648-0342-0>.

APPENDIX: SURVEY QUESTIONNAIRE**Welcome and thank you very much for coming today!**

There are number of questions below I would like to ask you. I will explain each of them step by step and help you answer them.

1. How old are you?

Gender F M

2. Where do you live?

| | |
|--------------------------|-----------------|
| <input type="checkbox"/> | In a town |
| <input type="checkbox"/> | Close to a town |
| <input type="checkbox"/> | Village |

3. How many people live in your household?

4. What is your marital status?

| | |
|--------------------------|---------|
| <input type="checkbox"/> | Single |
| <input type="checkbox"/> | Married |
| <input type="checkbox"/> | Widowed |

5. What is your highest level of education?

| No school education | Primary school | Secondary school | Technical training | University |
|---------------------|----------------|------------------|--------------------|------------|
| | | | | |

6. What is your occupation?

7. What is your approximate monthly household income?

8. Which kind of fuel do you use and how much do you use and how much do you spend on it?

| Fuel type | Where do you get the fuel | How much do you get and how long does it last you? | How much do you pay for it? |
|-----------|---------------------------|--|-----------------------------|
| | | | |

Now I have a few questions about -ISC Implementer- and the stove you got from them.

9. How did you first get in touch with ISC Implementer?
10. Why did you purchase the stove from ISC Implementer?
11. Was there someone that convinced you to purchase the stove from ISC Implementer?
12. With whom did you make the decision to buy the stove?
13. How did you learn how to use the stove? Did someone show you?
14. How do you finance the stove? Is someone helping you?
15. How satisfied or disappointed are you with your stove? Do you have any problems?

| | |
|--------------------------|------------------------------------|
| <input type="checkbox"/> | Very satisfied |
| <input type="checkbox"/> | Satisfied |
| <input type="checkbox"/> | Neither satisfied nor disappointed |
| <input type="checkbox"/> | Disappointed |
| <input type="checkbox"/> | Very disappointed |

Please tell us about problems:

16. Are you still in touch with the implementer now? With whom, why and how often?

| Who at the implementer | Why | How often? |
|------------------------|-----|------------|
| | | |

17. How satisfied or disappointed are you with ISC Implementer? Do you have any problems?

| | |
|--------------------------|------------------------------------|
| <input type="checkbox"/> | Very satisfied |
| <input type="checkbox"/> | Satisfied |
| <input type="checkbox"/> | Neither satisfied nor disappointed |
| <input type="checkbox"/> | Disappointed |
| <input type="checkbox"/> | Very disappointed |

Please tell us about problems:

And now a few last questions about whom you talk to regarding the stove.

18. Who do you turn to when you have a problem with your stove?
19. Who do you turn to regarding the financing of your stove?
20. Do you talk to others that have purchased the stove from (ICS Implementer) about the stove? What do you talk about?

| | |
|--------------------------|-------------------------|
| Yes, I talk to... | We talk about... |
| | |

21. Have you recommended the stove and implementer to anyone? And do you know if that person has made the decision to buy the stove?

| | |
|---|--|
| Yes, I recommended the stove and Implementer to: | Has that person purchased the stove from the implementer? |
| | |

22. Who in your household makes decision about the purchase of

| Cooking appliances? | Daily household needs? | Large household items? | Health care? |
|----------------------------|-------------------------------|-------------------------------|---------------------|
| | | | |

Thank you very much for your answers!

SEI - Headquarters

Stockholm

Sweden

Tel: +46 8 30 80 44

Executive Director: Johan L. Kuylenstierna

info@sei-international.org

Visitors and packages:

Linnégatan 87D

115 23 Stockholm, Sweden

Letters:

Box 24218

104 51 Stockholm, Sweden

SEI - Africa

World Agroforestry Centre

United Nations Avenue, Gigiri

P.O. Box 30677

Nairobi 00100

Kenya

Tel: +254 20 722 4886

Centre Director: Stacey Noel

info-Africa@sei-international.org

SEI - Tallinn

Lai str 34

10133 Tallinn

Estonia

Tel: +372 627 6100

Centre Director: Lauri Tammiste

info-Tallinn@sei-international.org

SEI - Asia

15th Floor

Witthayakit Building

254 Chulalongkorn University

Chulalongkorn Soi 64

Phyathai Road, Pathumwan

Bangkok 10330

Thailand

Tel: +(66) 2 251 4415

Centre Director: Niall O'Connor

info-Asia@sei-international.org

SEI - U.S.

Main Office

11 Curtis Avenue

Somerville, MA 02144

USA

Tel: +1 617 627 3786

Davis Office

400 F Street

Davis, CA 95616

USA

Tel: +1 530 753 3035

Seattle Office

1402 Third Avenue, Suite 900

Seattle, WA 98101

USA

Tel: +1 206 547 4000

Centre Director: Michael Lazarus

info-US@sei-international.org

SEI - Oxford

Florence House

29 Grove Street

Summertown

Oxford, OX2 7JT

UK

Tel: +44 1865 42 6316

Centre Director: Ruth Butterfield

info-Oxford@sei-international.org

SEI - York

Environment Building

Wentworth Way

University of York

York, YO10 5NG

UK

Tel: +44 1904 32 2897

Centre Director: Lisa Emberson

info-York@sei-international.org

Stockholm Environment Institute

SEI is an independent, international research institute. It has been engaged in environment and development issues at local, national, regional and global policy levels for more than a quarter of a century. SEI supports decision making for sustainable development by bridging science and policy.

sei-international.org

Twitter: @SEIresearch, @SEIclimate