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Factors Influencing Sustained use of Efficient Cook Stoves and Solar Lighting Solutions: A Case Study from Kenya

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African Centre for Technology Studies (ACTS)
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Abstract

Efficient cook stoves have been an important policy focus of international development efforts to address negative health and environmental problems associated with traditional cooking practices. However, major emphasis has been on ensuring initial acceptance of efficient stoves, overlooking the fact that some of the disseminated stoves are used less regularly or even abandoned. In this study, we examine factors that influence the level of use of efficient stoves. The study draws from lessons and experiences from the Piloting Scalable Models for Clean Energy Access project implemented by the African Centre for Technology Studies (ACTS) in collaboration with the Energy Resource Institute of India (TERI). Data were gathered from a survey of 80 households adopting efficient stoves. Results show that sustained use of efficient stoves over time is significantly influenced by the level of awareness creation activities offered by project implementing organizations, business case for the cook stoves and sociocultural reputation of the new stove among community members. The key lesson is that accelerating sustainable adoption of efficient stoves require holistic approach targeting not only dissemination but also addressing socio-cultural and capacity barriers to sustainable use of these stoves and using them as business ventures for groups of households. Further, results shows that improved cook stoves designed with efficient business models have the potential to transform sustainable livelihoods and vibrant microenterprises at local level where raw materials can easily be reproduced. Stove-disseminating agencies should pay attention to these factors to ensure not only are efficient stoves accepted but also sustainably used.

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1. Introduction

Lack of affordable modern energy services is a key challenge affecting a significant portion of the global population. Currently about 2.8 billion people worldwide depend on crude and inefficient cooking devices, burning traditional fuel sources, such as unprocessed firewood, cow dung, charcoal and crop residues (Shankar et al., 2014). Unmanaged use of traditional energy fuels has been known to result in adverse health and environmental consequences. WHO (2009: 34) has reported that indoor air pollution (IAP) (mainly from burning traditional solid fuels) results in 2 million deaths every year, effectively making IAP among the leading contributors to ill health in developing countries.

One way of addressing this challenge has been through large-scale dissemination of improved cooking technologies to developing countries. Existing research has emphasised on identifying factors that positively or negatively influence the willingness of project beneficiaries to initially accept improved cookstoves (see e.g. Jan, 2012; El Tayeb Muneer & Mukhtar Mohamed, 2003; Debbi et al., 2014; Lewis & Pattanayak, 2012). A recent example in the Kenyan context is a study by Mtsami (2010) which has detailed constraints to the adoption of improved cookstoves in Wundanyi, Mwatate and Voi districts. Policy intervention has often been aimed at addressing such constraints (through provision of incentives, awareness sensitizations and training of stove producers) and ensuring initial acceptance and dissemination of improved cooking devices.

Unsurprisingly perhaps, there has thus been a historical tendency of measuring the success of cookstove projects by the number of stoves disseminated within a specified period (Ruiz-Mercado et al., 2013; Pine et al., 2011). However, this has been indicated to be an unsuccessful strategy, since disseminating stoves may not necessarily translate to access and continued use (Shankar et al., 2014; Ruiz-Mercado et al., 2011). In support of this, Pine et al. (2011:177) have stated that:

> "[…] successful dissemination leading to widespread use of such stoves is not as easy as simply distributing them throughout communities; many programs to promote these improved technologies have failed in the long run because they did not take variations in cultural preferences, local cooking needs, patterns of household fuel use, and other social and economic factors into account"

Some evidence suggests that, in the best-case scenarios, rural households often use their new stoves in conjunction with their traditional stoves, resulting in failure to significantly reduce exposure to hazardous indoor air pollutants (Hanna et al., 2013). Others tend to try them but then abandon them (Ibid). Sustained use of these stoves over time remains a critical concern. Specifically understanding whether a stove has been regularly used once it is in the hands of its intended users or is abandoned and the factors contributing to such decisions are therefore key issues that need a thorough investigation.

The purpose of this study is to provide insights into efficient cookstove use patterns and the enabling factors for regular and sustained use of these stoves. The study draws evidence from the improved cookstoves project implemented by the African Centre for Technology Studies (ACTS), in collaboration with The Energy and Resources Institute (TERI) and other local partners.

The remaining sections of this discussion paper are outlined as follows. The succeeding section provides a brief background to the study and methods of data collection and analysis. In the results and discussion section, descriptive statistics of household socio-economic and stove use characteristics as well as quantitative analysis of factors predicting stove use level among Kenyan households are provided. Finally, the last section presents a brief summary of the key results and derives some conclusions that may be useful for efficient stove promoters.

2. Methods

2.1 Study background

The African Centre for Technology Studies (ACTS) in collaboration with the Energy Resource Institute of India (TERI) implemented an efficient energy access project from 2012 to 2015 in collaboration with local private partners. The project piloted the introduction of scalable business models for cooking stoves and lighting solutions among rural and peri-urban poor Kenyan households. It was funded by the Department for International Development (DFID). The programme aimed to increase community awareness and demand and thereby promote large-scale use of energy-efficient stoves. This was done through a review of existing technological solutions and delivery models and the identification of barriers to the promotion of efficient energy options.

The project employed the 'integrated distribution model' concept. This is an intervention approach where the entire value chain, i.e. suppliers, financial institutions, product agents and consumers, is targeted. The project conducted information campaigning, demonstrations, field trials, kitchen performance tests, controlled cooking tests of a variety of stove models, technical training of technicians and offered post-sale services. It also channelled incentives, which were systematically distributed along stove value chains.This included direct subsidy to end users, Institutional Development Grant (IDG) for distribution channel development and seed funding for affordable financing of products to end users. The program held a number of cookstove stakeholder and end-user sensitisation workshops, in collaboration with international and local development organisations and private commercial partners, such as the Netherlands Development Organisation to Kenya (SNV-Kenya) and the Sustainable Community Development (SCODE). The major aim of the workshops was to bring together entrepreneurs of improved cookstoves, microfinance institutions, improved cookstove fabricators and research and development institutions with the aim of discussing ideas on how new cooking solutions, such as forced draft and Philips cookstoves, can be disseminated. The project commercially distributed over 8,000 efficient stoves over a period of three years. The disseminated stoves burn either charcoal or wood, or both wood and charcoal. Some of the stoves were equipped with fan and lighting as well as mobile-phone charging components (see Figure 1 for examples of stoves promoted.

At the end of the project it became apparent that the project had taken the same approach as most other projects, assuming that adoption but also sustained use would result from the dissemination of the cook stoves. In light of the increasing recognition that more effort is often needed to ensure sustained use, the project – as part of

Ecozoom charcoal stove

Ecozoom wood stove

Burn charcoal stove

TERI Gasifier stove with fan, phone charging and lightin components powered by solar PV

Figure 1: Some of the stoves promoted by the project

its overall evaluation activities in its final year – decided to investigate the degree of sustained use amongst efficient cookstove adopters who had benefited from one of the 8,000 efficient stoves commercially distributed during the project period.

2.2 Data collection and analysis

In order to conduct this evaluation of sustained use within the project areas, a cross-sectional survey was conducted from April to June, 2015 in nine villages of Kenya, involving a total of 80 respondents (see Table 1 for the distribution of interviewees over different locations). The respondents were randomly selected from the list of over 8, 000 households who have bought efficient stoves from ACTS-TERI project. The household was taken as unit of analysis for the study. This is because household energy, in particular cooking, is an issue that concerns the entire household. The household head was therefore taken as the key respondent of the questions during the survey, while recognising that most household heads in the survey areas are men and are not directly involved in cooking activities. Nevertheless, head of households are well aware of their household issues, including cooking characteristics.

Table 1: Residence of respondents

Residence locations	Obs.	%
Dunga beach/Kisumu	22	27.5
NyamiraKisii	15	18.8
Mombasa	6	7.5
Kaloleni	13	16.3
Miritini	8	10
Kitui	6	7.5
Potriz	4	5
Mwiki	1	1.3
Mikindani	5	6.3
Total	80	100

Since the main objective of the study was to assess the level of use of efficient cooking stoves disseminated by ACTS and TERI as well as its influencing factors, several socio-economic and stove use characteristics were included in the survey questionnaire.

The major dependent variable for the study was the level of stove use (over a minimum of one-year period) that household had bought from ACTS-TERI project. This variable was normatively measured in a four-scale rating. Several independent variables were included to predict whether stove buyers fall in any of the four scales of stove use level. These independent variables were: household head gender, household head age, household estimated monthly income, household head education level, household location and household head occupation. Other independent explanatory factors that were included are family size , reputation of the stove among villagers , aesthetics of the stove , perceived quality of the stove by the households , cooking speed of the stove , cultural compatibility of the stove , indoor smoke hazard awareness and promotion. Table 2 summarizes the measurement of the dependent and independent variables.

The scales in the dependent variable are not equal. However, each scale is ordered from the lowest scale to the highest scale rating. In such situations, one of the appropriate econometric techniques to model the relationship between the dependent and independent variables is ordered Logit Regression (Greene, 2003: 736). Since the results of this discussion paper are intended for policy purposes, the marginal effects of explanatory variables on the dependent variable were additionally estimated. This is because the marginal effects can provide the effects of a unit increase of an independent variable (while keeping others at their mean) on the dependent variable, i.e. percentage changes in the odds of a household belonging to a particular stove use category.

The data were recorded in a Microsoft Excel spreadsheet. STATA/SE V.13.0 for Windows (Stata Corp LP, College Station, Texas USA) software was used for processing the data.

Table 2: Variables and their measurement

	Measurement
Level of stove use	Scale: Never=0… The whole time (regularly)=4
Household head gender	Dummy, Woman=1, 0 otherwise
Household head age	Scale, years: Below 20=1; 21 to 30 =2; 31 to 40=3; 41 to 50=4 above 50=5
Household monthly income	Scale, in KES: Below 5000=0; 10,000=1; 11,000 – 15,000=2; 16,000-20,000=3; 21,000-25,000=4; Above 26,000=5
Household head education	Scale: Unable to read and write=0; Basic literacy (read and write) =1; Primary school =2;Secondary school =3; Tertiary school and above=4
Household location	Scale: Rural=0; semi-urban(periphery of urban)=1; Urban=2
Household head occupation	Dummy, Non-professional=0; Professional (having been attended an academic study) =1
Family size	Numbers
Reputation	Scale: Disliked=0; Less liked (only a couple of people appreciate it) =1;Popular (admired by a number of people) =2; Very popular (widely admired) =3
Aesthetics of stove	Scale: Not good looking at all=0; Attractive=1; Very attractive=2
Perceived quality of stove	Scale: Not acceptable at all=0; Acceptable (good quality)=1; Very good quality=2
Cooking speed of stove	Scale: Slow=0; Fast=1; Very fast=2
Cultural compatibility of stove	Dummy: Not compatible at all=0; Compatible=1
Smoke hazard awareness	Dummy, Not aware=0; Aware=1
Promotion	Dummy: Yes =1; No=0

2.3 Methodological limitations

We believe that this study provides preliminary but relevant insights into the level of efficient cookstove use and its influencing factors in Kenyan households. Yet, there are some limitations that may affect the generalizability of these findings. First, while fourteen socio-economic, institutional and technological factors, which are expected to influence stove use intensity have been included, it is difficult to be sure whether these variables are exhaustive or not. Second, while data have been collected in different regions of Kenya, the sample distribution over the different regions has not been systematic. In particular, geographical matching was not done in terms of proportion of respondents based on degree of emphasis placed on the area within the project vs. others and the number of households which bought the stoves promoted in different locations. These factors may impact the 'power' of the result i.e. the degree to which the results are likely to be conclusive. Yet, the results – in and of themselves – raise interesting questions and issues for policy makers and cookstove project planners to address in order to more likely move from initial acceptance to sustained use of improved cookstoves.

3. Results and discussions

3.1 Household socio-economic and educational characteristics

Table 3 summarises basic descriptive statistics of household head gender, age and educational characteristics, household monthly income, location and family size of the households surveyed. It shows that nearly half of the surveyed households are headed by women. The mean household size is about six individuals. On average, households reported to have one child under the age of five whereas the same households had nearly three school-attending children at the time of the survey. About 40% of the household heads have educational qualifications of tertiary lvel and above. Findings show that 44% the surveyed households are residing in semi-urban areas whereas 26% and 24% of the households are located in rural and urban areas, respectively. About 32.5% of household heads are over 50 years old while the remaining are in between 21 and 50 years of age. All stove adopters have a monthly income of over $55.6[1] (Table 1). From this, we roughly estimated the mean monthly income (distributed over household members) to be about $1 per person per day. Indeed the data show that only 25% of the households have a daily income of about $1.6 per person. The low level of monthly income of efficient stove users suggests that the majority of program beneficiaries have indeed been the 'poor' households that the ACTS-TERI project had hoped to target. With regard to this, there is an increasing academic literature relating to potential of low-income people in developing countries, also called the Bottom of Pyramid (BOP), forming untapped potential for profit-oriented commercialisation of new technologies. Recently, two levels of BOP (labelled as BOP1 and BOP2) have been identified. BOP1 refers to people with income below $1.25 per day. BOP2 refers to those with income of above $1.25 per day per person but below $2.5 per day per person. It has been indicated that it is the BOP2 segment that is being targeted and can only be targeted because of their purchasing power relative to the very poor (Kaplinsky, 2011). The fact that the average daily income of the surveyed households who adopted the efficient stoves is about $1 per person means that our data do not support the BOP2 assertions.

1. As of June 10, $1 equals to KES 90.

3.2. Stove and fuel usage characteristics of households

Before buying the efficient cookstoves promoted by ACTS and TERI, about 64% (from 80 households) reported that they were using the traditional three-stone stoves that burn wood; whereas about 33 respondents (42.3%) stated that they are using the Kenya Ceramic Jiko (KCJ), which burns charcoal (see Table 4). About 95% of the 80 households reported that they buy their cooking fuel; and 64% of the surveyed households stated that the cost of charcoal and wood is too high and is increasingly becoming unaffordable to them.

Table 3: Summary statistics of socio-economic and demographic characteristics of surveyed households

		Obs.	Percent
Household head gender	Male	41	51.25
	Female	39	48.75
	Total	80	100
Household head education	Unable to read and write	16	20
	Basic literacy	5	6.25
	Primary school	17	21.25
	Secondary school	11	13.75
	Tertiary school and above	31	38.75
	Total	80	100
Location of the household	Rural	26	32.5
	semi-urban	35	43.75
	Urban	19	23.75
	Total	80	100
Household head age, years	Below 20	0	0
	21 to 30	12	15
	31 to 40	24	30
	41 to 50	18	22.5
	above 50	26	32.5
	Total	80	100
Occupation of household head	Non-professional	52	65
	Professional	28	35
	Total	80	100
Household estimated monthly income (KES)	Below 5000	0	0
	5000-10,000	37	46.25
	11,000 – 15,000	11	13.75
	16,000-20,000	5	6.25
	21,000-25,000	7	8.75
	above 26,000	20	25
	Total	80	100

Table 4: Cooking device usage of households prior to buying the new stove

	obs.[a]	Percent
Three stone	51	63.8
Kenya Ceramic Jiko	33	42.3
Paraffin stove	7	8.8
Locally improvised Jiko	2	2.5
Gas	1	2.3

[a] some households use two or more devices at the same time for cooking. Because of this, the cumulative percentage is more than 100%.

In addition to cooking devices and fuels, households were asked to report their light sources. The results show that the majority of households use electricity and solar lamp, while a few households (n=7) employ kerosene lantern and candles (see Table 5).

The respondents were also asked to characterise the type of stove they had bought from the TERI project. The results indicated that from the total of 80 stoves bought by the surveyed households, only one stove was equipped with a fan (see Table 6). Similarly, only few of the stoves (3.8%) had a lighting component. About 59% of efficient stove users reported that the stoves they bought from project is burning only charcoal while 37.5% noted that their stoves use both charcoal and wood. These results suggest that a variation of features exists among the stoves that households have bought from the ACTS-TERI project.

The households were asked to indicate why they choose their particular stove. The results show that fuel saving, being multi-purpose, speed of cooking, less smoke, energy saving, attractiveness and easy to work with are indicated as major reasons in a decreasing order (see Table 7). These results indicate that the surveyed households may have been well informed before buying their stoves about the key attributes of improved and efficient cooking technologies commonly advocated by improved cookstove proponents.

Table 5: Major household light sources

	obs.[a]	Percent
Electricity	41	51.3
solar lamp	39	49.8
kerosene lantern	6	7.5
Candle	1	1.25

[a] Note that some households use two or more of the items as the major source of household lighting.

Table 6: Stove characteristics

	Obs.	Percent
With fan	1	1.25
Charcoal burning	47	58.8
Wood burning	3	3.8
Wood and charcoal	30	37.5
With lightning component	3	3.8

Table 7: Reasons for choosing a particular stove

	Obs.[a]	Percent
Uses little fuel/Economical	49	62.25
Multipurpose	21	26.25
Speed of cooking	20	25
Less/no smoke	19	23.75
Energy saving	15	18.75
Attractive/aesthetic	12	15
Easy to work with	4	5
Heats the household	3	3.75
Cheap	2	2.5
Portable	1	1.25
Safety	1	1.25
Micro finance marketing	2	2.5

[a]**Note that some households indicated two or more reasons and these are also counted**.

Table 8 shows how this study evaluated of the use of cook stoves beyond adoption. . The analysed data show that about 86% of the surveyed households reported to have used the efficient stove 'the whole time'. The majority of households also reported that their stoves are well liked among the villagers. About 76% of the households are 'very satisfied' in using their new stove. In addition, the majority of households (77.5%) believe that their stoves are 'very attractive'; their stove's cooking speed is 'very fast' (73.8%) and is 'culturally compatible' (93.8%). Moreover, nearly all (98.8%) of the households think that they will continue using their stoves over the coming years. Additionally, 90% of households acknowledged that there have been awareness creation activities around efficient stoves.

Before buying the new stoves, a household on average had to spend $250 per year (~12% of the average household yearly income of those surveyed) to buy cooking fuel. The households reported that their fuel expenditure is reduced to an average of $102 per year per household (accounting for about 5% of average household yearly income) by using the efficient stoves. This has ensured a 60% fuel cost saving (i.e.

Table 8: Summary statistics of stove use level, reported stove characteristics, smoke hazard awareness of households and promotion provided by partners

		Obs.	Percent
Level of stove use	Never	1	1.25
	Once per occasion	2	2.5
	Once per month	2	2.5
	Once per week	6	7.5
	The whole time	69	86.25
	Total	80	100
Reputation	Disliked	3	3.75
	Less liked	2	2.5
	Popular	31	38.75
	Very popular	44	55
	Total	80	100
Aesthetics	Not good looking at all	2	2.5
	Attractive	16	20
	Very attractive	62	77.5
	Total	80	100
Perceived stove quality of stove	Not acceptable at all	3	3.75
	Acceptable (good quality)	15	18.75
	Very good quality	62	77.5
	Total	80	100
Cooking speed of stove	Slow	3	3.75
	Fast	18	22.5
	Very fast	59	73.75
	Total	80	100
Satisfaction on using stove	Not satisfied at all	2	2.5
	Satisfied	19	23.75
	Very satisfied	61	76.25
	Total	80	100
Cultural compatibility of stove	Not compatible at all	5	6.25
	Compatible	75	93.75
	Total	80	100
Smoke hazard awareness	Not aware	5	6.25
	Aware	75	93.75
	Total	80	100
Promotion	No	8	10
	Yes	72	90
	Total	80	100

$148 per year per household). The observations—i.e. the stoves save fuel expenses while cooking fast—seem to suggest the ACTS-TERI project had promoted an appropriate stove that meets the expectations and needs of the households (compare with Table 7).

Nearly all (98.8%) households also reported that visitors to their houses show interest in the new

cookstove. Asked the reasons why these visitors have not bought the stoves despite their interest, the respondents reported that high cost of the stoves (70%), failing to be a member of community bank (30%), limited availability of the stoves due to high demand (10%) and limited purchasing capacity of households (2.5%) to be the leading impeding factors.

3.3 Factors influencing sustained use of improved cookstoves

An Ordered Logit regression analysis was run to identify variables that influence the level of efficient stove use among the surveyed households. Before variables were entered into the regression, a multicolinearity test among the 14 independent variables was conducted to check the degree of correlation among the independent variables. The multicolnearity analysis shows that perceived quality of stove is significantly correlated with perceived aesthetics of the stove. Thus, the perceived stove quality variable was dropped from the regression. Additionally household monthly income was significantly correlated with household head education, household location and household head occupation. Thus, household occupation was dropped from the regression. The remaining twelve variables were included in the final model (see Table 9).

Table 9 shows that only three variables are significant predictors of the level of efficient stove use in the studied areas. In particular, the study suggests that a unit increase in the monthly household income, ceteris paribus, is likely to result in a 1.04 unit decrease in the ordered log-odds of being in a higher category of the level of efficient stove use. Since Ordered Logit is a proportional odds model, the effects of coefficients can also be estimated through the Odds Ratio (OR) calculation. Accordingly, a 1 unit increase in household monthly income, keeping all others constant, the predicted odds of observing a regular stove use (Y=4) vs. all other categories of stove use (i.e. Y=0 or Y=1 or Y=2 or Y=3) changes by a factor of Exp(-1.04) = 0.35.

The second significant variable is the reputation of the technology among the villagers. High level of reputation is likely to lead to regular use of efficient stoves. In particular, the result shows that a unit increase in the reputation variable (keeping the values of other independent variables constant) would result in a 2.12 unit increment in the ordered log-odds of being in higher category of the level of stove use. This result can be justified by the fact that social acceptance of new technologies and practices is often positively influenced by favourable opinions among community members, particularly from opinion leaders in rural and peri-urban areas of Kenya. Theoretically, this is related to the role of 'word of mouth communication (WMC)', which has been shown to be key factor in technology diffusion in marketing research (Lang and Hyde, 2013). WMC is a situation where community members communicate about a new technology or service without any commercial motive, and is widely considered as a key force that shapes consumer behaviour (Ibid). Since the 'word of mouth' notion is often discussed in the initial acceptance of new technologies, this study provides some insights into its role beyond this and to sustained use of products.

Awareness creation activities are also positively associated with the level of stove use. The results indicate that a unit increase in the promotion variable (keeping other variables fixed) would result in 4.5 unit increase in the ordered

log-odds of being in a higher value categories of the level of stove use variable. This result numerically supports the views of Goodwin et al. (2014:9) who have stated that use of 'behaviour changing techniques' such as 'shaping knowledge' through promotions can contribute to achieving the goals of efficient stove interventions, i.e. acceptance, continued and consistent use of efficient cooking technologies, and thereby ensuring their health and environmental benefits. While cooking speed of stove is near-statistically significant explanatory factor all other variables turn out to be insignificant. This may be due to the small sample size used.

In addition to coefficient estimates, a marginal effect of each independent variable, keeping other independent variables at their mean, on each category of stove use level is estimated (see Table 10). The result shows that a unit increment in reputation of a stove among villagers (e.g. an increase from disliked=0 to less liked=1 in the scale) would be associated with 8% significant chance of using the new stove 'the whole time'. Thus, it would be useful for development organisations to focus on building the reputation of a new efficient cookstove to ensure its sustained use after initial adoption.

On the other hand, a unit increase in the information campaigning variable (i.e. promoting stoves through information sensitisation, demonstrations, trials etc) would be associated with 17% significant chance of using stoves regularly. While the household monthly income has a significant coefficient estimate in the Ordered Logit estimation above, the marginal effects turned out being insignificant.

Table 9: Ordered Logit estimation of the predictors of stove use level

Independent variables	**Coef.**	**Std. Err.**	***P*-value**
Household head gender	-2.20	1.47	0.13
Household head age	0.45	0.49	0.36
Household monthly income	**-1.04**	0.47	**0.03**
Household head education	0.22	0.50	0.66
Household location	-0.02	0.72	0.98
Family size	0.21	0.22	0.34
Reputation of stove	**2.13**	0.86	**0.01**
Aesthetics of stove	-0.99	1.31	0.45
Cooking speed of stove	2.07	1.12	**0.07**
Cultural compatibility of stove	-1.47	1.70	0.39
Smoke hazard awareness	-1.79	1.49	0.23
Promotion	**4.50**	1.65	**0.01**
/cut1	0.87	3.41	
/cut2	2.44	3.23	
/cut3	3.16	3.22	
/cut4	4.58	3.27	
Number of obs	80.00		
LR chi2(12)	29.17		
Prob> chi2	0.00		
Log likelihood	-30.30		
Pseudo R2	0.32		

Table 10: Marginal affects estimates of Ordered Logit model for stove use level

	Level of stove use				
Independent variables	**Never**	**Once per occasion**	**Once per month**	**Once per week**	**The whole time**
Household head gender	0.00	0.01	0.01	0.06	-0.08
Household head age	0.00	0.00	0.00	-0.01	0.02
Household monthly income	0.00	0.00	0.01	0.03	-0.04
Household head education	0.00	0.00	0.00	-0.01	0.01
Household location	0.00	0.00	0.00	0.00	0.00
Family size	0.00	0.00	0.00	-0.01	0.01
Reputation of stove	0.00	-0.01	-0.01	-0.06	0.08*
Aesthetics of stove	0.00	0.00	0.00	0.03	-0.04
Cooking speed of stove	0.00	-0.01	-0.01	-0.06	0.08
Cultural compatibility of stove	0.00	0.01	0.01	0.04	-0.05
Smoke hazard awareness	0.00	0.01	0.01	0.05	-0.07
Promotion	0.00	-0.02	-0.02	-0.12*	0.17*

* Statistically significant

4. Concluding remarks

The African Centre for Technology Studies (ACTS) along with the Energy Institute of India (TERI) and other local Kenyan partners disseminated efficient stoves in different regions of Kenya from 2012 to 2015. For ACTS, TERI and other development and research organisations, ensuring regular use of such stoves and thereby attaining their full benefits is as equally important as ensuring their initial acceptance and commercialisation. It is with this goal that a survey was conducted involving 80 randomly selected efficient stove users of the ACTS-TERI project. The objective was to understand the degree of stove use intensity and its influencing factors. The first of the major results is that the household socio-economic descriptive statistics showed that the ACTS-TERI project stove users are comparatively low-income earners. This indicates that the projects' intention of targeting poor households has been met.

The stove and fuel use characteristics of stoves reveals that about two-third of the surveyed households used to depend on traditional three-stone stoves whereas over 40% of households were using the Kenyan ceramic jiko (KCJ) before buying the new efficient stoves promoted by the project. Before buying their stoves, households' fuel expenditure used to account for about 12% of their annual income. This significantly reduced once they started using the efficient stoves on a regular basis.

The stove-use level data showed that households tend to use their stoves 'the whole time'. Households rated their stoves highly in terms of their cooking speed, cultural compatibility, aesthetics and reputation among villagers. This is in addition to having saved the households money.

Ordered Logit regression analysis of the factors that affect regular use of efficient and efficient stoves showed that household monthly income, reputation of stoves among villagers and pro-

motion are the statistically significant variables. Contrary to our expectations, all the other nine variables turned out being insignificant.

The estimated marginal effects of a unit increase of each variable (keeping others at their mean) showed reputation among the villagers and institutional promotion being the key factors influencing the regular use of efficient stoves. It is therefore vital that stove-promoting agencies ensure a high level of promotion and strong reputation of improved cookstoves among community members to ensure that stoves are used regularly.

More generally, this study has offered some insights into the fact that sustained use of stoves over time is likely to be determined by household socio-economic factors, community-related characteristics and project approaches. There is therefore a need to identify such characteristics and go beyond the traditional focus of ensuring initial acceptance of new cooking solutions to sustained use of stoves. In light of this, a comprehensive research with large sample size and a broader survey that goes beyond identifying adoption determinants will be an asset for planning and implementing efficient cookstove projects in sub-Saharan Africa.

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