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Original Contribution

Determinants of Cookstoves and Fuel Choice Among Rural Households in India

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Abstract: Roughly 2.8 billion people depend on solid fuels for cooking needs, resulting in a tremendous burden of disease from exposure to household air pollution. Despite decades of effort to promote cleaner cooking technologies, displacement of polluting technologies has progressed slowly. This paper describes results of a randomized controlled trial in which eight communities in two regions of rural India were presented with a range of cooking choices including improved solid fuel stoves and clean cooking options like liquefied petroleum gas (LPG) and induction stoves. Using survey data and logistic and multinomial regression, we identify factors associated with two outcomes: (1) pre-intervention ownership of non-solid fuel technologies and (2) household preferences for clean fuels from the range of cooking options offered. The analysis allows us to examine the influence of education, wealth, gender empowerment, stove pricing, and stove exchanges, among other variables. The majority of participants across all communities selected the cleanest options, LPG and induction, irrespective of price, but there is some variation in preferences. Wealth and higher caste stand out as significant predictors of pre-intervention ownership and non-solid fuel cooking options as well as preference for cleaner technologies offered through the intervention. The experimental treatments also influence preferences in some communities. When given the opportunity to exchange, communities in one region are more likely to choose solid fuel stoves ($P < 0.05$). Giving free stoves had mixed results; households in one region are more likely to select clean options ($P < 0.05$), but households in the other region prefer solid fuels ($P < 0.10$).

Keywords: Improved cookstoves (ICS), Household energy transition, Biomass, LPG, Rural India, Multinomial regression, Logistic regression

INTRODUCTION

For decades, the global development community has strived to induce a transition from traditional biomass-

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burning cookstoves to cleaner and more efficient alternatives. Yet, in 2016, around 2.8 billion people globally used traditional biomass for cooking, typically in open fires or simple cookstoves characterized by poor combustion (IEA 2017). The success of any effort to encourage or facilitate the use of cleaner cookstoves relies on a clear understanding of household decision making and attitudes toward different technologies. Here, we present the initial results of a household choice experiment under different pricing and dissemination approaches in two rural districts in India to answer the following questions:

1. How do the types of cookstoves owned by households correlate with different household level factors: education, wealth, caste, household size, gender responsibilities, etc.?
2. How do experimental treatments, which involve varying stove pricing and offering periodic stove exchanges, affect households' stove choices during the intervention, conditional on the factors mentioned above?

Background

In 2016, exposure to household air pollution (HAP) was responsible for 2.6 million deaths, which is about 5% of the disease burden globally (IHME 2017). Inefficient combustion of solid biomass also contributes to 18–30% of anthropogenic black carbon (BC) and 2–8% of total anthropogenic climate forcing (Masera et al. 2015).

Multiple benefits of cleaner cookstoves—health, socioeconomic, and climate—have motivated hundreds of initiatives, awareness campaigns, and interventions by governments, donors, and non-governmental organizations (NGOs). For example, the Global Alliance for Clean Cookstoves (GACC) includes over 1800 partner organizations worldwide working to enable 100 million households to adopt clean cookstoves by 2020 (GACC 2014). Improved cookstoves (ICS) have a long history in India as well (Khandelwal et al. 2017; Kishore and Ramana 2002). The government's National Program on Improved Chulha (NPIC) ran from 1984 to 2002, but failed to achieve widespread adoption (Hanbar and Karve 2002; Kishore and Ramana 2002). In 2009, the Indian government launched a second program, the National Biomass Cookstove Initiative (NBCI), to promote a new generation of ICS with a stronger focus on health issues (Venkataraman 2010). More recently, the Indian government has shifted tactics to promote LPG, first by subsidizing it for all consumers and then encouraging middle class families to voluntarily opt out of their subsidy (Ministry of Petroleum and Natural Gas 2015), and ultimately shifting to a targeted scheme to provide LPG access for 50 million poor rural households (Prasad 2017).

Despite continuous collective and isolated efforts to make rural households transition away from traditional biomass-based cookstoves, the interventions have not produced the desired effect (Khandelwal et al. 2017; Simon et al. 2014). Nearly 5% of India's total disease burden in 2016 was attributed to HAP exposure, causing over 780,000 premature deaths (IHME 2017). Household level solid biomass burning is also the largest contributor of anthropogenic black carbon (BC) emissions in South Asia (Venkataraman et al. 2005). Additionally, fuelwood extraction can contribute to forest degradation and deforestation (Bhatt and Sachan 2004; Heltberg 2005; Rajwar and Kumar 2011; Samant et al. 2000; Singh et al. 2010), and fuelwood collection places a huge burden on time, particularly for women (Bloomfield 2014).

Many studies explore low adoption rates of ICS technologies and the success/failure of intervention programs. Previous studies have examined the factors that affect the adoption and use of ICS (Khandelwal et al. 2017; Palit and Bhattacharyya 2014). Low adoption rates have been associated with the high cost of technology as well as fuel (Masera et al. 2005; Wallmo and Jacobson 1998), limited education among targeted households (El Tayeb Muneer and Mukhtar Mohamed 2003; Jan et al. 2017), lack of coordination among implementing agencies (Pokharel 2003; Ramirez et al. 2012), lack of information about the benefits of adoption (Limmeechokchai and Chawana 2007; Mobarak et al. 2012), intra-household decision making (Troncoso et al. 2007), failure of stove designs to target specific user needs (Kishore and Ramana 2002; Mobarak et al. 2012; Rhodes et al. 2014), and knowledge and individual perceptions (Puzzolo et al. 2016; Rehfuess et al. 2014). In addition, researchers have shown that acquisition of stoves does not ensure sustained long-term use (Ruiz-Mercado et al. 2011). Households often continue to own multiple stoves, a phenomenon known as stove or fuel *stacking*, which has been pervasive across regions (Cheng and Urpelainen 2014; Ruiz-Mercado and Masera 2015). Many interventions have used behavior change techniques like shaping knowledge, social support or rewards and threats (Goodwin et al. 2015) to encourage clean cooking practices. Attempts have also been made to develop conceptual models of household energy use behavior (e.g., Kowsari and Zerriffi 2011). Despite continual efforts, the likelihood of a rapid transition to cleaner cooking fuels is low. One research group estimates that by 2030, over 700 million people in South Asia could still rely on solid fuels (Cameron et al. 2016).

Most studies of household energy transitions have been either cross-sectional or involved a single stove choice. Results show that wealth and education have been important drivers of stove or fuel transitions. Less attention has been paid to end-user perceptions, cooking practices, and gender preferences (Lewis and Pattanayak 2012; Mehetre et al. 2017), and few studies consider the effects of pricing and dissemination methods (Beltramo et al. 2015; Bensch and Peters 2017; Rosenbaum et al. 2015). Recent studies caution against a "one-size-fits-all" approach (Catalán-Vázquez et al. 2018; Lewis et al. 2015).

This paper reports on the initial stage of stove choice randomized control trial (RCT), which tests attributes like relative advantage, compatibility, and complexity (Rogers 2010) by offering participants a range of cookstoves that vary in performance, ease of use, and level of deviation from traditional practices. The inclusion of multiple stove options, particularly LPG and induction stoves, is an important change from previous studies. This allows us to test participants' preferences for a range of technologies and examine the extent to which cookstoves defined as "aspirational" by outsiders—also the cleaner technology options—are preferred and utilized by poor rural households. We also check the effects of providing end users with an option to periodically exchange their cookstoves for other options, giving them the ability to learn what they like and dislike about each stove technology. By varying stove *price* and *mode* of dissemination, we test differences in stove selection caused by (1) paying or receiving stoves for free, and (2) one-time choice versus the ability to test and exchange stoves.

A clearer understanding of various factors determining stove ownership and selection gives breadth to our conception of energy transition globally. One important feature of the intervention, not investigated in this paper, is "stove bazaars" in which community members gather, share stove knowledge and experiences, and, in half of the communities, exchange the stove they chose for a new one. These choices will be analyzed in a subsequent paper.

Methods

The intervention includes a variety of "improved" biomass cookstoves, from relatively simple and affordable "rocket" stoves to sophisticated forced-draft stoves. Choices also include two "aspirational" options, LPG and induction stoves (Table 1). The intervention was implemented in rural Indian communities. The fact that about two-thirds of households (approx. 165 million) in India are still reliant on solid fuel for cooking (Registrar General and Census Commissioner of India 2011) makes rural India an appropriate region for investigation.

The study was implemented in districts: Kullu in the northern state of Himachal Pradesh and Koppal in the southern state of Karnataka (Fig. 1). Details for both locations are provided in Table 2. As the table shows, differences between the two locations are significant. However, within each state, the chosen communities have similar socioeconomic characteristics and livelihood structures. The analyses in this paper have thus been performed separately for the two locations. This section describes the methodology of study design, data collection, and analyses.

Study Design

The intervention employs a cluster-randomized design (Fisher et al. 2011), which is ideal for testing community scale interventions. Five hundred households were recruited from 8 communities: 4 in Kullu District in Himachal Pradesh (HP) and 4 in Koppal district in Karnataka (recruitment procedures described below). Kullu and Koppal were selected as study sites as they represent two very different settings for a stove intervention program. They differ in terms of socioeconomic characteristics, existing stove usage, forest resources, energy service demands (e.g., the need for heating in Kullu), and different farming activities (the presence of orchards in Kullu versus crops in Koppal). Communities in each study site were selected from a set of communities with a presence of our NGO partner. They were selected to be similar to each other in terms of size, economic activity, proximity to resources, caste and other socio-demographics. Thus, we sought to have minimal variation between communities within a study site but maximal variation between study sites. Treatments were randomly assigned to communities with identical trials repeated in both locations.

Table 1. Details of the Stoves Included in the Intervention.

Stove type	Brand/model	Prices (INR)[d,e]	
Biomass stoves		Retail cost plus shipping	Subsidized price for participants
1-Pot, no chimney	Envirofit	2000	400–500
	Chulika	1800	360–450
	Greenway	1400–1500	300–350
2-Pot, with chimney	Prakti	2350–2810	530–590
	Envirofit	3700	740–925
Forced draft	TERI	5000	1000–1250
Improved Tandoor (Kullu only)[a]	Himanshu	5500	1375
Non-solid fuel (NSF)-based stoves			
Induction[b]	Pigeon "Rapido" 1800 W	2100–4000	420–1000
LPG stove[c]	–	4200–5700	1025–1140

[a]This stove provides cooking and space heating and was offered in Kullu, where there is seasonal heating demand.
[b]This is a single-burner tabletop electrical induction stove.
[c]The cost of LPG included registration for the government subsidy program, a double-burner tabletop stove, regulator, hose, and one full 14.2 kg cylinder plus the deposit on the cylinder.
[d]At the start of the study, the exchange rate was 64 INR per USD.
[e]Prices differed between the two study sites for several reasons: Subsidies offered by the project were 75% in Kullu and 80% in Koppal; some woodstoves incurred different shipping costs to each location; different induction stove models were available in the two locations; the two areas are served by different LPG companies.

Factorial Design

The study design incorporates the two dimensions of stove prices and mode of dissemination (Table 3). With respect to prices, households are either in a community where stoves are offered for free or in one where they pay a subsidized price. Subsidies were only offered on the technology. LPG and electricity for the induction stove would be purchased at the regular tariff (i.e., the same subsidized price all households in these communities pay) though assistance in applying for the subsidy was provided to the households which selected LPG. With respect to dissemination, households are either in a community where their initial stove choice is fixed throughout the study or in a community where they have the option to switch-out for another stove $\sim$ 9–12 months later. In all cases, households were informed that they would be able to keep the stove after the study was completed. In addition, control households were provided the opportunity to obtain a stove upon study completion. The two dimensions form a 2 by 2 factorial design (Table 3). As of February 2018, the second and final switch-outs including the follow-up surveys have been completed for all communities.

This paper focuses on understanding the factors influencing stove choice and acquisition among households. Although the entire intervention program consists of three phases spanning over 3 years, this paper investigates Phases I and II. The details and the timeline of these phases are presented next.

Phase I: In this phase, we selected communities, introduced project activities, and conducted a lottery to choose treatment and control households. In each community, we chose 50 treatments and 10 controls for a total sample of 480 households divided equally between eight communities (four in each study location). During this phase, we collected baseline data through surveys (described below) and air quality and emissions measurements. We include controls in order to monitor difference-in-difference outcomes for indicators that are not included in this paper, such as changes in fuel consumption and indoor air quality.

Phase II: After the baseline survey, initial stove bazaars were organized in which treatment households chose any stove from the menu of options described earlier.[1] These events were conducted in all communities. Based on the factorial design, they were either given stoves for free or at a subsidy. Half of these communities were notified that they

[1]The study imposed one constraint on stove choice: Households that already had a subsidized LPG connection could not select LPG through our intervention because the government program only allows one connection per household.

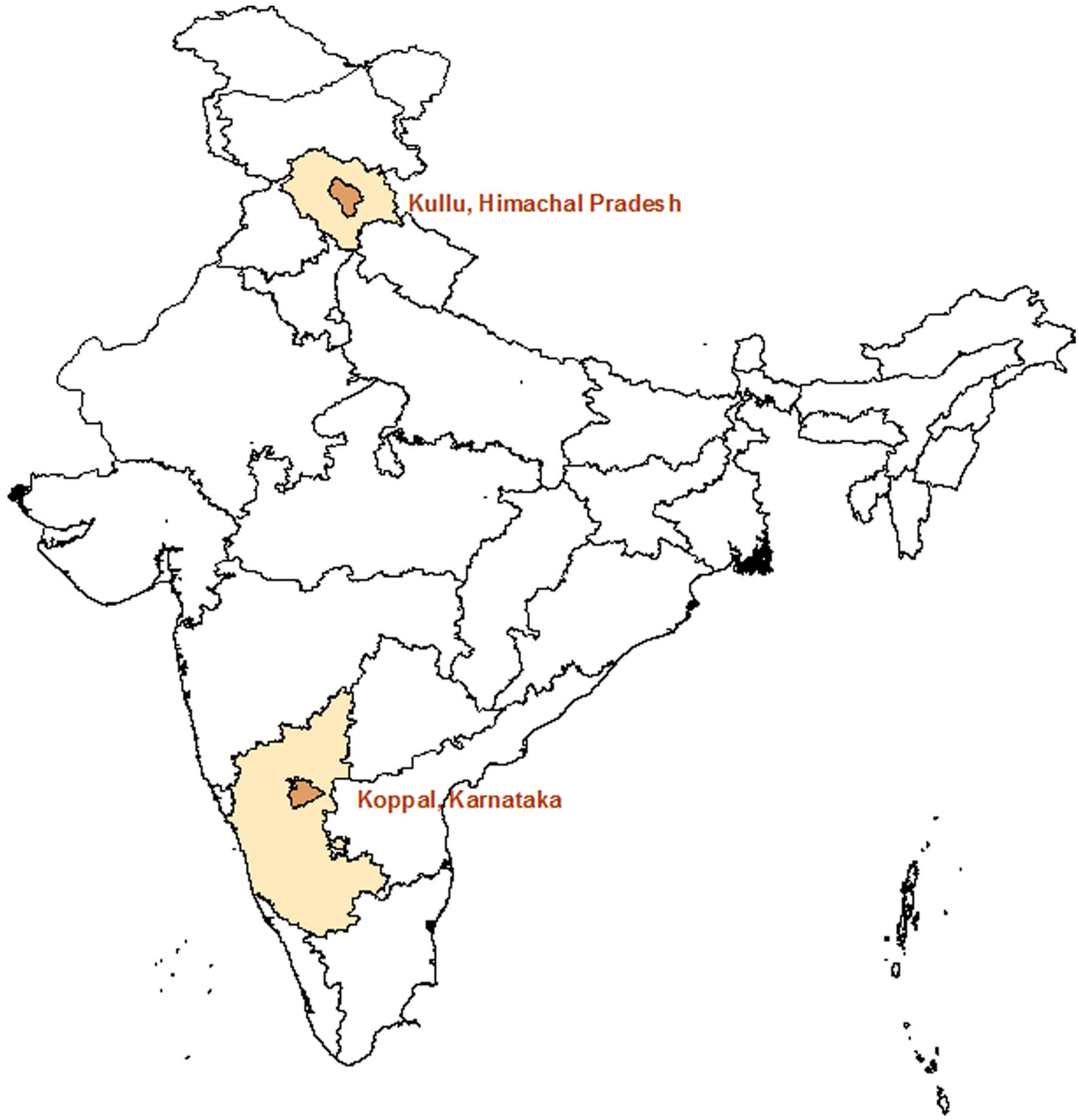

Figure 1. Geographical locations of the two districts covered in the intervention. [The representation of this map does not imply the expression of any opinion whatsoever on the part of the authors concerning the legal status of any territory, or concerning the delimitation of its frontiers or boundaries].

would be given an opportunity in Phase III to exchange their stoves for different models 9–12 months later at subsequent bazaars (these were only implemented in switch-out communities). The data analyzed in this paper were collected prior to those events, so the events themselves have no bearing on the outcome. Nevertheless, participants were aware of the treatments, and this awareness may have influenced their behavior, so we include treatments as explanatory variables in our analyses.

Data Collection

Given the scale of the project and the diverse variables of interest, the project uses different methods for data collection. However, this paper focuses on the *household surveys.* A series of closed-form surveys were administered for all households. They were coded into digital formats and administered through mobile tablets to aid with record keeping and avoid transcription errors. Surveys gathered socio-demographic and economic data as well as information about energy use, fuel collection patterns, stove own-

Table 2. Comparative Site Description.

Detail	Kullu (HP)	Koppal (Karnataka)
Topography	Himalayan foothills Seasonal heating, forest cover Approximate coordinates: 31°58′N 77°6′E	In the plains of the Deccan plateau Semiarid region, little forest cover Approximate coordinates: 15°33′N 76°25′E
Climate		
Avg. annual precipitation	1242 mm	615 mm
Avg. high (warmest month)	32 C (June)	38 C (April)
Avg. low (coldest month)	5 C (Jan)	18 C (Jan)
Demographic details[a]	Population (2011): 437,900 Rural: 91% Literacy rate (rural): 78%; 87% (male), 70% (female)	Population (2011): 1,389,900 Rural: 83% Literacy rate (rural): 66%; 77% (male), 55% (female)

[a]www.census2011.co.in.

Table 3. Factorial Design with Stove Pricing and Dissemination.

Pricing	Stove dissemination	
	One time (*O*)	Switch-out (*S*)
Free (*F*)	Kullu Community 1 Koppal Community 1	Kullu Community 2 Koppal Community 2
Subsidy (*S*)	Kullu Community 3 Koppal Community 3	Kullu Community 4 Koppal Community 4

ership, and pre-intervention stove use patterns. The survey design used guidelines developed by the World Bank for Living Standards Measurement Survey Modules on Household Energy with modifications as necessary (O'Sullivan and Barnes 2006). Data collected as the first two of the following datasets have been used in the analyses in this paper:

Baseline data: Data collected before the stove distribution (Phase I).
Stove choice data 1: Data collected at the time of first stove distribution (Phase II).
Stove choice data 2: Data collected at the first switch-outs (Phase III).
Stove choice data 3: Data collection at the second switch-outs (Phase III).

Analyses

In order to understand the relationships between different household/community-level factors and stove ownership or choices, we have used parametric regression techniques. A similar approach has earlier been used in cookstove adoption studies (Jan 2012; Jan et al. 2017; Mobarak et al. 2012; Pine et al. 2011). As described in the introduction section, education and income levels are the most common household level factors receiving the most attention in earlier studies. However, income varies seasonally and annually and may not truly capture a household's capacity to spend. We consider cumulative household wealth to be a more appropriate factor, which we define by a Wealth Index. The index has been derived using principal component analysis (PCA), following the methodology utilized by DHS (Filmer and Pritchett 1998; Rutstein and Johnson 2004). Table 4 lists the explanatory variables considered in the analyses that may show influence on stove ownership and choices. We then used two approaches with different models within each approach:

Approach 1: Solid Fuels Versus Non-solid Fuels

The first approach considers the stove as a binary variable—solid fuels (SF) (wood, crop residues, and dung) and non-solid fuels (NSF) (kerosene, LPG, and electricity). We use this dichotomous variable to analyze baseline stove ownership as well as initial stove choice (i.e., baseline data and stove choice data 1). We recognize that combining kerosene with LPG and electricity does not align with the division between polluting and non-polluting fuels currently used by household energy researchers because kerosene carries substantial health risks (World Health

Table 4. Explanatory Variables Included in the Regression Models.

Factors considered for baseline stove ownership	Factors considered for Initial stove selection
Caste	Caste
Wealth of the household (Wealth Index)	Wealth of the household (Wealth Index)
Education level of the household	Education level of the household
Household head education	Household head education
Main cook education	Main cook education
Used as a categorical variable with two levels (categories); Category 1: 7th std. and below, Category 2: 7th to 10th std	Used as a categorical variable with two levels (categories); Category 1: 7th std. and below, Category 2: 7th to 10th std
Age of the household head (HHH age)	Age of the household head (HHH age)
Whether household head is also the main cook (HHH = MC)	Whether household head is also the main cook (HHH = MC)
Number of household members (HH members)	Number of household members (HH members)
Whether the main cook does non-agricultural work	Whether the main cook does non-agricultural work
Main cook is also involved in major household decision making	Main cook is also involved in major household decision making
Change in wood collection distance (increase/no change)	Change in wood collection distance (increase/no change)
Community wide fixed effects	Community wide fixed effects
(For Kullu) If the community is located in Lag valley versus Garsa valley	(For Kullu) If the community is located in Lag valley versus Garsa valley
	Presence of non-solid fuel-based stove in the baseline
	Stove pricing: free versus subsidized
	Dissemination approach: one-time versus switch-outs

Organization 2015). Nevertheless, we maintain this division because kerosene is a commercial fuel and is therefore quite different from freely collected wood and crop residues. Study participants use kerosene for short cooking tasks, particularly in Koppal. This is similar to the ways they might use LPG and electricity and is distinct from the ways they use solid fuels. In addition, as we demonstrate below, pre-intervention ownership of NSF stoves (nearly all of which are kerosene in Koppal) is a significant predictor of stove/fuel preference in our intervention.

With the stove type as a dependent variable, the following logistic regression model is used to identify factors associated with stove ownership and stove choice.

$$[P(\text{stove} = \text{NSF}^*)] \sim \beta_0 + \beta_1 \text{Var}_1 + \beta_2 \text{Var}_2 + \beta_3 \text{Var}_3 + \cdots + \varepsilon \quad (1)$$

NSF, non-solid fuel-based cookstoves; Var_i, {(education)$_{\text{HH}}$, (Wealth Index)$_{\text{HH}}$, (caste)$_{\text{HH}}$...); β, regression coefficient; ε, residual error term.

Approach 2: Multiple Stove Choice Options

Participants in the study could choose from multiple stoves, including improved biomass stoves of various kinds as well as NSF stoves. In order to account for this multiple stove choice, we use multinomial regression to understand which factors might explain preferences between different stoves. This regression is represented by the equation below.

$$\left[P\begin{pmatrix} \text{Stove}_a/\text{Stove}_d \\ \text{Stove}_b/\text{Stove}_d \\ \text{Stove}_c/\text{Stove}_d \end{pmatrix}\right] \sim \begin{pmatrix} \beta_{0a} \\ \beta_{0b} \\ \beta_{0c} \end{pmatrix} + \begin{pmatrix} \beta_{1a} \\ \beta_{1b} \\ \beta_{1c} \end{pmatrix} \text{Var}_1 + \begin{pmatrix} \beta_{2a} \\ \beta_{2b} \\ \beta_{2c} \end{pmatrix} \text{Var}_2 + \begin{pmatrix} \beta_{3a} \\ \beta_{3b} \\ \beta_{3c} \end{pmatrix} \text{Var}_3 + \cdots + \begin{pmatrix} \varepsilon_a \\ \varepsilon_b \\ \varepsilon_c \end{pmatrix} \quad (2)$$

$\text{Stove}_{a,b,c,d} \equiv$ stove options; $\text{Stove}_\text{d} \equiv$ Reference category; $P\left(\text{Stove}_a/\text{Stove}_d\right)$ = probability of Stove_a versus Stove_d.

Regressions were performed separately for each set of communities. We found collinearity among certain predictor variables, so several models were analyzed. Our objective is to understand the explanatory power of different predictors, not to find the most "suitable" model;

Table 5. Summary Characteristics of Both Sites (Derived from Data for the Sample Households).

	Unit	Kullu	Koppal
% Households owning land	%	99%	80%
Scheduled caste (SC)/scheduled tribe (ST)	%	40%	44%
Other backward caste (OBC)	%	2%	56%
General	%	58%	–
% Households owning land	%	99%	80%
Av. land holding	Hectares	0.37	1.86
Av. wealth Index[a]	–	0.226	− 0.235
Households head education (% above 7th std.)	%	50%	4%
Main cook education (% above 7th std.)	%	34%	10%
Main fuel at baseline			
Wood	%	91%	99%
LPG	%	9%	1%
Dung cakes	%	< 1%	–
Crop residue	%	–	–

[a]Based on principle components analysis (PCA) on the asset data of both locations combined.

therefore, our discussion below includes insights drawn from different models.[2]

In addition, some participants faced an exogenous constraint with respect to stove choice, which affected our regression models. LPG in India is a regulated commodity with subsidies provided for eligible households through a nationwide program. As we explain below, many households in Kullu had legal LPG connections prior to our intervention. Households are only eligible for one subsidized connection through the government program; therefore, these households were not allowed to select LPG during our study. Moreover, a few households had informal connections, which were not eligible for the government subsidy on the LPG cylinders. They were permitted to formalize their connections through our intervention by purchasing LPG stoves and receive government subsidies. Results and a comparative assessment of all models are provided below.

Results

Baseline Stove Ownership

A snapshot of basic characteristics of the two project locations is shown in Table 5. In Kullu, there is nearly an equal division of general and lower caste households, while in Koppal, all families are either scheduled caste/tribe or "other backward classes" (OBC), both historically disadvantaged categories. In addition, in Kullu, households are comparatively better off. Although the average land holding in Kullu is lower than in Koppal, land productivity is higher in the temperate Himalayan foothills (Kullu) than the semiarid Deccan plateau (Koppal).

We also examine pre-intervention stove and fuel use. Figure 2 shows the prevalence of fuels for Kullu and Koppal prior to the intervention. Firewood was used by all participants and is the main cooking fuel in over 90% of households in both locations. In Kullu, 59% of households owned LPG stoves prior to the intervention, and 23% had an induction stove. In Koppal, after firewood, crop residue is the most common fuel, used seasonally by 96% of the households. Just 1% of households had an LPG connection. Stove ownership reflects fuel use: in Koppal, 84% owned SF stoves exclusively, while 13% also owned a kerosene stove, 1% owned LPG, and 2% owned some type of electric stove. In contrast, only 31% of households were exclusive SF users in Kullu.[3] In addition, 87% of households in Kullu had a tandoor, which is a wood-burning stove used for both cooking and space heating during colder months. We explore this heterogeneity in pre-intervention stove ownership in more detail below (Fig. 2).

[2]Models were tested for multicollinearity using variance inflation factor (VIF). Details are shown in "Appendix 2." Generalized VIF remains well below 2 for all combinations of variables, which indicates a low degree of collinearity among variables.

[3]These distributions are shown in "Appendix 3."

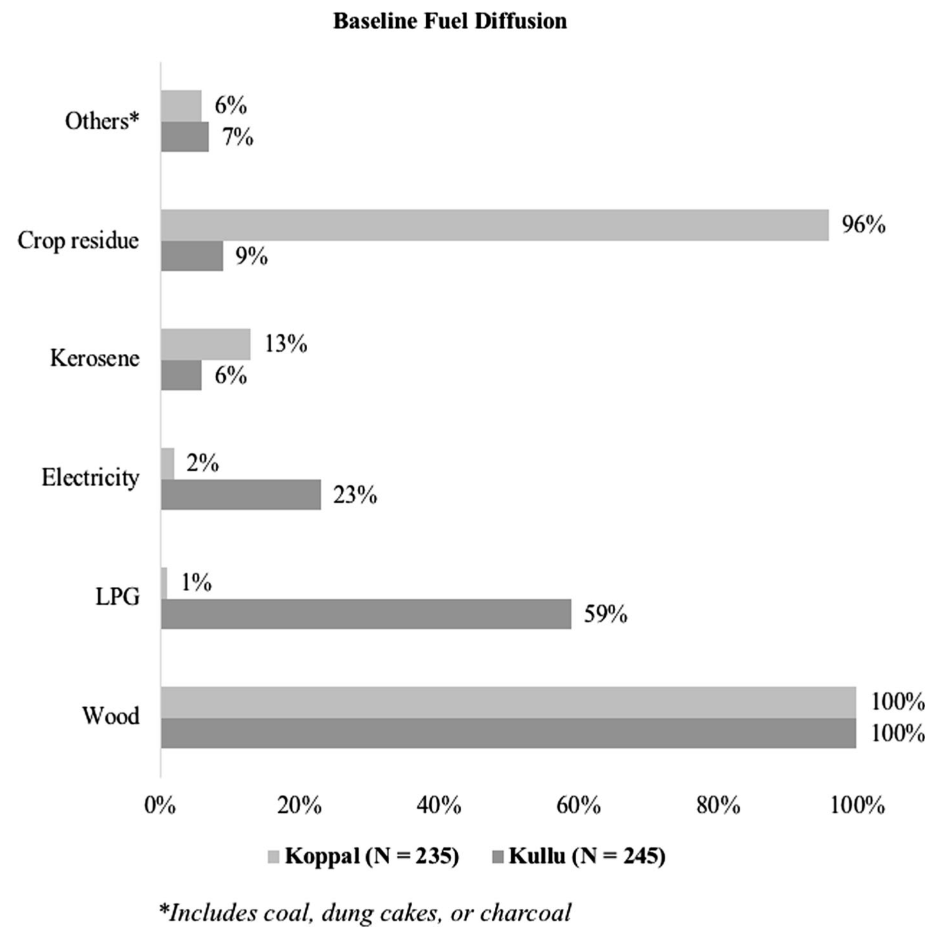

Figure 2. Prevalence of different fuels in the baseline.

Stove Selections

Initial Stove Selection

After baseline data collection, treatment households selected cookstoves that they either purchased at a subsidy or received for free based on the study design described in Table 3. As with baseline stove ownership, there was some heterogeneity in stove choices, which we also examine below.

The Sankey diagrams shown in Figures 3 and 4 show the breakdown of baseline stoves as well as initial stove selection based on baseline stove ownership among treatment households. As we explain above, households that had a subsidized LPG connection prior to the intervention could not select LPG for the study. In Kullu, where there was high baseline ownership of LPG, 29% selected induction stoves, 22% selected an improved tandoor (cooking and heating stove), and 9% selected an improved woodstove. However, among the LPG-eligible households in Kullu, over 80% selected LPG.

In Koppal, where just two households had LPG prior to the intervention, 73% chose LPG. The remaining 27% of selections in Koppal were divided evenly between induction stoves and improved biomass stoves. It is clear that irrespective of the stove ownership—LPG and induction stoves are the desired choices among all households in both locations. In Kullu, the Himanshu Tandoor (an improved cooking and heating stove) was selected by 22% of households. The remaining choices were divided among other improved biomass cookstoves: 9% in Kullu and 14% in Koppal.

Regressions

Several regression models help us to identify determinants of baseline stove ownership and initial stove selections. Also, because some participants' choices were constrained

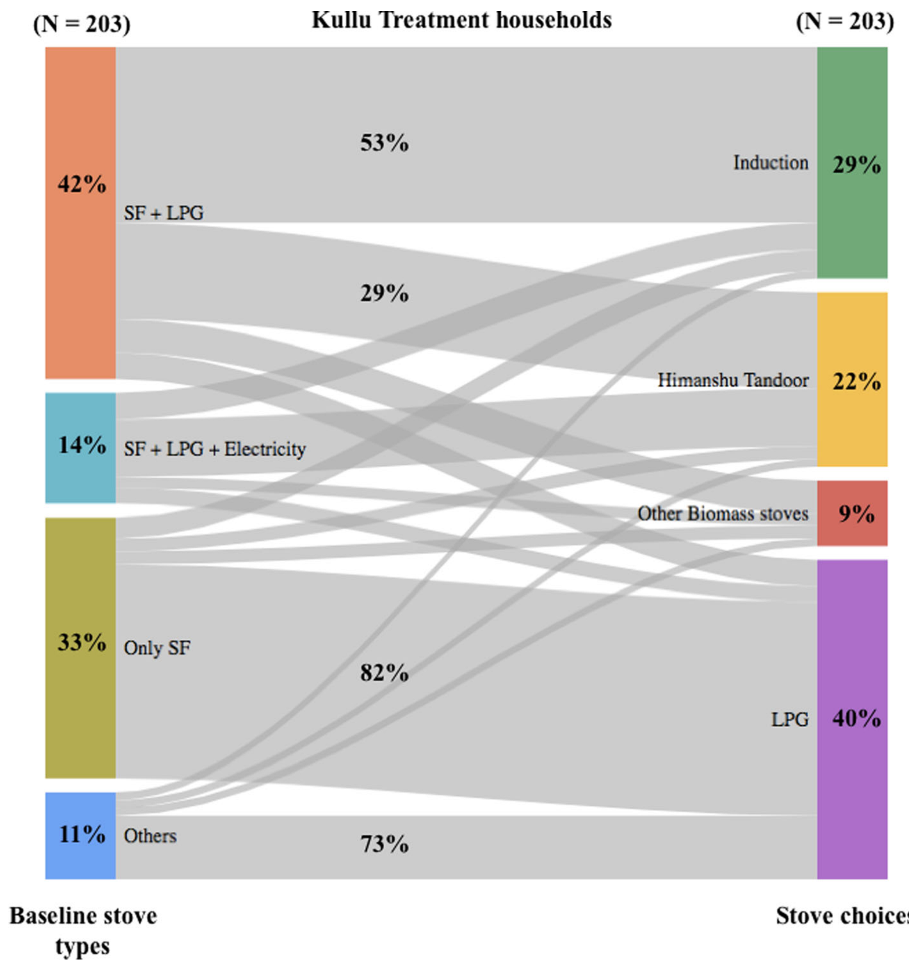

Figure 3. Baseline stove ownership and stove choices for Kullu (HP) (Color figure online).

by prior LPG ownership, we performed regression analyses on two subsets of Kullu treatment households:

- Subset 1: Households with subsidized LPG connections[4] in the baseline (N_{HH} = 103).
- Subset 2: Households without subsidized LPG connection in the baseline (N_{HH} = 88).

Here, we discuss regression results qualitatively. Quantitative results including the effect size estimates and confidence intervals are given in "Appendix" Tables 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18.

Baseline Stove Ownership

Table 6 shows the results for baseline stove ownership in both study areas. The dependent variable is binary: whether households owned some type of NSF stove. Columns show the direction of influence and the level of statistical significance.

The two sets of communities show different outcomes. In Kullu, we find that caste, wealth, and involvement of the main cook in major decision making are significantly associated with baseline NSF ownership ($P < 0.05$). However, if the household head is the main cook, there is a significant negative association with NSF ownership (HH head = main cook). The main cook's education and increased wood collection distance were also weakly significant, but with opposite effects ($P < 0.1$).

In Koppal, wealth is the only HH-level variable that was significantly associated with pre-intervention NSF ownership ($p < 0.05$). There was a less significant association ($P < 0.1$) between NSF ownership and the household head acting as the main cook as well as households that perceived increased wood collection distance.

In addition, community-level fixed effects in both study areas were also significant (Tables 9 and 10), indi-

[4]The informal connections were not included, because the objective of this analysis was to assess households' choices from among all non-LPG options.

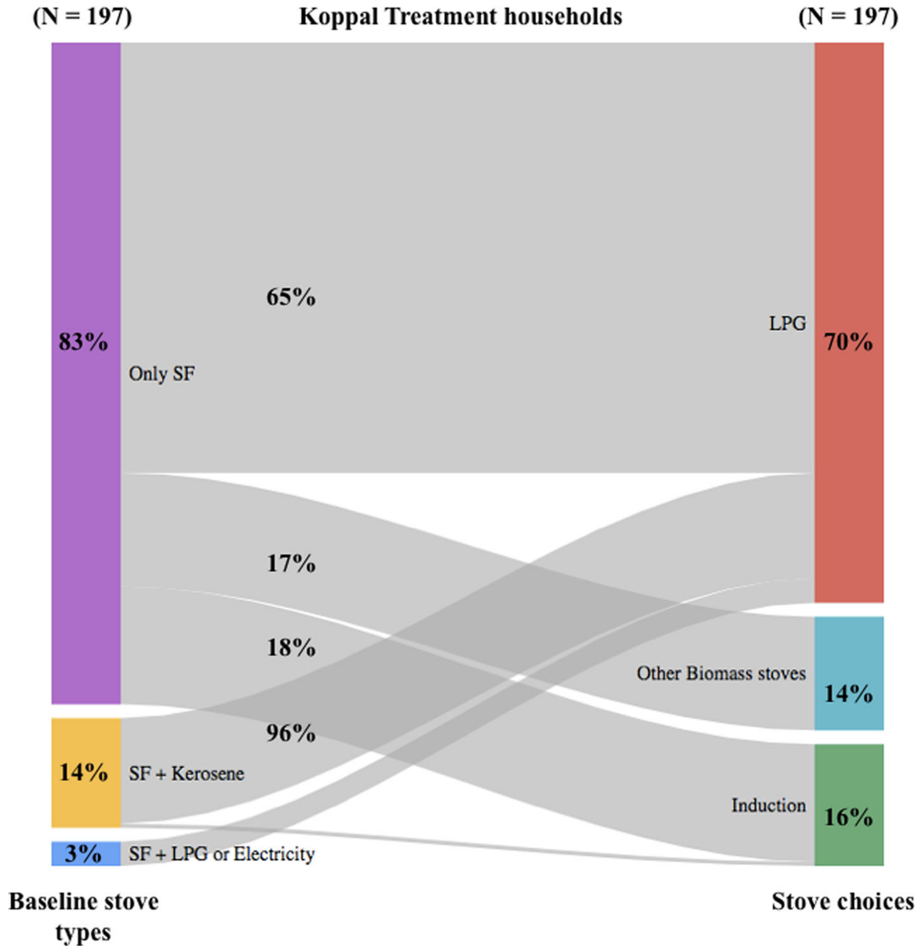

Figure 4. Baseline stove ownership and stove choices for Koppal (KA) (Color figure online).

cating that there was some heterogeneity between communities in baseline stove ownership despite similarities in most socioeconomic indicators.

Initial Stove Choices

In Phase II of the study, participants selected from a range of clean cooking options, here choice can be defined either as a binary (SF/NSF) or a multiple choice. For the analysis, we applied both logistic and multinomial regressions. Results are shown in Tables 7 and 8. In Kullu, three different regressions were implemented to accommodate constraints on LPG choice as described above. Column 3 shows the regression results for the entire Kullu population. Columns 4 and 5 show results for Subset 1 (had pre-intervention LPG) and Subset 2 (no pre-intervention LPG), respectively.

For the full sample, the prior ownership of an NSF stove, main cook's education, household wealth, and stove dissemination approach show statistically significant predictive power in explaining choices between SF and NSF stoves. For Subset 1, these effects are retained, with the exception of prior NSF ownership, which is no longer relevant (column 4 vs 3). Wealthier households in Subset 1 are less likely to choose an NSF stove ($P < 0.1$) (in this case, induction). This is likely because they preferred the Himanshu Tandoor for heating needs. Households with more educated main cooks are more likely to select an NSF stove ($P < 0.05$). With respect to the experimental treatments, households in Subset 1 with an option to exchange their selection later were less likely to choose an NSF stove ($P < 0.05$). In contrast, households that received stoves for free were more likely to choose an NSF stove than households that had to pay for the stoves ($P < 0.10$). In Subset 2, none of the regression results were statistically significant, which is likely due to minimal variation in selection: 80% of this group selected LPG.

In Koppal communities (Table 7; column 6), better-off households were more likely to opt for NSF stoves ($P < 0.05$). With respect to our experimental treatments, households receiving free stoves were *less likely* to select

Table 6. Conclusions of the Logistic Regression for the Baseline Stove Ownership with a Binary Dependent Variable with Two Levels: Non-solid Fuel-Based Stoves (1); Solid Fuel-Based Stoves (0) (Color table online).

Explanatory variables	Dependent variable: ownership of cleaner stoves (LPG + induction)		
	Hypothesis	Kullu	Koppal
Older HH head	+	ns	ns
More HH members	+	ns	ns
Higher education level for HH head	+	ns	ns
Higher education level for main cook	+	+*	ns
Upper caste	+	+***	ns
Higher wealth index	+	+***	+***
HH head = main cook	+	−**	+*
Main cook involved in major decision making	+	+**	ns
Main cook doing non-agricultural work	+	ns	ns
Increase in wood collection distance	+	−*	−*

Results are presented using a conservative principle, i.e., if the P value for any coefficient varies from 0.02 to 0.09 across models, the higher value is considered for the following conclusions.
Green, in line with the hypothesis; red, not in line with the hypothesis.
ns not significant.
Significance levels: $^{*}P < 0.1$; $^{**}P < 0.05$; $^{***}P < 0.01$.

NSF stoves ($P < 0.1$; Table 7), than those paying for the stoves. This result may reflect the long-term recurring cost of stoves like LPG, which may be a concern for Koppal families who are generally less well off than families in Kullu (Table 4).

Multinomial logistic regressions provide additional insight into stove choices in the communities (Tables 8, 15, 16, 17, 18). The reference category for the dependent variable ought to be chosen based on conceptual and theoretical grounds. Significantly high interest in LPG (Figs. 4, 5) in both locations prompted us to consider LPG as the reference category to better evaluate preference for other options in relation to it. We do this for Koppal; however, for Kullu, we used the Himanshu Tandoor as a reference category, because of the choice constraint on LPG. Multinomial regression results for Kullu and Koppal are shown in Table 8 with full details provided in the appendices. As with the logistic regression, we report the results of three multinomial regressions for Kullu: the full sample (column 4), Subset 1 (column 5), and Subset 2 (column 6).

For Subset 1 in Kullu, we find wealth ($P < 0.01$), main cook's education ($P < 0.05$), caste ($P < 0.05$), and option to exchange ($P < 0.05$) are statistically significant predictors of stove preferences. A better educated main cook makes the household 4 times more likely to select an induction over the Himanshu Tandoor (Table 16). However, wealthier households are significantly more likely to make the opposite choice ($P < 0.01$). Looking at selections of other improved biomass stoves, which were chosen by just 9% of participants in Kullu, we find caste has some explanatory power. Upper caste households were significantly less likely to choose an improved biomass stove over the tandoor than lower caste households ($P < 0.05$). Given the option to exchange their stoves later, households are significantly more likely to select the tandoor over induction stove ($P < 0.05$) (Table 16). These results are preserved in the full sample analysis as well. However, regressions performed on Subset 2 do not yield any significant outcomes; as with the logistic regression, preference for LPG resulted in little variation in outcome.

In Koppal (Table 8), wealth is associated with preference for biomass stoves over LPG ($P < 0.05$). Baseline ownership of NSF stoves, mainly kerosene, is also a strong predictor; none of the Koppal households that owned an NSF stove prior to the intervention opted for a biomass stove at the initial bazaar. In addition, they were nearly 5 times more likely to select LPG over induction ($P < 0.1$; Table 18). Both experimental treatments also had an impact. With stove pricing, households getting stoves for free are more likely to choose LPG over induction ($P < 0.1$). Similarly, households with the option to exchange their stoves later were more likely to choose LPG over induction ($P < 0.05$).

Table 7. Conclusions of the Logistic Regression for Initial Stove Choice with a Binary Dependent Variable with Two Levels: Non-solid Fuel (NSF)-Based Stoves (1); Solid Fuel (SF)-Based Stoves (0) (Color table online).

Explanatory variables	Direction of influence on the binary variable; ref level: SF				
	Null hypothesis	Kullu $N_{HH} = 203$	Kullu (only w/ legal LPG) $N_{HH} = 103$	Kullu (w/o LPG) $N_{HH} = 88$	Koppal $N_{HH} = 191$
Presence of any non-solid fuel based stove	+	−**	NA	ns	**ns**
Older HH head	+	ns	ns	ns	ns
More HH members	+	ns	ns	ns	ns
Higher education level for HH head	+	ns	ns	ns	ns
Higher education level for main cook	+	+*	+**	ns	ns
Upper caste	+	ns	ns	ns	ns
Higher wealth index	+	ns[#]	−*	ns	+**
HH head = main cook	+	ns	ns	ns	ns
Main cook involved in major decision making	+	ns	ns	ns	ns
Main cook doing non-agricultural work	+	ns	ns	ns	ns
Increase in wood collection distance	+	ns	ns	ns	ns
Fixed effects: Free versus subsidized	+	ns	+*	ns	−*
Fixed effects: switch-outs versus one time	−	−*	−**	ns	ns

Results are presented using a conservative principle, i.e., if the P value for any coefficient varies from 0.02 to 0.09 across models, the higher value is considered for the following conclusions.
Green, in line with the hypothesis; red, not in line with the hypothesis.
ns not significant.
Significance levels: $^{*}P < 0.1$; $^{**}P < 0.05$; $^{***}P < 0.01$; [#]7 out of 8 models show statistical significance.

Discussion

Here, we summarize the results for different variables and draw some potentially generalizable observations about the ownership of and preference for NSF stoves.

- *Wealth* Household wealth is a significant predictor of stove/fuel choice in nearly every analysis.[5] We find wealthier households were more likely to own NSF options prior to our intervention (OR[6] 2.44 [1.15, 3.73] in Koppal, OR 4.76 [1.46, 8.05] in Kullu; $P < 0.01$ in both locations). In Koppal, wealthier families were also more likely to choose NSF options when given a choice between SF and NSF stoves (OR 2.32 [0.77, 3.87]; $P < 0.05$). In Kullu, where most better-off households already owned LPG prior to the intervention, wealth was significantly associated with a preference for SF stoves, specifically the Himanshu Tandoor (OR 0.38 [0.09, 0.66]; $P < 0.05$).
- *Caste* The Kullu communities have a mix of upper and lower caste families, but in Koppal, all families are from scheduled castes or tribes. In Kullu, caste is a statistically significant predictor of pre-intervention ownership as well as stove selection. Controlling for wealth disparities, higher caste households were much more likely to own an NSF stove prior to the intervention (OR 6.04 [0.11, 11.97]; $P < 0.01$). With respect to stove choice, higher caste households were much less likely to choose other stoves over Himanshu Tandoors (OR 0.16 [− 0.12, 0.44]; $P < 0.05$). Caste did not influence outcomes in Koppal because there is less variation among those communities.
- *Education* We found education, particularly of main cooks, was influential in Kullu, but not Koppal, where education levels are significantly lower (Table 4). The education of the household head was only significant in explaining the selection of the Himanshu Tandoor over LPG among the full sample in Kullu—this is due to the constraints imposed by prior ownership of LPG, discussed above. In contrast, the *main cook's* education was a significant predictor of numerous outcomes. More

[5]Except for one model (out of total 8) in the logistic regression for Kullu full sample (Table 11).

[6]This section reports odds ratios (OR) with 95% confidence intervals in brackets.

Table 8. Conclusions of the Multinomial (Logit) Regression for Initial Stove Choice (Color table online).

Explanatory variable	Ref level: Himanshu Tandoor (HT)					Ref level: LPG		
	Preference	Null hypothesis	Kullu $N_{HH} = 203$	Kullu (only w/ legal LPG) $N_{HH} = 103$	Kullu (w/o LPG) $N_{HH} = 88$	Preference	Null hypothesis	Koppal $N_{HH} = 191$
Presence of any NSF based stove	LPG / HT	+	–***	NA	ns			
	Induction / HT	=	ns	ns	ns	Induction / LPG	+	–*
	Other / HT	–	ns	ns	ns	Other / LPG	–	NA
Older HH head	LPG / HT	+	ns	NA	ns			
	Induction / HT	=	ns	ns	ns	Induction / LPG	+	ns
	Other / HT	–	ns	ns	ns	Other / LPG	–	ns
More HH members	LPG / HT	+	ns	NA	ns			
	Induction / HT	+	ns	ns	ns	Induction / LPG	–	ns
	Other / HT	–	ns	ns	ns	Other / LPG	–	ns
Higher education level for HH head	LPG / HT	+	–**	NA	ns			
	Induction / HT	+	ns	ns	ns	Induction / LPG	+	ns
	Other / HT	–	ns	ns	ns	Other / LPG	–	ns
Higher education level for main cook	LPG / HT	+	ns	NA	ns			
	Induction / HT	+	+**	+**	ns	Induction / LPG	+	ns
	Other / HT	–	ns	ns	ns	Other / LPG	–	ns
Upper caste	LPG / HT	+	ns	NA	ns			
	Induction / HT	+	ns	ns	ns	Induction / LPG	≡	ns
	Other / HT	–	–**	–**	ns	Other / LPG	–	ns
Higher wealth index	LPG / HT	+	–*	NA	ns			
	Induction / HT	+	–*	–***	ns	Induction / LPG	+	**ns**
	Other / HT	–	ns	ns	ns	Other / LPG	–	–**
HH head = main cook	LPG / HT	+	ns	NA	ns			
	Induction / HT	+	ns	ns	ns	Induction / LPG		ns
	Other / HT	–	ns	ns	ns	Other / LPG	–	ns
Main cook involved in major decision making	LPG / HT	+	ns	NA	ns			
	Induction / HT	+	ns	ns	ns	Induction / LPG	+	ns
	Other / HT	–	ns	ns	ns	Other / LPG	–	ns
Main cook doing non-agricultural work	LPG / HT	+	ns	NA	ns			
	Induction / HT	+	ns	ns	ns	Induction / LPG		ns
	Other / HT	–	ns	ns	ns	Other / LPG	–	ns
Increase in wood collection distance	LPG / HT	+	ns	NA	ns			
	Induction / HT	+	ns	ns	ns	Induction / LPG	+	ns
	Other / HT	–	ns	ns	ns	Other / LPG	–	ns
Fixed effects: free versus subsidized	LPG / HT	+	ns	NA	ns			
	Induction / HT	+	ns	ns	ns	Induction / LPG	–	–*
	Other / HT	–	ns	ns	ns	Other / LPG	–	ns
Fixed effects: switch -outs versus one time	LPG / HT	=	ns	NA	ns			
	Induction / HT	=	–**	–**	ns	Induction / LPG	=	–**
	Other / HT	+	ns	ns	ns	Other / LPG	+	ns

The dependent variable is an ordinal variable with three or more categories. The regression analyses have been performed by using *Himanshu Tandoor* and *LPG* stove as the reference category, for Kullu and Koppal, respectively. Results are presented using a conservative principle, i.e., if the *P* value for any coefficient varies from 0.02 to 0.09 across models, the higher value is considered for the following conclusions.
Green, in line with the hypothesis; red, not in line with the hypothesis.
ns, not significant; NA, could not be calculated because the sample did not include this variable.
Significance levels, *$P < 0.1$; **$P < 0.05$; ***$P < 0.01$.

educated main cooks in Kullu were more likely to own NSF stoves at baseline (OR 2.34 [0.12, 4.56]; $P < 0.1$) and more likely to choose them over SF stoves during stove selections (OR 2.17 [0.44, 3.89]; $P < 0.1$). Some previous studies also found education was associated with adoption of cleaner cooking options (Jan et al. 2017) while others found education had little effect (Wuyuan et al. 2010) or was mediated by gender dynamics in the household (Muneer and Mohamed 2003). This brings us to another important factor of household decision making—gender.

- *Gender* There have been calls for empirical research focused on women's decision-making power with respect to adoption of energy services (Pachauri and Rao 2013). We consider several ways that gender may influence outcomes. Our survey questions identified the main cook in each household and asked them to respond to questions related to cooking. In total, 97% of the main cooks are women; thus, our "main cook" variables serve as proxies for women's influence on decisions about clean cooking options. Surveys ask about main cook's involvement in major household decisions and whether the main cook is the household head. In Kullu, the main cook's involvement in major household decisions is strongly associated with baseline ownership of NSF stoves (OR 4.04 [− 0.41, 8.49]; $P < 0.05$). Similarly, in Koppal, households in which the main cook is the head of the household were more likely to own an NSF stove prior to our intervention (OR 2.91 [− 0.31, 6.13]; $P < 0.1$) (Table 10). These findings support research which found that women, who do the bulk of the cooking, often prefer cleaner options (Miller and Mobarak 2013; Rehfuess et al. 2014). However, in Kullu, we found that households in which the main cook is the head of the household were significantly less likely (OR 0.15 [− 0.05, 0.35]; $P < 0.01$) (Table 9) to own an NSF stove before our intervention. This runs counter to what we expected to see.

- *Wood collection distance* We expect that increasing scarcity of wood would lead people to consider other cooking options. However, we found that households reporting increased wood collection distance in the last 3 years in both study locations were less likely (OR 0.42 [0.06, 0.79] in Kullu, $P < 0.05$ and 0.38 [− 0.04, 0.80], $P < 0.1$ in Koppal) to own NSF options prior to our intervention. Reasons for this are unclear. This variable does not show any statistical significance with respect to the stove choices made in the intervention.
- *Experimental Treatment—Stove Pricing* High cost is often cited as a barrier to the adoption of cleaner cooking options. However, there are also concerns that giving away stoves for free results in low adoption because recipients do not value things they receive for free. We tested this by providing free stoves to half of our study participants. Our findings show different effects in the two study areas. In Kullu, where there was already a high degree of NSF stove ownership at baseline, we found households that had LPG prior to our intervention and received stoves for free were more likely to select an NSF stove (OR 2.61 [0.01, 5.21]; $P < 0.1$). In contrast, in Koppal, where there was almost no LPG penetration before the intervention, households receiving stoves for free were significantly less likely to select an NSF option than households that paid for their stoves (OR 0.41 [0.03, 0.80], $P < 0.1$) (Tables 12, 14).
- *Experimental Treatment—Stove Exchanges* We hypothesize that stove exchanges allow participants to test cooking options without making long-term commitments and eventually settle on the best option for their household, which would ultimately lead to higher adoption rates. In this paper, we only consider the initial choice, so the full impact of exchanges is not yet apparent. Nevertheless, the option to exchange appears to have an effect on initial stove selection. For example, in Kullu, households with an option to switch-out were more likely to select the Himanshu Tandoor, an improved cooking and heating stove, in this phase of the study than households that did not have the option to exchange (OR 0.37 [0.03, 0.70]; $P < 0.05$). The reason for this is not clear, though we speculate that the ability to exchange might lead people to choose a less familiar option, knowing if they are unsatisfied, they could opt for something else later on. The Himanshu Tandoor is a new model that is unfamiliar to most families, and induction stoves have been available in Kullu for several years. In Koppal, households with an option to exchange were more likely to select LPG over induction than households unable to exchange (OR 0.35 [0.02, 0.68]; $P < 0.05$). In this case, the logic applied in Kullu does not hold because LPG is probably more familiar than induction in these communities.
- *Baseline stove ownership* Previous stove ownership is also a significant predictor of stove choice. In Kullu, prior ownership of a subsidized LPG connection constrained a subset of participants to choose between induction and some type of SF stove. This group was more likely to select an NSF stove than the group that did not have a prior LPG connection (OR 0.28–0.34; $P < 0.05$) (Table 11). In Koppal communities, no participants had subsidized LPG connections prior to the intervention, two households used unsubsidized LPG, five had an electric stove (not induction), and 27 owned a kerosene stove. Nobody was constrained, 26 of these participants selected LPG, one selected an induction stove, and none of them took a SF option (Fig. 4). Choices among participants that did not own NSF stoves prior to the intervention were more varied. Thus, in Koppal, NSF owners were more likely to select LPG over induction (OR 0.19 [− 0.13, 0.51], $P < 0.1$) and SF options. (OR can not be computed because no NSF users selected a SF stove.)
- *Number of household members and the age of the household head*: Neither of these variables had a significant impact on cookstove-related decisions.
- *Community-level characteristics* Although communities in each location were chosen for their similar character-

istics (Table 4), there may still be community-specific factors that cause household choices to differ. In our analyses, we include the community as a fixed variable with one community in each study area selected as the reference. In Kullu, we find participants in one community were more likely to select the improved cooking and heating stove over other options than participants in the reference community (OR 0.29 [− 0.01, 0.58]; $P < 0.05$) (Table 11). In Koppal, we also see variation in stove choice across communities. Households in one community appeared to be less enthusiastic for LPG; the regression results show they were much more likely to choose SF over NSF options (OR 13.29 [− 16.51, 43.09]; $P < 0.05$) (Table 14) and induction over LPG (OR 3.83 [− 1.17, 8.82]; $p < 0.05$) (Table 18) than households in the reference community.

Limitations

As with all research, there are limitations to the study reported here. First, as with all RCTs, the study subjects had a defined set of options to choose from determined by the project investigators. The results of the study can only, therefore, be interpreted in the context of households being able to choose among this particular set of stoves. However, we endeavored to provide a wider range of real-world options than prior RCTs in this space. Second, the treatment arms regarding pricing of the stoves are not necessarily representative of the real-world decision-making environment. However, comparing outcomes of treatments in which stoves are offered for free and at a subsidy allows us to directly address a question that has been raised in the literature regarding the relative efficacy of interventions that require payments. Third, we lack long-term baseline data on factors such as changes in local biomass availability that could influence household decisions. To the best of our abilities, we incorporated such factors into the surveys (e.g., questions regarding changes in collection practices from the past).

Conclusion

Faced with a range of options, LPG clearly stands out as the main preference for households that did not use it previously. In addition, induction stoves, which are relatively new to rural India, received interest from participants, particularly where LPG has already penetrated. Both are far cleaner than solid fuel options available to participants. Thus, we find a hierarchy of choices: The majority of HHs that relied fully on SF options selected LPG over other choices; the majority of participants who already use LPG selected induction over a wide variety of improved wood stoves.

We show that numerous socioeconomic factors are associated with the cooking choices in Koppal and Kullu prior to our intervention. In particular, wealth in both communities and caste in Kullu play important roles. Other social factors such as whether the main cook is head of household and main cook's level of education are also significant, albeit with opposite influence in the two study sites. In addition, the main cook's participation in major household decisions plays a significant role in Kullu, but not Koppal.

Variation in stove choice is also explained by wealth and caste, but other socioeconomic factors are not as significant. However, both experimental treatments appear to affect stove choice. Our future analyses will show whether treatments impact long-term use of cleaner options and changes in HAP exposure.

Critically, during our study, in May 2016, the government of India launched the Pradhan Mantri Ujjwala Yojana (PMUY) scheme, which aims to provide LPG connections to 50 million households living below the poverty line by 2019 (Prasad 2017). PMUY has received a lot of attention and cautiously optimistic praise (Kar and Zerriffi 2018). Our results show that the rural poor indeed want access to LPG, though questions remain, both in our study and in PMUY more generally, about how much LPG poor people will use and to what extent it will lead to reductions in HAP and associated health benefits. The arrival of aspirational cooking options does not guarantee sustained use or benefits. In our upcoming analyses, we will report on participants' selections at interim and final switch-outs, examine the degree to which they incorporated LPG and induction stoves into their daily practices, and analyze emissions and impacts on indoor air quality.

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Appendix 1

See Tables 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, and 19.

Table 9. Logistic Regression Results for Kullu Baseline Stove Ownership.

	Exp (coef): odds ratio (95% CI)			
	Model 1	Model 2	Model 3	Model 4
Dependent variable: stove ownership (presence of NSF stove)				
Upper caste	6.27***	5.97***	6.04***	5.94***
	(.23, 12.32)	(.59, 11.36)	(.11, 11.97)	(.46, 11.41)
Wealth Index	4.53***	4.69***	4.76***	5.04***
	(1.41, 7.64)	(1.52, 7.85)	(1.46, 8.05)	(1.58, 8.51)
Main cook involved in non-agricultural work	.73	.86	.79	.96
	(.16, 1.30)	(.21, 1.50)	(.16, 1.43)	(.21, 1.70)
More educated HH head	1.02	1.02		
	(.12, 1.92)	(.15, 1.89)		
More educated main cook			2.34*	2.31*
			(.12, 4.56)	(.15, 4.48)
Increase in wood collection distance	.41**	.48*	.42**	.50*
	(.07, .75)	(.12, .84)	(.06, .79)	(.11, .89)
HH head = main cook	.18***	.23**	.15***	.20**
	(− .05, .40)	(− .07, .52)	(− .05, .35)	(− .06, .47)
Main cook involved in major HH decisions	3.30**	2.86**	4.04**	3.40**
	(− .18, 6.78)	(− .05, 5.78)	(− .41, 8.49)	(− .23, 7.04)
Older HH head	1.00	.99	1.01	1.00
	(.97, 1.03)	(.96, 1.02)	(.97, 1.04)	(.97, 1.03)
No. of HH members	1.01	.99	.99	.98
	(.73, 1.29)	(.72, 1.25)	(.71, 1.27)	(.71, 1.25)
Community 1	4.17**		4.40**	
	(−.65, 9.00)		(−.85, 9.65)	
Community 2	1.51		1.41	
	(− .19, 3.21)		(− .22, 3.05)	
Community 3	4.20**		3.78**	
	(− .88, 9.28)		(− .87, 8.43)	
Valley		1.25		1.28
		(.26, 2.25)		(.24, 2.32)
Constant	.50	1.58	.31	.95
	(− .87, 1.87)	(− 2.37, 5.53)	(− .53, 1.14)	(− 1.36, 3.26)
Nagelkerke's R^2	0.586	0.554	0.605	0.575
Observations	244	244	239	239
Log likelihood	− 85.63	− 90.31	− 80.77	− 85.15
Akaike inf. crit.	197.26	202.63	187.54	192.30

HH household, *NSF* non-solid fuel.

*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$ CI at 95% level.

Table 10. Logistic Regression Results for Koppal Baseline Stove Ownership.

	Exp (coef): odds ratio (95% CI)	
	Model 1	Model 2
Dependent variable: stove ownership (presence of NSF stove)		
Upper caste	1.40	1.35
	(.21, 2.59)	(.20, 2.49)
Wealth Index	2.44***	2.53***
	(1.15, 3.73)	(1.16, 3.91)
Main cook involved in non-agricultural work	1.93	1.91
	(− .03, 3.90)	(− .04, 3.85)
More educated HH head	.48	
	(− .62, 1.57)	
More educated main cook		1.56
		(− .59, 3.71)
Increase in wood collection distance	.38*	.39*
	(− .04, .80)	(− .04, .82)
HH head = main cook	2.91*	2.71*
	(− .31, 6.13)	(− .28, 5.69)
Main cook involved in major HH decisions	1.04	1.08
	(.11, 1.96)	(.11, 2.04)
Older HH head	.99	.99
	(.95, 1.02)	(.95, 1.02)
No. of HH members	.89	.88
	(.70, 1.07)	(.69, 1.07)
Community 1	7.87*	7.5*
	(− 9.21, 24.95)	(− 8.70, 23.61)
Community 2	8.84*	7.87*
	(− 10.43, 28.12)	(− 9.29, 25.04)
Community 3	12.14**	11.14**
	(− 14.15, 38.43)	(− 13.06, 35.34)
Constant	.05*	.05*
	(− .10, .20)	(− .10, .21)
Nagelkerke's R^2	0.279	0.278
Observations	234	234
Log likelihood	− 77.01	− 77.04
Akaike inf. crit.	180.02	180.08

HH household, *NSF* non-solid fuel.
$^{*}P < 0.1$; $^{**}P < 0.05$; $^{***}P < 0.01$ CI at 95% level.

Table 11. Logistic Regression Results for Kullu Stove Choice (Full Sample).

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Dependent variable: stove preferences (non-solid fuel vs solid fuel)								
Upper caste	1.30	1.10	1.26	1.30	1.05	.95	1.03	1.05
	(.10, 2.49)	(.11, 2.09)	(.08, 2.44)	(.10, 2.49)	(.07, 2.03)	(.08, 1.82)	(.05, 2.01)	(.07, 2.03)
Presence of NSF stove	.28**	.34**	.33**	.28**	.29**	.34**	.33**	.29**
	(− .01, .58)	(− .01, .69)	(− .02, .68)	(− .01, .58)	(− .01, .59)	(− .02, .69)	(− .02, .68)	(− .01, .59)
Wealth Index	.64*	.71	.64*	.64*	.52**	.59**	.52**	.52**
	(.33, .96)	(.37, 1.05)	(.32, .96)	(.33, .96)	(.26, .79)	(.30, .88)	(.25, .80)	(.26, .79)
Main cook involved in non-agricultural work	1.30	1.43	1.43	1.30	1.30	1.43	1.43	1.30
	(.43, 2.17)	(.46, 2.41)	(.45, 2.41)	(.43, 2.17)	(.42, 2.18)	(.44, 2.41)	(.44, 2.43)	(.42, 2.18)
More educated HH head	.64	.71	.62	.64				
	(.14, 1.15)	(.16, 1.26)	(.13, 1.12)	(.14, 1.15)				
More educated main cook					2.25**	2.18*	2.17*	2.25**
					(.48, 4.02)	(.48, 3.87)	(.44, 3.89)	(.48, 4.02)
Increase in wood collection distance	1.06	.99	1.00	1.06	1.12	1.08	1.07	1.12
	(.33, 1.78)	(.31, 1.67)	(.29, 1.70)	(.33, 1.78)	(.34, 1.91)	(.32, 1.84)	(.30, 1.84)	(.34, 1.91)
HH head = main cook	1.50	1.60	1.46	1.50	1.66	1.75	1.62	1.66
	(− .59, 3.59)	(− .59, 3.78)	(− .57, 3.49)	(− .59, 3.59)	(− .66, 3.98)	(− .65, 4.16)	(− .63, 3.86)	(− .66, 3.98)
Main cook involved in major HH decisions	1.05	1.02	.98	1.05	1.02	.98	.95	1.02
	(.17, 1.92)	(.17, 1.87)	(.13, 1.82)	(.17, 1.92)	(.16, 1.89)	(.15, 1.80)	(.12, 1.79)	(.16, 1.89)
Older HH head	1.00	.99	.99	1.00	1.00	1.00	1.00	1.00
	(.97, 1.02)	(.96, 1.02)	(.96, 1.02)	(.97, 1.02)	(.97, 1.03)	(.97, 1.02)	(.97, 1.02)	(.97, 1.03)
No. of HH members	1.01	1.01	1.01	1.01	1.05	1.05	1.05	1.05
	(.82, 1.21)	(.82, 1.21)	(.81, 1.20)	(.82, 1.21)	(.84, 1.26)	(.84, 1.27)	(.84, 1.27)	(.84, 1.26)
Free stove	1.92*				1.76			
	(.57, 3.27)				(.51, 3.00)			
Option to switch-out		.54*				.52*		
		(.17, .90)				(.16, .89)		
Community 1			.27**				.29**	
			(− .005, .55)				(− .01, .58)	
Community 2			.44				.43	
			(− .03, .90)				(− .04, .89)	

Table 11. continued

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Community 3			.46				.40*	
			(− .003, .91)				(− .02, .82)	
Lag valley versus Garsa Valley				.52*				.57
				(.15, .89)				(.17, .97)
Constant	4.63	10.01**	16.71**	8.89*	2.12	5.00	7.25*	3.73
	(− 5.41, 14.68)	(− 12.45, 32.46)	(− 23.06, 56.47)	(− 10.73, 28.51)	(− 2.17, 6.42)	(− 5.36, 15.36)	(− 8.43, 22.94)	(− 3.72, 11.18)
Nagelkerke's R^2	0.201	0.2	0.22	0.201	0.212	0.217	0.235	0.212
Observations	203	203	203	203	199	199	199	199
Log likelihood	− 109.37	− 109.45	− 107.70	− 109.37	− 105.67	− 105.24	− 103.79	− 105.67
Akaike inf. crit.	242.74	242.90	243.41	242.74	235.34	234.49	235.58	235.34

HH household, *NSF* non-solid fuel
*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$ CI at 95% level.

Table 12. Logistic Regression Results for Kullu Stove Choice (Only for HHs with an LPG Connection).

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Dependent variable: stove preferences (non-solid fuel vs solid fuel)								
Upper caste	.80	.54	.72	.80	.61	.42	.56	.61
	(− .16, 1.77)	(− .10, 1.19)	(− .17, 1.61)	(− .16, 1.77)	(− .16, 1.37)	(− .10, .95)	(− .17, 1.28)	(− .16, 1.37)
Wealth Index	.49**	.54*	.46**	.49**	.39**	.47**	.38**	.39**
	(.16, .83)	(.18, .89)	(.13, .78)	(.16, .83)	(.10, .68)	(.15, .80)	(.09, .66)	(.10, .68)
Main cook involved in	1.41	1.52	1.65	1.41	1.43	1.54	1.64	1.43
non-agricultural work	(.18, 2.64)	(.17, 2.87)	(.15, 3.15)	(.18, 2.64)	(.13, 2.74)	(.11, 2.98)	(.09, 3.19)	(.13, 2.74)
More educated HH head	1.58	1.83	1.64	1.58				
	(− .12, 3.28)	(− .16, 3.82)	(− .18, 3.45)	(− .12, 3.28)				
More educated main cook					3.64**	3.25**	3.35**	3.64**
					(− .25, 7.52)	(− .13, 6.63)	(− .28, 6.98)	(− .25, 7.52)
Increase in wood collection distance	.69	.51	.54	.69	.70	.55	.56	.70
	(.07, 1.30)	(.03, .98)	(.01, 1.08)	(.07, 1.30)	(.04, 1.36)	(.02, 1.07)	(− .01, 1.13)	(.04, 1.36)

Table 12. continued

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
HH head = main cook	4.99	3.49	4.00	4.99	3.93	2.96	3.26	3.93
	(− 6.76, 16.74)	(− 4.79, 11.78)	(− 5.55, 13.55)	(− 6.76, 16.74)	(− 5.08, 12.93)	(− 4.14, 10.06)	(− 4.47, 10.98)	(− 5.08, 12.93)
Main cook involved in major HH decisions	1.43	1.42	1.32	1.43	1.38	1.37	1.28	1.38
	(− .06, 2.92)	(− .08, 2.92)	(− .13, 2.78)	(− .06, 2.92)	(− .08, 2.84)	(− .09, 2.83)	(− .14, 2.69)	(− .08, 2.84)
Older HH head	1.02	1.02	1.02	1.02	1.03	1.02	1.02	1.03
	(.98, 1.06)	(.98, 1.06)	(.98, 1.06)	(.98, 1.06)	(.99, 1.07)	(.98, 1.06)	(.98, 1.06)	(.99, 1.07)
No. of HH members	.97	.94	.94	.97	.92	.90	.91	.92
	(.73, 1.21)	(.71, 1.18)	(.70, 1.19)	(.73, 1.21)	(.69, 1.16)	(.67, 1.13)	(.67, 1.15)	(.69, 1.16)
Free stove	2.34*				2.61*			
	(.13, 4.56)				(.01, 5.21)			
Option to switch-out		.36**				.35**		
		(.02, .70)				(.01, .70)		
Community 1			.17**				.15***	
			(− .06, .40)				(− .06, .36)	
Community 2			.43				.32	
			(− .22, 1.09)				(− .19, .82)	
Community 3			.36				.30	
			(− .13, .86)				(− .13, .74)	
Lag valley versus Garsa Valley				.43*				.38*
				(.02, .83)				(.002, .76)
Constant	.25	1.29	1.65	.59	.31	2.16	2.73	.80
	(− .44, .94)	(− 2.45, 5.03)	(− 3.31, 6.60)	(− .99, 2.16)	(− .46, 1.07)	(− 3.56, 7.88) (− 4.87, 10.33)	(− 1.11, 2.71)	
Nagelkerke's R^2	0.15	0.167	0.197	0.15	0.212	0.222	0.256	0.212
Observations	103	103	103	103	101	101	101	101
Log likelihood	− 64.86	− 64.12	− 62.77	− 64.86	− 60.87	− 60.45	− 58.87	− 60.87
Akaike inf. crit.	151.72	150.24	151.54	151.72	143.74	142.89	143.73	143.74

HH household.
$*P < 0.1$; $**P < 0.05$; $***P < 0.01$ CI at 95% level.

Table 13. Logistic Regression Results for Kullu Stove Choice (Excluding HHs with LPG Connections).

	Exp (Coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Dependent variable: stove preferences (non-solid fuel vs solid fuel)								
Upper caste	2.54	2.45	1.25	2.54	1.72	1.59	.88	1.72
	(− 3.24, 8.32)	(− 3.25, 8.14)	(− 1.67, 4.18)	(− 3.24, 8.32)	(− 1.93, 5.36)	(− 1.89, 5.08)	(− 1.05, 2.81)	(− 1.93, 5.36)
Presence of NSF stove	.20	.20	.27	.20	.26	.24	.33	.26
	(− .22, .63)	(− .23, .63)	(− .31, .85)	(− .22, .63)	(− .27, .78)	(− .26, .74)	(− .36, 1.02)	(− .27, .78)
Wealth Index	3.15	3.26	3.26	3.15	2.18	2.24	1.95	2.18
	(− 1.34, 7.64)	(− 1.41, 7.92)	(− 1.88, 8.40)	(− 1.34, 7.64)	(− .80, 5.16)	(− .84, 5.32)	(− .84, 4.75)	(− .80, 5.16)
Main cook involved in non-agricultural work	1.44	1.48	1.78	1.44	2.05	1.95	2.46	2.05
	(− .83, 3.72)	(− .80, 3.75)	(− 1.23, 4.80)	(− .83, 3.72)	(− 1.07, 5.16)	(− .98, 4.88)	(− 1.48, 6.39)	(− 1.07, 5.16)
More educated HH head	.25	.26	.23	.25				
	(− .21, .70)	(− .21, .73)	(− .20, .67)	(− .21, .70)				
More educated main cook					2.26 (− 3.01, 7.54)	2.17 (− 2.87, 7.21)	2.52 (− 3.57, 8.60)	2.26 (− 3.01, 7.54)
Increase in wood collection distance	1.55	1.57	1.63	1.55	1.73	1.63	1.55	1.73
	(− .97, 4.08)	(− .96, 4.10)	(− 1.10, 4.36)	(− .97, 4.08)	(− 1.02, 4.48)	(− .92, 4.17)	(− 1.02, 4.12)	(− 1.02, 4.48)
HH head = main cook	.45	.45	.49	.45	.64	.52	.57	.64
	(− .56, 1.47)	(− .54, 1.44)	(− .75, 1.73)	(− .56, 1.47)	(− .77, 2.05)	(− .62, 1.67)	(− .87, 2.01)	(− .77, 2.05)
Main cook involved in major HH decisions	.44	.43	.54	.44	.30	.30	.40	.30
	(− .63, 1.50)	(− .63, 1.49)	(− .80, 1.87)	(− .63, 1.50)	(− .40, 1.00)	(− .39, .98)	(− .53, 1.33)	(− .40, 1.00)
Older HH head	.96	.97	.97	.96	.98	.98	.98	.98
	(.92, 1.01)	(.92, 1.01)	(.92, 1.02)	(.92, 1.01)	(.93, 1.02)	(.93, 1.02)	(.93, 1.03)	(.93, 1.02)
No. of HH members	1.05	1.04	1.10	1.05	1.12	1.09	1.19	1.12
	(.50, 1.61)	(.48, 1.61)	(.48, 1.72)	(.50, 1.61)	(.54, 1.71)	(.51, 1.67)	(.53, 1.85)	(.54, 1.71)
Free stove	1.20 (− .85, 3.25)				.91 (− .60, 2.42)			
Option to switch-out		1.24				1.33		
		(− 1.01, 3.49)				(− 1.03, 3.70)		

Table 13. continued

	Exp (Coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Community 1			8,474,080.00 (− 26,747, 917,465.00,26,764, 865,625.00)				10,763,912.00 (− 35,010,197, 762.00, 35,031, 725,585.00)	
Community 2			.38 (− .40, 1.16)				.46 (− .51, 1.44)	
Community 3			.36 (− .47, 1.20)				.43 (− .52, 1.37)	
Lag valley versus Garsa Valley				.83 (− .59, 2.25)				1.10 (− .72, 2.92)
Constant	220.67* (− 1003.19, 1444.52)	228.49* (− 1056.17, 1513.14)	251.57* (− 1256.04, 1759.18)	265.03* (− 1300.40, 1830.46)	49.22 (− 188.79, 287.24)	54.18 (− 212.51, 320.87)	35.24 (− 140.25, 210.73)	44.82 (− 185.33, 274.98)
Nagelkerke's R^2	0.239	0.24	0.31	0.239	0.202	0.204	0.274	0.202
Observations	88	88	88	88	87	87	87	87
Log likelihood	− 27.19	− 27.19	− 25.27	− 27.19	− 28.08	− 28.03	− 26.18	− 28.08
Akaike inf. crit.	78.39	78.38	78.54	78.39	80.16	80.07	80.36	80.16

HH household, *NSF* non-solid fuel.

$^*P < 0.1$; $^{**}P < 0.05$; $^{***}P < 0.01$ CI at 95% level.

Table 14. Logistic Regression Results for Koppal Stove Choice (Full Sample).

	Exp (coef): odds ratio (95% CI)					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent variable: stove preferences (non-solid fuel vs solid fuel)						
Upper caste	.81	1.03	1.30	.80	1.07	1.30
	(.07, 1.55)	(.09, 1.97)	(− .03, 2.63)	(.07, 1.53)	(.09, 2.05)	(− .04, 2.64)
Presence of NSF stove	21,101,178.00	14,503,582.00	44,024,008.00	19,553,761.00	13,811,449.00	39,624,067.00
	(− 42,534,401,906.00, 42,576,604,261.00)	(− 30,317,373,374.00, 30,346,380,537.00)	(− 143,489,634,205.00, 143,577,682,221.00)	(− 39,740,887,063.00, 39,779,994,585.00)	(− 28,880,751,921.00, 28,908,374,819.00)	(− 130,034,112,084.00, 130,113,360,218.00)
Wealth Index	2.46***	2.21**	2.32**	2.50***	2.15**	2.30**
	(.88, 4.04)	(.84, 3.59)	(.77, 3.87)	(.85, 4.16)	(.79, 3.51)	(.73, 3.86)
Main cook involved in non-agricultural work	.47	.57	.63	.45	.53	.60
	(− .13, 1.06)	(− .15, 1.30)	(− .18, 1.44)	(− .13, 1.03)	(− .15, 1.21)	(− .17, 1.37)
More educated HH head	2.05 (− 1.27, 5.36)	1.50 (− .95, 3.94)	1.70 (− 1.21, 4.61)			
More educated main cook				1.64 (− 2.03, 5.30)	2.13 (− 2.73, 6.99)	1.95 (− 2.63, 6.53)
Increase in wood collection distance	1.51	1.54	2.03	1.49	1.54	2.05
	(− .09, 3.11)	(− .12, 3.20)	(− .19, 4.26)	(− .08, 3.07)	(− .12, 3.21)	(− .19, 4.29)
HH head = main cook	5.00*	4.24	3.61	4.81*	4.27	3.50
	(− 3.92, 13.93)	(− 3.49, 11.98)	(− 3.03, 10.24)	(− 3.79, 13.41)	(− 3.54, 12.08)	(− 2.97, 9.96)
Main cook involved in major HH decisions	1.06	1.06	1.05	1.08	1.09	1.12
	(.07, 2.05)	(.08, 2.03)	(.04, 2.06)	(.08, 2.08)	(.08, 2.09)	(.04, 2.19)
Older HH head	1.01	1.00	1.01	1.00	1.00	1.00
	(.97, 1.04)	(.96, 1.03)	(.97, 1.04)	(.97, 1.04)	(.96, 1.03)	(.97, 1.04)
No. of HH members	1.18	1.23*	1.18	1.17	1.23	1.18
	(.89, 1.48)	(.93, 1.54)	(.88, 1.48)	(.88, 1.46)	(.92, 1.54)	(.88, 1.47)
Free stove	.41* (.03, .80)			.43* (.03, .84)		
Option to switch-out		.52 (.03, 1.02)			.49 (.04, .95)	
Community 1			.83 (− .15, 1.81)			.93 (− .16, 2.02)
Community 2			12.42** (− 15.48, 40.32)			13.29** (− 16.51, 43.09)
Community 3			.90 (− .27, 2.06)			.95 (− .30, 2.20)
Constant	2.84	2.39	1.00	3.49	2.46	1.02
	(− 4.00, 9.69)	(− 3.40, 8.17)	(− 1.64, 3.63)	(− 4.81, 11.80)	(− 3.35, 8.27)	(− 1.69, 3.74)
Nagelkerke's R^2	0.265	0.252	0.321	0.26	0.254	0.321

Table 14. continued

	Exp (coef): odds ratio (95% CI)					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Observations	194	194	194	194	194	194
Log likelihood	− 64.40	− 65.25	− 60.77	− 64.72	− 65.14	− 60.80
Akaike inf. crit.	152.81	154.50	149.54	153.45	154.27	149.59

HH household, *NSF* non-solid fuel.
*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$ CI at 95% level.

Table 15. Multinomial Regression Results for Kullu Stove Choice (Full Sample).

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Dependent variable: stove preferences (vs Himanshu Tandoor)								
Intercept (induction/HT)	.41	1.06	1.48	.70	.23	.65	.83	.37
	(− .84, 1.66)	(− 2.30, 4.42)	(− 3.34, 6.30)	(− 1.45, 2.84)	(− .44, .90)	(− 1.27, 2.57)	(− 1.68, 3.34)	(− .68, 1.41)
Intercept (LPG/HT)	14.08*	28.25**	29.27**	27.26**	2.07	4.83	4.84	3.81
	(− 29.78, 57.93)	(− 62.51, 119.01)	(− 69.01, 127.54)	(− 59.36, 113.88)	(− 3.65, 7.79)	(− 8.89, 18.54)	(− 9.37, 19.04)	(− 6.61, 14.23)
Intercept (other/HT)	.35	.45	.24	.33	.18	.21	.13	.18
	(− 1.14, 1.84)	(− 1.56, 2.46)	(− .87, 1.34)	(− 1.09, 1.75)	(− .52, .88)	(− .65, 1.07)	(− .42, .67)	(− .50, .86)
Upper caste (induction/HT)	.39	.33*	.35	.39	.28*	.25**	.24**	.28*
	(− .12, .90)	(− .09, .74)	(− .11, .81)	(− .12, .90)	(− .10, .66)	(− .08, .58)	(− .09, .56)	(− .10, .66)

Table 15. continued.

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Upper caste (LPG/HT)	1.06 (− .47, 2.59)	.93 (− .39, 2.26)	1.18 (− .56, 2.92)	1.06 (− .47, 2.59)	.91 (− .40, 2.22)	.82 (− .35, 1.99)	1.01 (− .48, 2.50)	.91 (− .40, 2.22)
Upper caste (other/HT)	.13** (− .10, .37)	.14** (− .09, .37)	.15** (− .11, .41)	.13** (− .10, .37)	.15** (− .10, .39)	.15** (− .09, .39)	.16** (− .12, .44)	.15** (− .10, .39)
Presence of NSF stove (induction/HT)	2.76 (− 2.03, 7.54)	3.73 (− 2.87, 10.33)	3.91 (− 3.06, 10.89)	2.76 (− 2.03, 7.54)	4.18 (− 3.57, 11.93)	5.40* (− 4.78, 15.57)	6.25* (− 5.70, 18.19)	4.18 (− 3.57, 11.93)
Presence of NSF stove (LPG/HT)	.09*** (− .05, .23)	.10*** (− .05, .25)	.10*** (− .05, .25)	.09*** (− .05, .23)	.09*** (− .05, .24)	.11*** (− .06, .27)	.10*** (− .06, .27)	.09*** (− .05, .24)
Presence of NSF stove (other/HT)	1.62 (− 1.64, 4.88)	1.55 (− 1.65, 4.75)	1.60 (− 1.70, 4.89)	1.62 (− 1.64, 4.88)	1.62 (− 1.69, 4.93)	1.61 (− 1.77, 4.98)	1.61 (− 1.77, 5.00)	1.62 (− 1.69, 4.93)
Wealth Index (induction/HT)	.53** (.20, .86)	.56* (.22, .90)	.52** (.19, .84)	.53** (.20, .86)	.45** (.15, .74)	.48** (.17, .78)	.42** (.14, .71)	.45** (.15, .74)
Wealth Index (LPG/HT)	.50* (.15, .85)	.53* (.16, .90)	.49* (.14, .84)	.50* (.15, .85)	.39*** (.11, .66)	.42** (.13, .72)	.39** (.10, .67)	.39*** (.11, .66)
Wealth Index (other/HT)	.56 (.06, 1.06)	.52 (.06, .97)	.53 (.05, 1.01)	.56 (.06, 1.06)	.52 (.05, .98)	.48* (.07, .88)	.48 (.05, .92)	.52 (.05, .98)
Main cook involved in non-agricultural work (induction/HT)	.91 (.15, 1.67)	1.06 (.15, 1.97)	1.05 (.14, 1.96)	.91 (.15, 1.67)	.81 (.11, 1.51)	.93 (.10, 1.75)	.93 (.10, 1.77)	.81 (.11, 1.51)
Main cook involved in non-agricultural work (LPG/HT)	1.08 (.08, 2.08)	1.16 (.08, 2.24)	1.14 (.07, 2.21)	1.08 (.08, 2.08)	1.11 (.09, 2.14)	1.19 (.08, 2.30)	1.15 (.07, 2.23)	1.11 (.09, 2.14)
Main cook involved in non-agricultural work (other/HT)	.36 (− .13, .84)	.36 (− .13, .85)	.36 (− .14, .85)	.36 (− .13, .84)	.32 (− .12, .76)	.31 (− .12, .74)	.31 (− .12, .75)	.32 (− .12, .76)
More educated HH head (induction/HT)	1.00 (− .03, 2.03)	1.10 (− .03, 2.23)	.97 (− .05, 1.99)	1.00 (− .03, 2.03)				
More educated HH head (LPG/HT)	.28** (− .02, .59)	.31** (− .02, .64)	.29** (− .03, .60)	.28** (− .02, .59)				

Table 15. continued.

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
More educated HH head (other/HT)	.71 (− .32, 1.73)	.68 (− .30, 1.67)	.71 (− .32, 1.75)	.71 (− .32, 1.73)				
More educated main cook (induction/HT)					2.95** (.08, 5.82)	2.77** (.06, 5.49)	3.05** (− .01, 6.11)	2.95** (.08, 5.82)
More educated main cook (LPG/HT)					1.38 (− .07, 2.83)	1.35 (− .06, 2.76)	1.32 (− .07, 2.72)	1.38 (− .07, 2.83)
More educated main cook (other/HT)					.50 (− .37, 1.37)	.46 (− .33, 1.25)	.47 (− .34, 1.28)	.50 (− .37, 1.37)
Increase in wood collection distance (induction/HT)	.89 (.10, 1.67)	.76 (.08, 1.44)	.75 (.06, 1.43)	.89 (.10, 1.67)	.92 (.08, 1.76)	.81 (.06, 1.55)	.73 (.03, 1.43)	.92 (.08, 1.76)
Increase in wood collection distance (LPG/HT)	1.15 (.07, 2.22)	1.03 (.06, 2.00)	1.20 (.03, 2.36)	1.15 (.07, 2.22)	1.27 (.08, 2.46)	1.16 (.07, 2.25)	1.30 (.04, 2.56)	1.27 (.08, 2.46)
Increase in wood collection distance (other/HT)	.94 (− .24, 2.12)	.81 (− .22, 1.85)	.91 (− .27, 2.09)	.94 (− .24, 2.12)	.95 (− .26, 2.15)	.79 (− .24, 1.82)	.89 (− .28, 2.06)	.95 (− .26, 2.15)
HH head = main cook (induction/HT)	2.15 (− 1.67, 5.97)	1.88 (− 1.47, 5.24)	1.86 (− 1.48, 5.20)	2.15 (− 1.67, 5.97)	2.56 (− 2.08, 7.20)	2.20 (− 1.85, 6.25)	2.16 (− 1.80, 6.11)	2.56 (− 2.08, 7.20)
HH head = main cook (LPG/HT)	.76 (− .72, 2.23)	.71 (− .64, 2.05)	.74 (− .70, 2.17)	.76 (− .72, 2.23)	1.07 (− .99, 3.14)	1.03 (− .91, 2.97)	1.06 (− .99, 3.12)	1.07 (− .99, 3.14)
HH head = main cook (other/HT)	1.30 (− 2.16, 4.77)	.89 (− 1.48, 3.25)	1.11 (− 1.83, 4.04)	1.30 (− 2.16, 4.77)	1.61 (− 2.76, 5.98)	1.15 (− 1.97, 4.28)	1.53 (− 2.63, 5.68)	1.61 (− 2.76, 5.98)
Main cook involved in major HH decisions (induction/HT)	1.73 (− .10, 3.56)	1.64 (− .13, 3.40)	1.64 (− .18, 3.45)	1.73 (− .10, 3.56)	1.70 (− .16, 3.57)	1.61 (− .19, 3.42)	1.69 (− .26, 3.65)	1.70 (− .16, 3.57)
Main cook involved in major HH decisions (LPG/HT)	1.08 (− .13, 2.29)	1.09 (− .13, 2.30)	.92 (− .15, 1.99)	1.08 (− .13, 2.29)	1.06 (− .10, 2.21)	1.03 (− .10, 2.15)	.91 (− .13, 1.94)	1.06 (− .10, 2.21)
Main cook involved in major HH decisions (other/HT)	2.40 (− 1.80, 6.59)	2.40 (− 1.83, 6.62)	2.21 (− 1.78, 6.20)	2.40 (− 1.80, 6.59)	2.48 (− 1.90, 6.85)	2.52 (− 2.01, 7.05)	2.43 (− 2.04, 6.90)	2.48 (− 1.90, 6.85)
Older HH head (induction/HT)	1.01 (.98, 1.05)	1.01 (.97, 1.05)	1.01 (.97, 1.05)	1.01 (.98, 1.05)	1.02 (.98, 1.05)	1.01 (.97, 1.04)	1.01 (.97, 1.05)	1.02 (.98, 1.05)
Older HH head (LPG/HT)	1.00 (.96, 1.03)	.99 (.96, 1.03)	.99 (.96, 1.03)	1.00 (.96, 1.03)	1.01 (.98, 1.05)	1.01 (.97, 1.04)	1.01 (.97, 1.05)	1.01 (.98, 1.05)

Table 15. continued.

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Older HH head (other/HT)	1.03	1.03	1.03	1.03	1.03	1.03	1.04	1.03
	(.98, 1.08)	(.98, 1.08)	(.98, 1.09)	(.98, 1.08)	(.99, 1.08)	(.98, 1.08)	(.98, 1.09)	(.99, 1.08)
No. of HH members (induction/HT)	.98	.97	.97	.98	.99	.98	.99	.99
	(.74, 1.21)	(.74, 1.20)	(.73, 1.20)	(.74, 1.21)	(.74, 1.24)	(.73, 1.24)	(.73, 1.25)	(.74, 1.24)
No. of HH members (LPG/HT)	1.02	1.02	1.01	1.02	1.13	1.12	1.11	1.13
	(.74, 1.30)	(.74, 1.30)	(.73, 1.30)	(.74, 1.30)	(.81, 1.44)	(.81, 1.43)	(.80, 1.42)	(.81, 1.44)
No. of HH members (other/HT)	.92	.92	.92	.92	1.00	1.01	1.00	1.00
	(.60, 1.24)	(.59, 1.25)	(.59, 1.24)	(.60, 1.24)	(.63, 1.36)	(.63, 1.38)	(.62, 1.37)	(.63, 1.36)
Free stove (induction/HT)	1.71				1.58			
	(.19, 3.22)				(.14, 3.02)			
Free stove (LPG/HT)	1.94				1.84			
	(.07, 3.80)				(.07, 3.62)			
Free stove (other/HT)	.94				1.00			
	(− .30, 2.18)				(− .33, 2.33)			
Option to switch-out (induction/HT)		.38**				.37**		
		(.04, .72)				(.03, .70)		
Option to switch-out (LPG/HT)		.61				.58		
		(.02, 1.21)				(.02, 1.14)		
Option to switch-out (other/HT)		.85				.85		
		(− .27, 1.97)				(− .30, 2.00)		
Community 1 (induction/HT)			.26**				.26**	
			(− .06, .57)				(− .07, .58)	
Community 1 (LPG/HT)			.35				.34	
			(− .14, .84)				(− .14, .81)	
Community 1 (other/HT)			1.28				1.16	
			(− 1.39, 3.95)				(− 1.31, 3.63)	
Community 2 (induction/HT)			.46				.37	
			(− .16, 1.07)				(− .15, .89)	
Community 2 (LPG/HT)			.89				.83	
			(− .40, 2.18)				(− .39, 2.04)	

Table 15. continued.

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Community 2 (other/HT)			1.87				1.67	
			(− 1.96, 5.69)				(− 1.82, 5.17)	
Community 3 (induction/HT)			.29*				.20**	
			(− .07, .66)				(− .07, .48)	
Community 3 (LPG/HT)			1.03				.88	
			(− .41, 2.46)				(− .35, 2.10)	
Community 3 (other/HT)			1.47				1.39	
			(− 1.55, 4.48)				(− 1.53, 4.31)	
Lag valley versus				.59				.63
Garsa Valley (induction/HT)				(.06, 1.11)				(.06, 1.21)
Lag valley versus				.52				.54
Garsa Valley (LPG/HT)				(.02, 1.01)				(.02, 1.06)
Lag valley versus Garsa				1.07				1.00
Valley (other/HT)				(− .35, 2.48)				(− .33, 2.34)
AIC	435.25	432.92	432.62	435.25	423.18	419.96	418.53	423.18
Observations	203	203	203	203	199	199	199	199
R^2	.23	.23	.24	.23	.23	.24	.26	.23
Log likelihood	− 198.62	− 197.46	− 194.31	− 198.62	− 192.59	− 190.98	− 187.26	− 192.59
LR test	117.13***	119.46***	125.76***	117.13***	118.16***	121.37***	128.80***	118.16***
	(df = 36)	(df = 36)	(df = 42)	(df = 36)	(df = 36)	(df = 36)	(df = 42)	(df = 36)

HT Himanshu Tandoor, *HH* household.
*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$ CI at 95% level.

Table 16. Multinomial Regression Results for Kullu Stove Choice (Only for HHs with an LPG Connection).

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Dependent variable: stove preferences (vs Himanshu Tandoor)								
Intercept (induction/HT)	2.58 (− 5.88, 11.04)	12.00 (− 30.51, 54.50)	13.43 (− 35.54, 62.40)	4.64 (− 10.54, 19.82)	1.65 (− 3.52, 6.82)	10.76 (− 24.96, 46.48)	11.90 (− 27.94, 51.74)	3.10 (− 6.26, 12.47)
Intercept (other/HT)	4.45 (− 17.26, 26.17)	3.18 (− 14.13, 20.49)	1.45 (− 7.29, 10.20)	4.80 (− 18.82, 28.43)	1.56 (− 5.76, 8.87)	.80 (− 3.35, 4.96)	.51 (− 2.37, 3.39)	1.36 (− 4.53, 7.26)
Upper caste (induction/HT)	.26 (− .19, .70)	.21* (− .15, .58)	.25 (− .19, .69)	.26 (− .19, .70)	.18* (− .14, .51)	.16** (− .13, .45)	.18* (− .15, .51)	.18* (− .14, .51)
Upper caste (other/HT)	.08** (− .10, .27)	.08** (− .09, .25)	.08** (− .10, .26)	.08** (− .10, .27)	.09** (− .11, .29)	.09** (− .10, .29)	.09** (− .11, .30)	.09** (− .11, .29)
Wealth Index (induction/HT)	.35*** (.08, .62)	.33*** (.07, .60)	.31*** (.05, .56)	.35*** (.08, .62)	.23*** (.01, .45)	.23*** (.01, .45)	.20*** (− .003, .40)	.23*** (.01, .45)
Wealth Index (other/HT)	.69 (− .16, 1.54)	.66 (− .17, 1.49)	.64 (− .18, 1.46)	.69 (− .16, 1.54)	.66 (− .28, 1.60)	.60 (− .28, 1.48)	.61 (− .32, 1.54)	.66 (− .28, 1.60)
Main cook involved in non-agricultural work (induction/HT)	.82 (.03, 1.61)	.89 (.01, 1.77)	.93 (− .002, 1.85)	.82 (.03, 1.61)	.77 (− .01, 1.55)	.83 (− .04, 1.70)	.86 (− .05, 1.77)	.77 (− .01, 1.55)
Main cook involved in non-agricultural work (other/HT)	.51 (− .34, 1.36)	.53 (− .34, 1.41)	.52 (− .36, 1.40)	.51 (− .34, 1.36)	.39 (− .29, 1.07)	.45 (− .31, 1.21)	.44 (− .33, 1.20)	.39 (− .29, 1.07)
More educated HH head (induction/HT)	.98 (− .19, 2.15)	1.16 (− .22, 2.54)	1.04 (− .27, 2.36)	.98 (− .19, 2.15)				
More educated HH head (other/HT)	.36 (− .28, 1.01)	.37 (− .27, 1.02)	.43 (− .35, 1.20)	.36 (− .28, 1.01)				
More educated main cook (induction/HT)					4.39** (− .90, 9.67)	4.20** (− .94, 9.34)	4.39** (− 1.10, 9.87)	4.39** (− .90, 9.67)
More educated main cook (other/HT)					.21 (− .36, .79)	.22 (− .37, .81)	.24 (− .40, .88)	.21 (− .36, .79)
Increase in wood collection distance (induction/HT)	.56 (− .04, 1.16)	.43 (− .04, .90)	.47 (− .06, 1.00)	.56 (− .04, 1.16)	.58 (− .09, 1.25)	.47 (− .08, 1.03)	.48 (− .10, 1.07)	.58 (− .09, 1.25)
Increase in wood collection distance (other/HT)	.77 (− .46, 1.99)	.75 (− .49, 1.99)	.84 (− .64, 2.32)	.77 (− .46, 1.99)	.68 (− .49, 1.85)	.67 (− .57, 1.90)	.72 (− .62, 2.05)	.68 (− .49, 1.85)

Table 16. continued

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
HH head = main cook (induction/HT)	3.38	2.21	2.42	3.38	3.32	2.17	2.43	3.32
	(− 4.88, 11.64)	(− 3.13, 7.55)	(− 3.49, 8.33)	(− 4.88, 11.64)	(− 4.54, 11.17)	(− 3.01, 7.35)	(− 3.42, 8.29)	(− 4.54, 11.17)
HH head = main cook (other/HT)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(− .004, .004)	(− .003, .003)	(− .003, .003)	(− .004, .004)	(− .004, .004)	(− .003, .003)	(− .003, .003)	(− .004, .004)
Main cook involved in major HH decisions (induction/HT)	1.36	1.26	1.18	1.36	1.32	1.21	1.18	1.32
	(− .19, 2.91)	(− .23, 2.75)	(− .25, 2.61)	(− .19, 2.91)	(− .24, 2.88)	(− .29, 2.72)	(− .31, 2.67)	(− .24, 2.88)
Main cook involved in major HH decisions (other/HT)	1.26	1.23	1.09	1.26	1.01	1.06	.98	1.01
	(− 1.12, 3.63)	(− 1.12, 3.59)	(− 1.04, 3.22)	(− 1.12, 3.63)	(− 1.00, 3.02)	(− 1.05, 3.18)	(− .98, 2.93)	(− 1.00, 3.02)
Older HH head (induction/HT)	1.02	1.02	1.02	1.02	1.04	1.03	1.03	1.04
	(.98, 1.07)	(.98, 1.06)	(.98, 1.07)	(.98, 1.07)	(.99, 1.08)	(.98, 1.07)	(.98, 1.07)	(.99, 1.08)
Older HH head (other/HT)	1.02	1.02	1.03	1.02	1.02	1.03	1.03	1.02
	(.95, 1.09)	(.95, 1.09)	(.95, 1.10)	(.95, 1.09)	(.95, 1.09)	(.96, 1.10)	(.95, 1.11)	(.95, 1.09)
No. of HH members (induction/HT)	.93	.90	.90	.93	.89	.87	.88	.89
	(.67, 1.18)	(.64, 1.16)	(.64, 1.16)	(.67, 1.18)	(.62, 1.16)	(.60, 1.13)	(.61, 1.16)	(.62, 1.16)
No. of HH members (other/HT)	.87	.90	.91	.87	1.05	1.10	1.08	1.05
	(.52, 1.22)	(.53, 1.27)	(.53, 1.28)	(.52, 1.22)	(.56, 1.53)	(.58, 1.62)	(.57, 1.58)	(.56, 1.53)
Free stove (induction/HT)	1.80				1.88			
	(− .07, 3.66)				(− .13, 3.90)			
Free stove (other/HT)	1.08				.87			
	(− .76, 2.92)				(− .60, 2.35)			
Option to switch-out (induction/HT)		.32**				.29**		
		(− .01, .65)				(− .03, .60)		
Option to switch-out (other/HT)		1.14				1.10		
		(− .82, 3.10)				(− .89, 3.09)		
Community 1 (induction/HT)			.21**				.18**	
			(− .10, .52)				(− .09, .45)	
Community 1 (other/HT)			1.59				1.63	
			(− 2.75, 5.93)				(− 2.80, 6.06)	

Table 16. continued

	Exp (coef): odds ratio (95% CI)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Community 2 (induction/HT)			.69 (− .45, 1.83)				.49 (− .35, 1.32)	
Community 2 (other/HT)			2.32 (− 4.65, 9.29)				2.35 (− 4.56, 9.27)	
Community 3 (induction/HT)			.37 (− .17, .90)				.25* (− .15, .65)	
Community 3 (other/HT)			2.45 (− 4.34, 9.23)				2.02 (− 3.63, 7.68)	
Lag valley versus Garsa Valley (induction/HT)				.56 (− .02, 1.14)				.53 (− .04, 1.10)
Lag valley versus Garsa Valley (other/HT)				.93 (− .65, 2.50)				1.15 (− .79, 3.08)
AIC	191.33	186.54	189.04	191.33	178.3	173.6	175.77	178.3
Observations	103	103	103	103	100	100	100	100
R^2	.15	.17	.18	.15	.19	.22	.23	.19
Log likelihood	− 83.67	− 81.27	− 80.52	− 83.67	− 77.15	− 74.80	− 73.88	− 77.15
LR test	28.63 (df = 22)	33.42* (df = 22)	34.92 (df = 26)	28.63 (df = 22)	36.48** (df = 22)	41.18*** (df = 22)	43.01** (df = 26)	36.48** (df = 22)

HT Himanshu Tandoor, *HH* household.
*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$ CI at 95% level.

Table 17. Multinomial Regression Results for Kullu Stove Choice (Excluding HHs with LPG Connections).

	Exp (coef)]: odds ratio							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Dependent variable: stove preferences (vs Himanshu Tandoor)								
Intercept (induction/HT)	3.13E+07	7.19E+07	1.30E+08	7.09E+07	1.77E+07	1.83E+09	2.70E+11	5.32E+07
Intercept (LPG/HT)	16.27	91.72	23,470.60	315.2	1.46	0	0	30.09
Intercept (other/HT)	3.96E+09	1.18E+10	1.37E+10	5.06E+09	8.39E+08	9.59E+10	7.18E+12	9.99E+08
Upper caste (induction/HT)	3.06	3.2	3.12	3.06	3.03	3.72	6.18	3.03
Upper caste (LPG/HT)	0.71	0.25	0.000*	0.71	0.08	0	0	0.08
Upper caste (other/HT)	5.58	6.02	3.35	5.58	3.22	5.18	3.71	3.22
Presence of NSF stove (induction/HT)	1.11	0.66	0.75	1.11	1.63	0.7	0.53	1.63
Presence of NSF stove (LPG/HT)	0.17	1.04	12.79	0.17	1.08	4.28E+07	8.15E+100	1.08
Presence of NSF stove (other/HT)	0.26	0.14	0.21	0.26	0.29	0.09	0.08	0.29
Wealth Index (induction/HT)	1.61	2.2	1.69	1.61	1.47	2.65	3.38	1.47
Wealth Index (LPG/HT)	16.55*	27.98*	6146.72**	16.55*	2.92	4.55	6.60E+82	2.92
Wealth Index (other/HT)	3.38	4.52	4.03	3.38	2.63	4.66	6.16	2.63
Main cook involved in non-agricultural work (induction/HT)	6.84	5.86	4.54	6.84	12.41	8.22	8.51	12.41
Main cook involved in non-agricultural work (LPG/HT)	5.63	10.09	46.24*	5.63	6.43	1.33E+08	4.69E+67	6.43
Main cook involved in non-agricultural work (other/HT)	4.44	3.25	3.64	4.44	6.01	4.02	4.5	6.01
More educated HH head (induction/HT)	0.56	0.62	0.76	0.56				
More educated HH head (LPG/HT)	0.21	0.32	0.06	0.21				
More educated HH head (other/HT)	0.19	0.18	0.19	0.19				
More educated main cook (induction/HT)					0	0	0	0
More educated main cook (LPG/HT)					2.67	1.86E+15	4.63E+120	2.67
More educated main cook (other/HT)					0.8	0.66	0.63	0.8
Increase in wood collection distance (induction/HT)	1.44	1.33	1.38	1.44	1	1.25	1.15	1
Increase in wood collection distance (LPG/HT)	0.45	2.37	0.08	0.45	0.28	0	0	0.28
Increase in wood collection distance (other/HT)	2.54	2.11	2.37	2.54	2.68	3.04	3.22	2.68
HH head = main cook (induction/HT)	0.4	0.37	0.38	0.4	0.26	0.33	0.2	0.26
HH head = main cook (LPG/HT)	0.1	0.27	0.01	0.1	0.08	4.31E+07	5.69E+38	0.08
HH head = main cook (other/HT)	0.32	0.22	0.28	0.32	0.38	0.24	0.18	0.38
Main cook involved in major HH decisions (induction/HT)	0	0	0	0	0	0	0	0
Main cook involved in major HH decisions (LPG/HT)	1.16	0.88	58.59	1.16	0.46	1.12E+06	1.40E+19	0.46
Main cook involved in major HH decisions (other/HT)	0	0	0	0	0	0	0	0
Older HH head (induction/HT)	0.98	0.98	0.99	0.98	1	1	0.99	1
Older HH head (LPG/HT)	0.98	0.96	0.94	0.98	1.01	0.97	0.21	1.01

Table 17. continued

	Exp (coef)]: odds ratio							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Older HH head (other/HT)	0.95	0.95	0.96	0.95	0.97	0.97	0.97	0.97
No. of HH members (induction/HT)	0.88	0.78	0.85	0.88	0.86	0.74	0.59	0.86
No. of HH members (LPG/HT)	0.87	0.98	0.94	0.87	0.85	1.36	5.19E+13	0.85
No. of HH members (other/HT)	1.06	0.89	1.02	1.06	1.12	0.87	0.76	1.12
Free stove (induction/HT)	2.26				3.01			
Free stove (LPG/HT)	19.38				20.61			
Free stove (other/HT)	1.28				1.19			
Option to switch-out (induction/HT)		3.93				5.14		
Option to switch-out (LPG/HT)		0				0		
Option to switch-out (other/HT)		3.61				5.74		
Community 1 (induction/HT)			0.64				0.7	
Community 1 (LPG/HT)			0.2				0	
Community 1 (other/HT)			4.26E+07				1.04E+10	
Community 2 (induction/HT)			0.82				0.77	
Community 2 (LPG/HT)			.001*				0	
Community 2 (other/HT)			0.56				0.56	
Community 3 (induction/HT)			3.62				9.36	
Community 3 (LPG/HT)			0				0	
Community 3 (other/HT)			1.25				3.57	
Lag valley versus Garsa Valley (induction/HT)				0.44				0.33
Lag valley versus Garsa Valley (LPG/HT)				0.05				0.05
Lag valley versus Garsa Valley (other/HT)				0.78				0.84
AIC	136.33	132.93	125.96	136.33	130.29	121.05	99.87	130.29
Observations	88	88	88	88	87	87	87	87
R^2	0.23	0.26	0.36	0.23	0.25	0.33	0.55	0.25
Log likelihood	− 49.16	− 47.46	− 40.98	− 49.16	− 46.14	− 41.53	− 27.94	− 46.14
LR test	30.06 (*df* = 36)	33.46 (*df* = 36)	46.43 (*df* = 42)	30.06 (*df* = 36)	30.89 (*df* = 36)	40.13 (*df* = 36)	67.31*** (*df* = 42)	30.89 (*df* = 36)

HT Himanshu Tandoor, *HH* household.
*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$ CI at 95% level.

Table 18. Multinomial Regression Results for Koppal Stove Choice (Full Sample).

	Exp (coef): odds ratio (95% CI)					
	Model 1	Model 2	Model 3	Model 3	Model 5	Model 6
Dependent variable: stove preferences (vs LPG)						
Intercept (induction/LPG)	.32	.37	.12*	.57	.45	.15
	(− .39, 1.04)	(− .44, 1.19)	(− .17, .41)	(− .68, 1.83)	(− .48, 1.37)	(− .23, .53)
Intercept (other/LPG)	.50	.62	1.12	.45	.62	1.11
	(− .74, 1.75)	(− .92, 2.15)	(− 1.88, 4.11)	(− .65, 1.54)	(− .87, 2.10)	(− 1.89, 4.11)
Upper caste (induction/LPG)	.72	.95	1.08	.64	.93	1.03
	(.10, 1.34)	(.13, 1.77)	(.05, 2.11)	(.08, 1.21)	(.11, 1.76)	(.02, 2.04)
Upper caste (other/LPG)	1.13	.95	.78	1.12	.91	.77
	(.08, 2.19)	(.07, 1.83)	(− .03, 1.58)	(.07, 2.18)	(.06, 1.77)	(− .03, 1.58)
Presence of NSF stove (induction/LPG)	.26*	.20*	.21*	.24*	.20*	.19*
	(− .16, .67)	(− .12, .53)	(− .13, .54)	(− .15, .62)	(− .12, .52)	(− .13, .51)
Presence of NSF stove (other/LPG)	0.000	0.000	0.000	0.000	0.000	0.000
	(− 0.000, 0.000)	(− 0.000, 0.000)	(− 0.000, 0.000)	(− 0.000, 0.000)	(− 0.000, 0.000)	(− 0.000, 0.000
Wealth Index (induction/LPG)	.73	.67	.70	.94	.81	.87
	(.35, 1.10)	(.32, 1.03)	(.32, 1.07)	(.40, 1.47)	(.35, 1.26)	(.36, 1.39)
Wealth Index (other/LPG)	.39***	.42***	.41***	.40***	.45**	.43**
	(.13, .64)	(.16, .69)	(.13, .68)	(.13, .67)	(.16, .74)	(.13, .72)
Main cook involved in non-agricultural work (induction/LPG)	2.11	2.39	2.72*	2.34	2.51	2.90*
	(− .28, 4.51)	(− .34, 5.13)	(− .50, 5.94)	(− .36, 5.05)	(− .37, 5.39)	(− .56, 6.35)
Main cook involved in non-agricultural work (other/LPG)	2.56	2.20	1.98	2.66	2.41	2.10
	(− .77, 5.88)	(− .68, 5.09)	(− .62, 4.57)	(− .82, 6.13)	(− .80, 5.62)	(− .68, 4.88)
More educated HH head (induction/LPG)	1.27	.96	.93			
	(− .37, 2.90)	(− .28, 2.20)	(− .32, 2.17)			
More educated HH head (other/LPG)	.51	.64	.57			
	(− .32, 1.33)	(− .42, 1.70)	(− .41, 1.56)			
More educated main cook (induction/LPG)				.15*	.19	.16
				(− .18, .47)	(− .23, .62)	(− .20, .52)
More educated main cook (other/LPG)				.48	.38	.43
				(− .61, 1.57)	(− .50, 1.25)	(− .59, 1.44)
Increase in wood collection distance (induction/LPG)	.60	.50	.72	.57	.48	.73
	(− .08, 1.28)	(− .06, 1.07)	(− .13, 1.56)	(− .08, 1.22)	(− .06, 1.02)	(− .14, 1.60)
Increase in wood collection distance (other/LPG)	.60	.58	.47	.60	.57	.47
	(− .05, 1.24)	(− .06, 1.22)	(− .05, .99)	(− .04, 1.25)	(− .05, 1.20)	(− .05, .98)
HH head = main cook (induction/LPG)	2.71	2.12	2.08	2.28	1.87	1.81
	(− .76, 6.18)	(− .57, 4.81)	(− .66, 4.81)	(− .59, 5.15)	(− .45, 4.19)	(− .52, 4.14)
HH head = main cook (other/LPG)	.27	.29	.33	.28	.28	.33
	(− .22, .76)	(− .25, .84)	(− .28, .94)	(− .23, .78)	(− .25, .81)	(− .29, .95)

Table 18. continued

	Exp (coef): odds ratio (95% CI)					
	Model 1	Model 2	Model 3	Model 3	Model 5	Model 6
Main cook involved in major HH decisions (induction/LPG)	1.13	1.15	1.16	1.15	1.20	1.28
	(.14, 2.12)	(.13, 2.17)	(.12, 2.20)	(.12, 2.17)	(.12, 2.27)	(.10, 2.47)
Main cook involved in major HH decisions (other/LPG)	.96	.98	.97	.95	.96	.93
	(.05, 1.87)	(.06, 1.90)	(.03, 1.92)	(.05, 1.85)	(.05, 1.87)	(.02, 1.84)
Older HH head (induction/LPG)	.99	.98	.98	.98	.98	.98
	(.95, 1.02)	(.94, 1.01)	(.94, 1.02)	(.95, 1.02)	(.94, 1.01)	(.95, 1.02)
Older HH head (other/LPG)	.99	1.00	.99	.99	1.00	.99
	(.96, 1.03)	(.96, 1.03)	(.95, 1.03)	(.96, 1.03)	(.96, 1.03)	(.96, 1.03)
No. of HH members (induction/LPG)	1.13	1.18*	1.16	1.11	1.17*	1.14
	(.93, 1.33)	(.97, 1.39)	(.94, 1.37)	(.91, 1.31)	(.96, 1.38)	(.93, 1.35)
No. of HH members (other/LPG)	.87	.84	.87	.87	.84	.87
	(.65, 1.09)	(.63, 1.05)	(.65, 1.09)	(.65, 1.09)	(.63, 1.06)	(.65, 1.09)
Free stove (induction/LPG)	.44*			.40*		
	(.03, .85)			(.02, .78)		
Free stove (other/LPG)	2.01			1.87		
	(.09, 3.93)			(.07, 3.67)		
Option to switch-out (induction/LPG)		.34****			.35**	
		(.02, .65)			(.02, .68)	
Option to switch-out (other/LPG)		1.48			1.57	
		(.04, 2.91)			(.08, 3.06)	
Community 1 (induction/LPG)			1.39			1.24
			(− .50, 3.27)			(− .47, 2.94)
Community 1 (other/LPG)			1.29			1.13
			(− .27, 2.86)			(− .23, 2.50)
Community 2 (induction/LPG)			3.84**			3.83**
			(− 1.08, 8.75)			(− 1.17, 8.82)
Community 2 (other/LPG)			.12*			.11*
			(− .15, .39)			(− .14, .37)
Community 3 (induction/LPG)			.67			.62
			(− .41, 1.75)			(− .39, 1.63)
Community 3 (other/LPG)			1.08			1.00
			(− .35, 2.50)			(− .34, 2.34)
AIC	295.11	294.27	286.3	291.63	290.97	282.7
Observations	194	194	194	194	194	194
R^2	.16	.16	.20	.17	.17	.21
Log likelihood	− 134.55	− 134.13	− 128.15	− 132.81	− 132.48	− 126.35
LR test	50.88***	51.73***	63.69***	54.37***	55.02***	67.30***
	(*df* = 24)	(*df* = 24)	(*df* = 28)	(*df* = 24)	(*df* = 24)	(*df* = 28)

HH household, *NSF* non-solid fuel.

*$P < 0.1$; **$P < 0.05$; ***$P < 0.01$ CI at 95% level.

Table 19. Means Test Comparing Treatments and Controls in Each Set of Study Communities.

	Karnataka			Kullu		
	Treatment	Control	Significance	Treatment	Control	Significance
No. of people in household	6.2	5.9	n.s.	5.2	4.7	$P < 0.05$
Age of household head	49	49	n.s.	50	47	n.s.
Female-headed HH	27.5%	24.1%	n.s.	14.5%	9.7%	n.s.
Solid fuel as primary fuel at baseline	100.0%	98.5%	n.s.	88.4%	98.6%	$P < 0.05$
HH has electricity	100.0%	100.0%	n.s.	97.2%	98.3%	n.s.
HH collects all wood (never purchases)	82.5%	85.4%	n.s.	95.4%	97.2%	n.s.
HH is below poverty line	95.0%	88.9%	n.s.	42.7%	55.1%	n.s.
HH head education						
No schooling	57.9%	63.9%	n.s.	23.4%	21.1%	n.s.
Primary only	39.5%	33.0%	n.s.	22.2%	36.6%	$P < 0.05$
Secondary school or more	2.6%	3.1%	n.s.	54.4%	42.3%	n.s.
Main cook education						
No schooling	65.0%	68.2%	n.s.	24.2%	39.7%	$P < 0.05$
Primary only	27.5%	24.1%	n.s.	35.4%	38.2%	n.s.
Secondary school or more	7.5%	7.7%	n.s.	40.4%	22.1%	$P < 0.05$

Appendix 2

Model Diagnostics

The most important issue logistic regression models ought to be tested for is the issue of multicollinearity among the independent variables. The method used here to test for this is the variance inflation factor (VIF). The VIFs for different unique sets of independent variables considered across regression models are shown in Tables 20 and 21.

Table 20. Variance Inflation Factors (VIFs) for the Independent Variables in Kullu Communities.

Kullu	VIF	VIF	VIF	VIF	VIF	VIF	VIF	VIF	VIF	VIF	VIF	VIF
Caste	1.593	1.464	1.551	1.431	1.678	1.569	1.699	1.678	1.661	1.578	1.703	1.661
Presence of any NSF-based stove	NA	NA	NA	NA	1.425	1.431	1.436	1.425	1.441	1.445	1.447	1.441
Wealth Index (WI)	1.506	1.479	1.321	1.322	2.098	1.983	2.095	2.098	2.030	1.832	2.025	2.030
Main cook doing non-agricultural work	1.080	1.063	1.085	1.067	1.038	1.067	1.068	1.038	1.034	1.066	1.065	1.034
Household head education	1.336	1.311	NA	NA	1.433	1.398	1.433	1.433	NA	NA	NA	NA
Main cook education	NA	NA	1.040	1.035	NA	NA	NA	NA	1.283	1.259	1.288	1.283
Household head same as main cook	1.240	1.066	1.247	1.083	1.048	1.071	1.103	1.048	1.044	1.062	1.093	1.044
Increase in wood collection distance	1.264	1.174	1.292	1.176	1.058	1.067	1.068	1.058	1.066	1.082	1.082	1.066
Involvement of main cook in major household decisions	1.398	1.377	1.434	1.407	1.126	1.139	1.183	1.126	1.145	1.158	1.199	1.145
Household head age	1.352	1.328	1.337	1.285	1.412	1.470	1.472	1.412	1.289	1.319	1.330	1.289
No. of people in the household	1.301	1.260	1.224	1.190	1.351	1.364	1.361	1.351	1.270	1.277	1.278	1.270
Community	1.699	NA	1.681	NA	NA	NA	1.525	NA	NA	NA	1.451	
Valley	NA	1.171	NA	1.158	NA	NA	NA	1.190	NA	NA	NA	1.149
Stove price (payment)	NA	NA	NA	NA	1.190	NA	NA	NA	1.149	NA	NA	NA
Stove distribution approach	NA	NA	NA	NA	NA	1.117	NA	NA	NA	1.102	NA	NA

Table 21. Variance Inflation Factors (VIFs) for the Independent Variables in Koppal Communities.

Koppal	VIF	VIF	VIF	VIF	VIF	VIF	VIF	VIF
Caste	1.099	1.107	1.071	1.087	1.296	1.084	1.109	1.316
Presence of any NSF-based stove	NA	NA	1.000	1.000	1.000	1.000	1.000	1.000
Wealth Index (WI)	1.552	1.622	1.359	1.323	1.405	1.424	1.347	1.433
Main cook doing non-agricultural work	1.264	1.264	1.251	1.263	1.233	1.271	1.301	1.257
Household head education	1.049	NA	1.077	1.124	1.147	NA	NA	NA
Main cook education	NA	1.141	NA	NA	NA	1.125	1.119	1.136
Household head same as main cook	1.076	1.067	1.064	1.090	1.108	1.059	1.086	1.107
Increase in wood collection distance	1.266	1.244	1.889	1.914	1.975	1.910	1.922	1.996
Involvement of main cook in major household decisions	1.212	1.223	1.131	1.128	1.145	1.135	1.133	1.155
Household head age	1.235	1.248	1.307	1.329	1.414	1.255	1.291	1.359
No. of people in the household	1.405	1.421	1.351	1.332	1.368	1.317	1.307	1.336
Community	1.216	1.224	NA	NA	1.569	NA	NA	1.549
Stove price (payment)	NA	NA	1.169	NA	NA	1.187	NA	NA
Stove distribution approach	NA	NA	NA	1.140	NA	NA	1.095	NA

There are different recommendations for the threshold for the acceptable levels of VIF in the literature. Most generally, a value higher than 10 has been used as a rule of thumb to indicate a clear signal of multicollinearity (e.g., Hair et al. 1995; Kennedy 2003). However, other recommendations include 5 (e.g., Ringle et al. 2015; Rogerson 2001) as well. As can be seen from the two tables above, the VIF values are well below 5, and in fact all of them are < 2. Thus, it can safely be concluded that the regression models do not face the issue of multicollinearity among variables.

Appendix 3

See Figure 5.

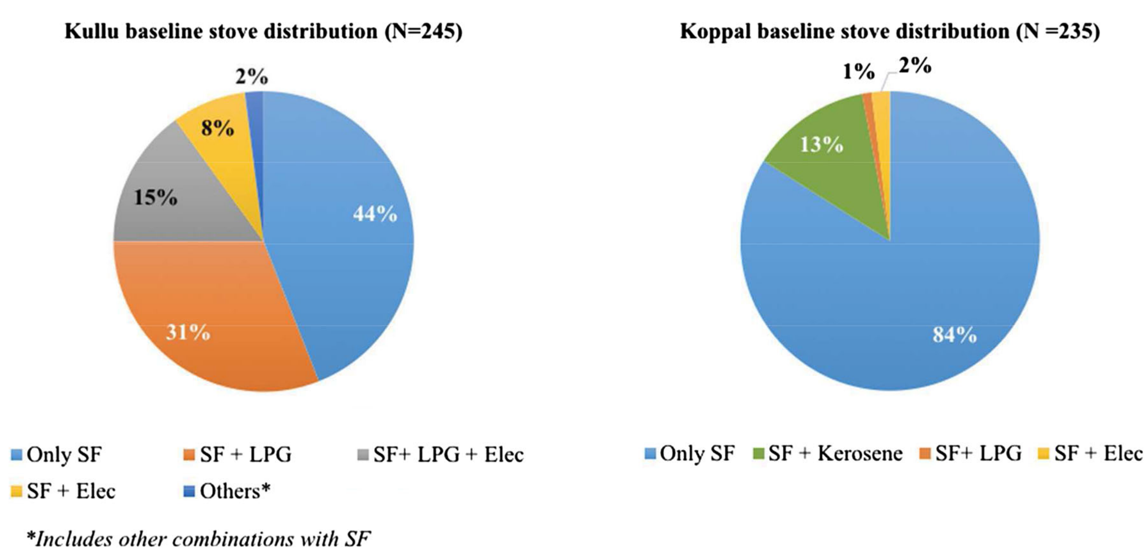

Figure 5. Stove (based on fuel type) ownership in the baseline.

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