



## The Kaleidoscope of Cooking

Understanding Cooking Behaviour and Stove Preferences in Rural India

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Understanding Cooking

Behaviour and Stove

Preferences in Rural India

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April 2014

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# Abbreviations

<b>DNES</b>	Department of Non-Conventional Energy Sources
<b>FGD</b>	Focus Group Discussion
<b>GOI</b>	Government of India
<b>IAP</b>	Indoor Air Pollution
<b>ICS</b>	Improved Cook Stove
<b>IGEN-RE</b>	Indo-German Energy Programme – Renewable Energy Component
<b>INR</b>	Indian Rupee
<b>MFI</b>	Micro-finance Institutions
<b>MNRE</b>	Ministry of New and Renewable Energy
<b>NBCI</b>	National Biomass Cookstoves Initiative
<b>NGO</b>	Non-Governmental Organizations
<b>NPIC</b>	National Programme for Improved Cookstoves
<b>USAID</b>	United States Agency for International Development
<b>VLE</b>	Village Level Entrepreneurs
<b>WHO</b>	The World Health Organization
<b>WWF</b>	World Wildlife Fund

# Executive Summary

In India, 166 million households depend on solid biomass fuel as their main energy source for cooking. The World Health Organization (WHO) estimates that Indoor Air Pollution (IAP) caused by the use of solid biomass fuels in inefficient traditional cookstoves leads to approximately 488,000 deaths in India every year. IAP from burning biomass fuels can be reduced by the use of improved cookstoves (ICS). In order to realize the potential of ICS in reducing fuelwood consumption and IAP, the Government of India launched the National Programme for Improved Cookstoves (NPIC) in 1983. This programme distributed more than 35 million ICS in India before it was discontinued in 2002 (Liedtke 2013). NPIC, however, was not as successful as expected in ensuring the sustained use of ICS since data compiled by the Global Alliance for Clean Cookstoves suggest that only a fraction (0.25%) of Indian households actually uses ICS today. Several studies found that NPIC and other similar initiatives by government and donor agencies selected cookstoves without factoring in user needs and preferences, or different fuel mixes – these factors, however, are crucial for the use and adoption of ICS. Moreover, studies found a lack in engagement on awareness creation measures concerning IAP and ICS solutions in rural areas (Liedtke 2013). Exploring preferences and cooking patterns of rural cooks and identifying technologies suitable for their needs is therefore central to ensure sustained deployment of ICS.

This study conducted an empirical comparative evaluation of six different types of ICS models exploring the following themes:

- main features that households like or dislike in traditional cookstoves and in ICS;
- households' preference for different types of cookstove technologies/models;
- users' preferences in different socio-economic and geographical contexts.

This study explored users' preferences for ICS in six different villages in the North Indian states of Bihar, Uttar Pradesh and West Bengal. The study followed a multi-phase approach to gain a better understanding of consumer preferences through a household survey, a user acceptance test and comprehensive feedback collected by questionnaires, focus group discussions,

and ICS auctions. The user acceptance test comprised of six different ICS, which were rotated among 180 participating households on a weekly basis, with feedback on each of the models collected at the end of every week.

The analysis of data from the household survey, FGDs and auction provided a good understanding of households' socio-economic status, existing cooking practices in these locations and users' preferences for different ICS technologies/models.

## The Household Context

Households did not have access to reliable electricity limiting their options for cooking energy to solid biomass and LPG; the latter was available to less than 12% of the households. The economic profile of households suggested that the majority of were poor; households earned an average of INR 7,500 per month and saved approximately INR 1,700. This makes purchasing an ICS ranging between INR 1,700 and 2,000 a significant investment.

Cardio-vascular diseases, respiratory diseases and eye problems, which are often attributed to IAP, were very common in the villages. On average, households spent about 7% of their overall annual income on the treatment of diseases. The education levels of most of the households were found to be low; this highlights that any intervention on awareness creation and behavioural change regarding IAP and ICS must include measure to reach audiences with limited educational backgrounds.

Even though all locations shared several similar cooking practices, fuel choices including fuel collection and preparation, as well as local dishes, varied significantly across the study locations. The analysis of cooking practices highlighted that virtually all households used traditional cookstoves made of brick and/or mud as their primary cookstoves. Households did not spend any money on traditional cookstoves; the stoves were constructed using local materials, which were available for free. Most households had a single burner as well as a two burner traditional cookstoves that they used for cooking as per their convenience and requirements. The single burner cookstoves were primarily used in the evening. Most of the household cooked twice a day;

the cooking in the morning was longer as both breakfast and lunch were prepared in one go. More than half of the households across the study locations cooked in closed spaces on a regular basis; these spaces were not necessarily dedicated kitchens, but often the living room or in some cases even the bedroom.

Most households used cow dung, crop residue or fuelwood as their main cooking fuels and spent more than one and a half hours daily on either collecting fuelwood or preparing cow dung cakes. The choice of fuel changed according to fuel availability in different seasons. Whereas in Uttar Pradesh and Bihar hardly any of the households paid for their fuel, most households in West Bengal spent about INR 275 per month on purchasing fuelwood from the local market.

Across the study locations the most common problems associated with traditional cookstoves were mentioned to be smoke emission, the effort of procuring fuel as well as time consuming cooking processes and the inability to control the cooking flame. Despite the fact that only 12% of households had access to LPG, rural cooks often benchmarked their traditional cookstoves against LPG cookstoves with their well-known advantages.

Considering the socio-economic context and cooking practices outlined above, the study explored users' perceptions of ICS.

### Perception of ICS

Users perceived ICS to be superior to traditional cookstoves and they liked their portability, reduced fuel consumption and smoke emission and aesthetics of ICS. However, households also suggested several improvements in particular regarding the ability to accommodate a larger range of local fuels, making the cooking experience easier and reducing the cooking time required. It was also evident that ICS with only one burner were not a proper replacement for the traditional cookstoves with two burners, which are commonly used.

The following main points describe users' perception towards ICS:

- Stove users' preferences varied significantly among households. There was no clear favourite ICS model.
- Cooking was perceived easier with ICS than with traditional cookstoves. Stove users highlighted that ICS were easy to light and that there was no need to constantly blow air for the flame to be strong. However, they did not like small combustion chambers in ICS, which filled up with ash and fuel residue very quickly.
- Stove users appreciated the reduced fuel consumption by ICS. The majority believed that fuel consumption was significantly reduced.
- Stove users perceived that ICS produced less smoke than traditional cookstoves; however, very often the reduction

was not perceived significant.

- Due to the availability of multiple burners, traditional cookstoves were often perceived to cook faster than a single ICS with only one burner.
- Rural cooks did not rate stove performance based only on reduced smoke emissions and biomass consumption. Portability, aesthetics, and the ability to accommodate different types of utensils also played very important roles.
- ICS were considered good secondary cookstoves for specific cooking tasks such as the preparation of small meals, snacks and tea. Stove users were also more likely to use ICS for cooking in the evening or for less than six family members.
- Households expressed the need for improvements in ICS in the following main areas:
  - a. Ability to accommodate more fuel types** - Households used a diverse fuel mix made of cow-dung, crop residue and wood of different size. They demanded better combustion chambers that can accommodate all types of common fuels they use.
  - b. Ability to accommodate all types of common utensils** - Most stove users complained about utensils not being stable on the ICS and highlighted a general need for improvement in that respect.
  - c. Stove material** - Stove users perceived metallic bodies of the ICS to be unsafe and did not like the use of plastic in the cookstoves.
  - d. Cooking time** - Stove users complained about the slow cooking on ICS. The majority of users perceived that it took more time to prepare a dish on ICS than on a traditional cookstove.

### Implications for the Sector

The above findings have many implications for key stakeholders in the clean cooking energy sector. The first and foremost is that users should be in the centre of clean cooking interventions. The variations in users' perception underlined the need for designing any cookstove intervention only after properly understanding the users' preferences, cooking habits and fuel use.

The study suggests that the following key areas related to user behaviour and stove design need to be addressed in order to strengthen the Indian cookstove sector:

- **Incorporation of local contexts and user preferences in technology selection** – The study suggest that sustained adoption will depend on user acceptance and the selection of appropriate technologies. Hence, any intervention should include pilot interventions to identify ICS that are suitable to local fuel uses, cooking practices and user preferences.
- **Providing multiple options to users** – As stove preferences may vary significantly from household to household even within the same village or socio-economic group, users

should be able to make a choice between multiple ICS options to identify the ICS solution which best suits their cooking needs.

- **Developing two-burner ICS models** – Many stove users were of the opinion that one-burner ICS models were no suitable replacement for the traditional two-burner stove. Hence, there is a need to focus on research and development of two-burner ICS models. While manufacturers and research institutions should focus on the development of appropriate technologies, government agencies may consider the development of standards and quality control measures for two-burner ICS.
- **Improving existing ICS models** – Several users disliked the small combustion chambers of ICS and desired significantly higher smoke reduction even when ICS were used with fuel other than firewood. Users also complained about the stability of utensils while cooking on ICS. Manufacturer, designers and research institutions should incorporate this feedback into the development process of new ICS models.

- **Conducting studies on stove efficiency and emissions under field conditions** – This study is based entirely on users' perception of ICS performance and can therefore not make any reliable statement on actual smoke emissions and efficiency. Users' perception of limited smoke reduction suggest significant differences between stove performance in the field and performance in controlled lab tests, in particular in the context of varying fuel mixes and cooking behaviour. Donor and government agencies should conduct field performance studies across the country to understand technology performance under field conditions.
- **Increasing awareness and providing user trainings** – The study suggests that many households underestimate the ill-effects of cooking on traditional cookstoves and therefore do not value the ICS's benefits enough to make a purchase decision. The government, donor agencies and other philanthropic agencies should consider implementing / supporting mass awareness campaigns to help demand creation for ICS.

### Study Context

The “Indo-German Energy Programme - Renewable Energy Component” (IGEN-RE) is a bilateral technical cooperation measure between the German Federal Ministry for Economic Cooperation and Development (BMZ), and the Indian Ministry of New and Renewable Energy (MNRE). The project aims at improving the conditions for access to clean energy in rural areas from renewable energy sources. BMZ has commissioned the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) with the implementation of the German project contribution. GIZ is a federal enterprise based in Eschborn and Bonn, Germany.

To facilitate the development of innovative business models for the market based dissemination of ICS, IGEN-RE is addressing challenges in demand creation and quality stove supply while supporting sector stakeholders in developing a more favorable ecosystem for clean cooking solution. This study was undertaken to better understand consumer preferences for different ICS products and identify suitable ICS technologies/models for users in Bihar, Uttar Pradesh and West Bengal.

For more information, please visit [www.igen-re.in](http://www.igen-re.in)

## 1

## Introduction

**166 million**

households in India depend on solid biomass fuels as main cooking energy source

**488,000**






premature deaths occur annually due to IAP



According to the World Energy Outlook 2013, 2.6 billion people worldwide are relying on traditional biomass fuels for their cooking needs. In the absence of further action, this number will apparently still remain the same in 2030. The biomass used in inefficient traditional cookstoves causes hazardous levels of indoor air pollution (IAP). The World Health Organization (WHO) reports that globally nearly 2 million people die prematurely from illnesses caused by IAP (WHO 2013).

In India, 166 million households depend on solid biomass fuel as their main energy source for cooking (Census of India 2011). More than 90% of these households use traditional cookstoves for preparing their daily meals. These cookstoves not only produce harmful IAP and contribute to global warming, but also deplete India's natural resources through the excessive consumption of biomass. WHO estimates that IAP is the cause of approximately 488,000 deaths in India every year. The majority of these deaths occur in rural India where clean cooking options are available to less than 12% of households (see table 1).



Cooking Fuel	India	Urban	Rural
Firewood 	49%	20%	62%
Crop Residue & Cow Dung 	18%	6%	24%
Kerosene 	3%	8%	<1%
LPG 	28%	65%	11%
Other 	1%	<1%	1%

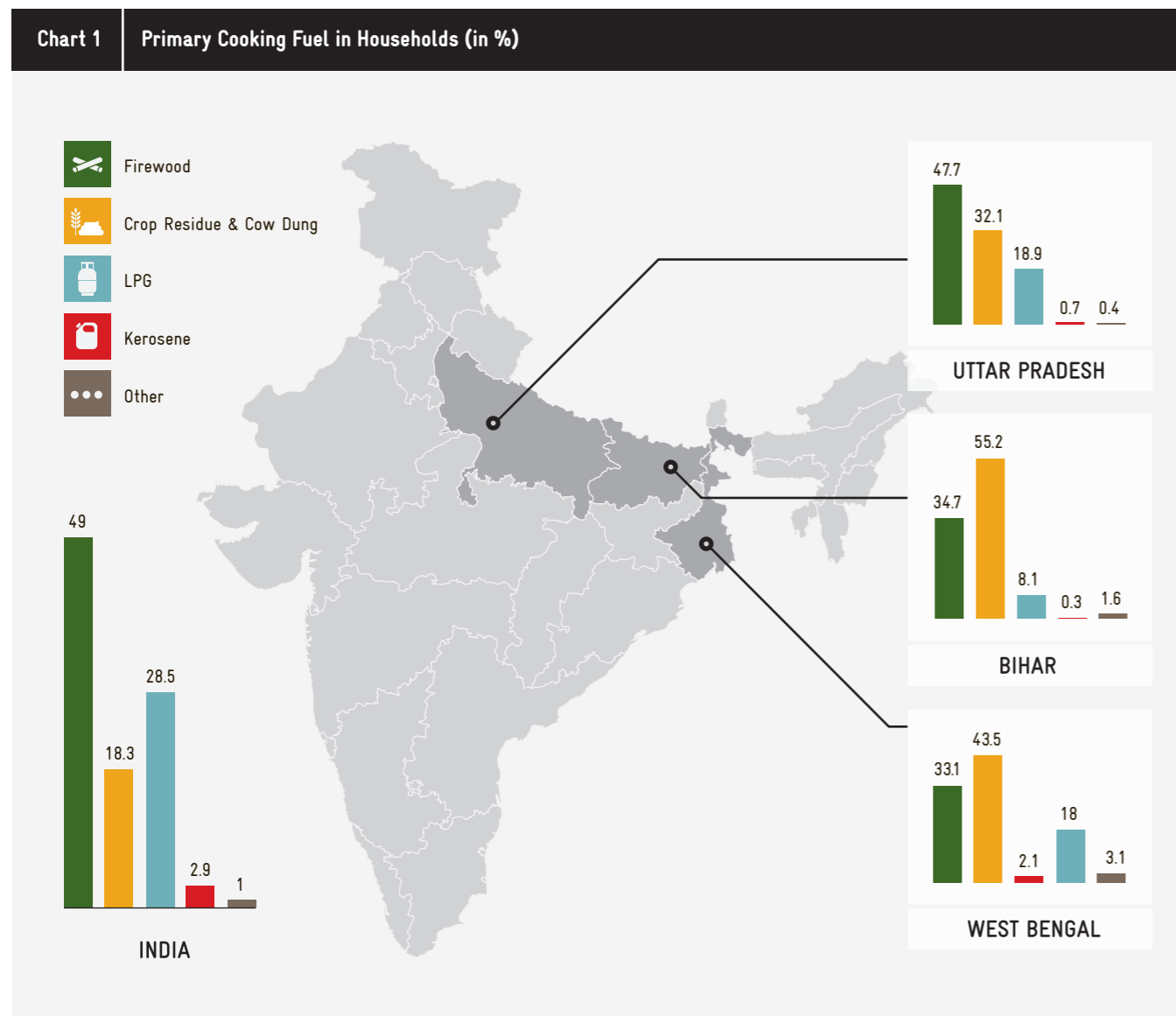
Source: Census of India, 2011. The numbers are rounded off to the nearest integer.

IAP from burning biomass fuels can be substantially reduced by the use of improved cookstoves (ICS). These cookstoves have the proven capacity to reduce fuel consumption and to significantly reduce smoke emissions by optimising the combustion process while avoiding unnecessary heat loss (Jetter and Kariher 2009). The Government of India assigned ICS a key role in reducing IAP and saving natural resources. In 1983, the Department of Non-Conventional Energy Sources (DNES), which was later known as the Ministry of New and Renewable Energy (MNRE), launched the National Programme for Improved Cookstoves (NPIC). Aiming at reducing firewood consumption and alleviating deforestation, the programme had distributed more than 35 million ICS before it was discontinued in 2002. NPIC was not as successful as expected in ensuring the sustainable adoption of ICS (Venkataraman 2010; Barnes 2012; IIT & TERI 2010). Several studies on NPIC suggest that the programme did not focus on fully understanding users' needs for cooking energy solutions (Liedtke 2013, for more information on NPIC refer to Liedtke 2013: Lessons Learned from NPIC, available at [www.igen-re.in/library](http://www.igen-re.in/library)).

As of July 2013, data compiled by the Global Alliance for Clean Cookstoves suggest that only a fraction (0.25%) of Indian households uses an ICS. However, there are many recent initiatives that aim to increase the ICS adoption rate in India. MNRE is implementing the National Biomass Cookstoves Initiative (NBCI) to develop 'the next-generation of household cookstoves, biomass-processing technologies, and deployment models' (Venkataraman 2010). NBCI plans to incorporate a number of the lessons learned from NPIC, and has developed

measures for ensuring cookstove quality by introducing standards and testing institutions, considering user needs and having a third party monitor the implementation process. Apart from the MNRE initiative, there are several other programmes that are being implemented by multilateral and bilateral donor agencies, private initiatives and civil society organisations.

Fuel-use patterns and cooking practices vary significantly throughout India (see chart 1 and chart 3). Requirements and preferences for the specific design of cookstove technologies are therefore also very likely to vary from region to region. It is for this reason that exploring the preferences and cooking patterns of rural cooks is central to the development of an effective cookstove adoption programme. The lack of emphasis placed on users' preferences and cooking practices has often been identified as one of the primary reasons why ICS have not been widely adopted. Several studies suggest that many of the earlier approaches mostly failed to effectively incorporate users' preferences and local cooking practices (Barnes et al., Crewe, 1997) and did not provide users with many technology options (Winrock 2004). Furthermore, a recent study by Stockholm Environment Institute, conducted in India, suggests that the success of cookstove adoption programmes depends not only on the technical performance of the improved stoves but most critically, on user acceptance (Lambe et al. 2012).



Source: Census of India, 2011

## 1.1 Objective of the Study

This study explores user preferences for different types of ICS based on an empirical comparative evaluation of six different ICS models. The study aims at facilitating the selection of appropriate ICS technologies on the basis of consumer preferences and cooking practices in the selected study locations.

In particular, the study explores the following key themes:

- main features that households like or dislike in traditional cookstoves and in ICS;
- households' preference for different types of cookstove technologies/models;
- households' preference for different types of cookstove technologies/models;

## 1.2 Study Partners

The study was conducted in partnership with two organisations that are currently exploring options for ICS distribution: Dharma Life (Gajam India Private Limited) and SwitchOn (Environment Conservation Society). Both organisations have considerable experience in the distribution and marketing of renewable energy systems such as solar lighting products in parts of Bihar, Uttar Pradesh, and West Bengal. Both organisations provided the necessary operational expertise and manpower to ensure high quality implementation of the study in the selected locations.



Picture 1: Traditional Indian Two-burner Cookstove (left) and Fixed Improved Single-burner Cookstove (right)

### 1.2.1 Dharma Life

Dharma Life is an early stage social enterprise that has established itself as one of the leading rural distribution organisations in India. Dharma Life has developed a village-level entrepreneur (VLE) network that is educating consumers and selling a range of products across categories including access to energy, indoor air pollution, access to safe drinking water, nutrition, hygiene and livelihood products. Products in the Dharma Life portfolio include: improved cookstoves, solar lights, nutritional drinks and water purifiers.

Products and services exist in most markets but they are typically not accessible or affordable, nor do they have the awareness around them for the last mile customer. Dharma Life has developed a business model that addresses these issues and has to date impacted almost one million people through the consumption of socially impactful products sold by more than 1500 village-level entrepreneurs, across five states in India (including Uttar Pradesh and Bihar).

Dharma Life previously worked with ABT Associates, with support from the United States Agency for International Development (USAID), to conduct a research study on how ICS uptake could be increased through partnerships with MFIs or direct sales through VLE. In that light Dharma Life has:

- engaged in direct marketing through VLEs with a range of consumer finance options.
- partnered with micro-finance institutions to help consumers purchase these products through easy monthly / quarterly instalments.

Dharma Life is a long-term strategic partner of the Shell Foundation – an independent charity that works to co-create and scale market-based solutions to global development challenges.

Over the last decade, Shell Foundation has found that the problem of last-mile distribution is a major market barrier preventing social enterprises from producing social impact products (such as cleaner cook stoves or solar lights) from achieving scale and viability in emerging markets. Shell Foundation has partnered with Dharma Life since 2010 to address this challenge; providing patient grant finance, business skills and market linkages to support Dharma Life to validate its sustainable model for delivering development impact and build capacity to scale.

More information on Dharma Life and its activities can be obtained at [www.dharmalife.in](http://www.dharmalife.in)

### 1.2.2 SwitchON

SwitchON is a non-governmental organisation (NGO) working to provide last-mile access to energy and to promote livelihoods through rural energy entrepreneurship. It provides training and capacity development, and supports innovation in the area of clean energy entrepreneurship.

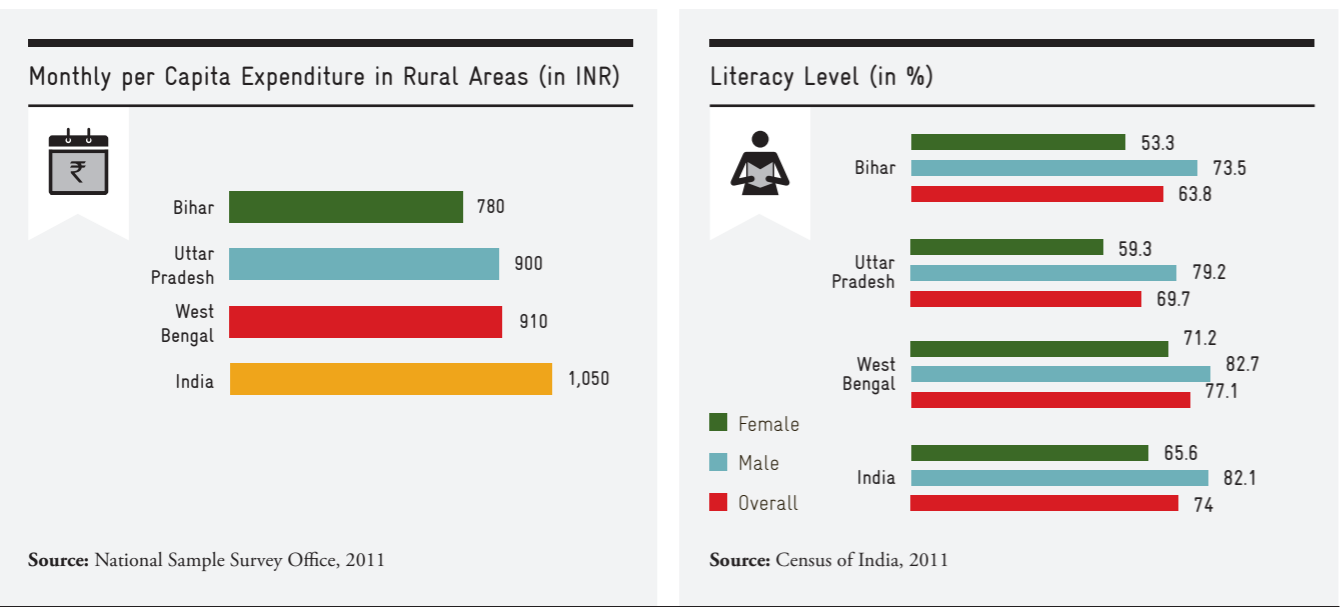
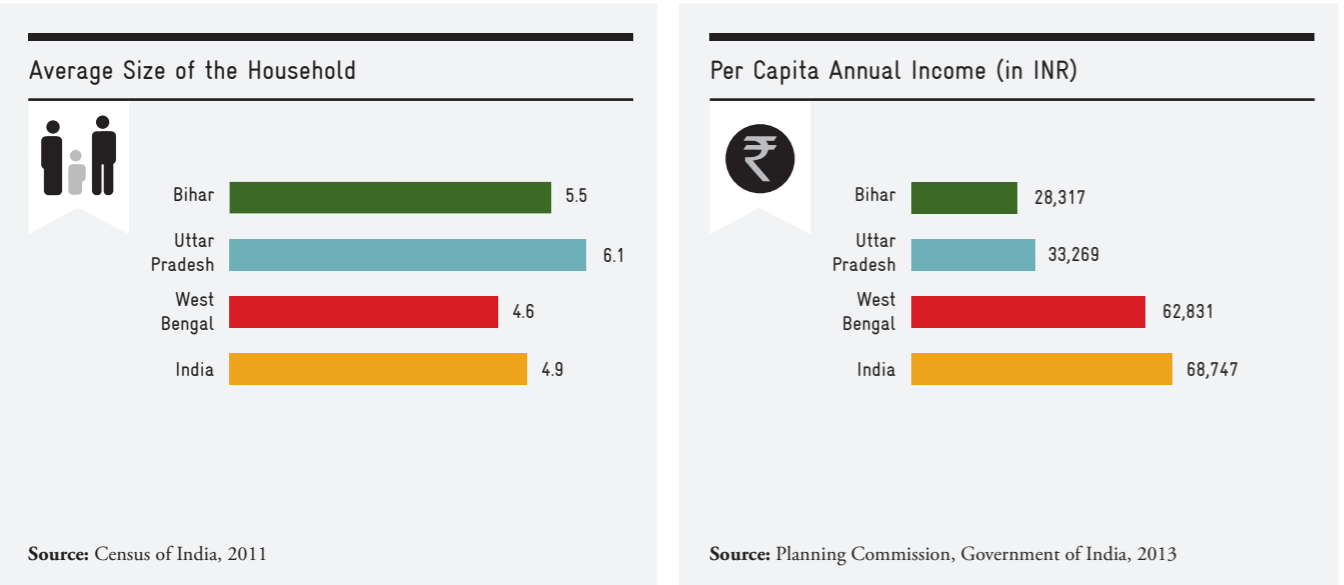
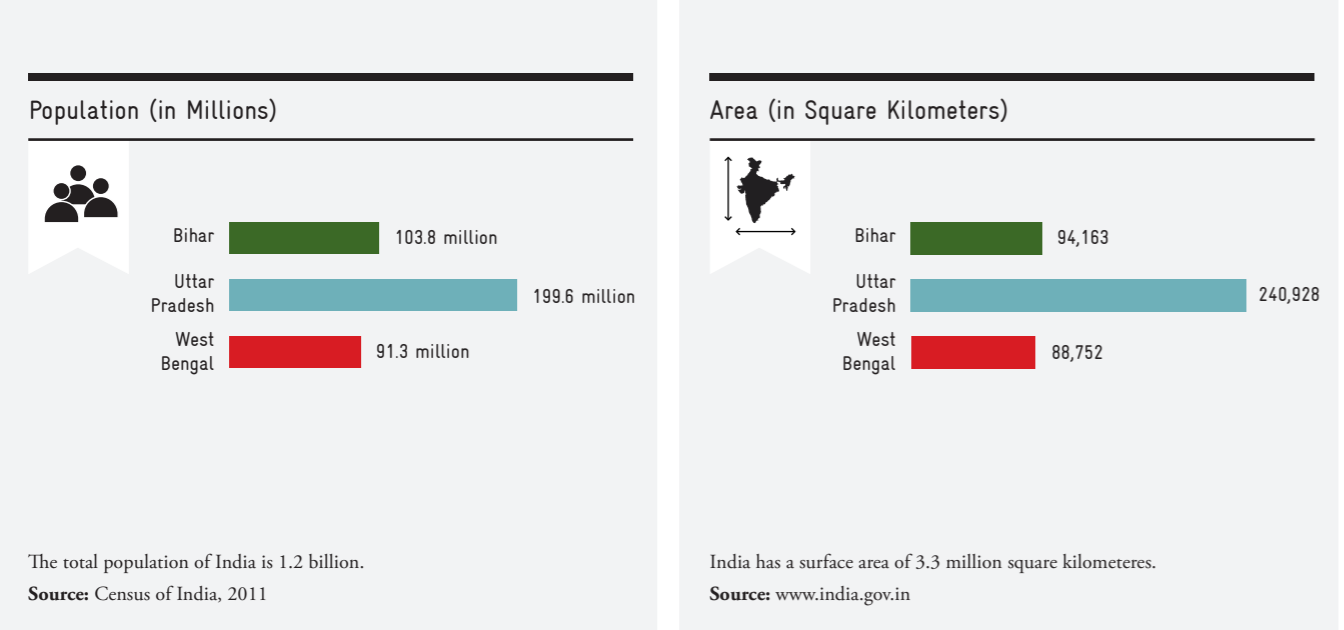
SwitchON's training programmes, awareness-raising campaigns and market-development activities have reached more than 100,000 people and have helped many entrepreneurs working in renewable energy consumer product segments.

SwitchON has a good network of social enterprises and MFIs in West Bengal and Orissa that helps the NGO in achieving its objective of last-mile energy access.

SwitchON has trained over 2,000 youth in climate leadership through workshops, and has organised many conferences in partnership with the Times of India and organisations such as WWF, Greenpeace, 350.org, etc. More information on SwitchON and its activities can be obtained at [www.switchon.org.in](http://www.switchon.org.in)



**Chart 2 Bihar, Uttar Pradesh and West Bengal at a Glance**



**Chart 3 Dietary and Cooking Habits in India**

Zone	Staple Food	Accompaniments	Key Cooking Activities	Equipment	Heat Intensity
North	Thick rotis (tandoori rotis, naan, paratha)	Meat Vegetables Dairy products	Baking Boiling Frying	Kadhai Tava Smoke oven	High
Central	Thin rotis (roti and chapati)	Dal Lentils Vegetables	Baking Boiling Frying	Tava Kadhai	Medium
East	Rice	Fish Meat Vegetables	Frying Grilling Steaming	Pots Kadhai Smokehouse	Low
West	Thick rotis (chapati, millet rotis)	Vegetables Lentils Seafood Dairy products	Baking Boiling Frying	Tava Kadhai	Medium
South	Rice Dosa (rice pancake)	Dal Lentils Vegetables Dairy products	Boiling Frying Steaming	Pots Tava Kadhai	Low

Source: GACC India Clean Cookstoves and Fuels Market Assessment, 2013

**Common Utensils used for Cooking**

- Pot
- Kadhai
- Tava

## 2

## Methodology

- 1 Preparation Phase
- 2 Household Survey
- 3 User Acceptance Test
- 4 Final Feedback from Users

This study applied a multi-phase approach for understanding users' preferences for different ICS models. In the first phase, study locations and cookstove models were identified and research protocols were developed. The second phase consisted of a household survey to gather basic information on household economics and traditional cooking practices. The survey was also used to identify households willing to participate in the subsequent user acceptance test.

In the third phase, a user acceptance test was carried out in the selected study locations. After an initial training of stove users on how to properly use ICS, cookstoves were rotated through all households on a weekly basis with detailed user feedback collected at the end of each testing week. In the fourth phase, a final comparative user feedback was collected based on comprehensive user experience of all the tested cookstove models. The feedback was collected through questionnaires, Focus Group Discussions (FGD) and an auction of used cookstoves.

## 2.1 Preparation Phase

The preparation phase of the study consisted of identifying study locations, selecting ICS models, and developing the research design.

### 2.1.1 Selection of Study Locations

The states of Bihar, West Bengal, and Uttar Pradesh were identified by GIZ in accordance with the operational mandate of the Indo-German Energy Programme – Renewable Energy Component (IGEN-RE). The study locations within the states were selected on the basis of:

- village size and socio-economic patterns representing most villages in the respective states;
- fuel-use pattern reflecting the overall fuel-use pattern of rural households in the respective state;

- operational feasibility in terms of availability of manpower and outreach of study partners;
- non-existence of previous ICS dissemination efforts.

Operational feasibility was a major factor in finalising the locations, as the study required manpower and an organisational presence to mobilise households, distribute cookstoves and consistently monitor and support the participating households.

Based on the aforementioned parameters, two villages in one each state were selected (see table 2).

	Bihar		Uttar Pradesh		West Bengal	
District	Aurangabad		Jaunpur		24 South Paragana	
Selected Villages	Kunda	Khaira	Bumkaha	Isapur	Lakshmikantpur	Dakshinbarasat
Distance from District Head Quarter in km	10	35	48	45	17	34
Number of Households	325	450	280	650	300	500

### 2.1.2 Selection of Improved Cookstove Models

The IGEN-RE team conducted background research on cookstove models available in India. Based on the findings, a list of the major cookstove manufacturers was prepared. As this study focused on cookstoves that can be used in remote and non-electrified villages, forced draft cookstoves that require electricity for fans were not included in the list. The research team sent a request for detailed additional information to all manufacturers and, based on this information, selected one fixed and five portable cookstoves models for the detailed user testing (see table 3). The final selection of the cookstove models was based on the following criteria:

- **Ability to accommodate a diverse fuel mix:** The majority of households in the selected states uses a diverse fuel mix consisting of cow dung, firewood, and crop residue. Therefore, only ICS models capable of accommodating such a diverse fuel mix (as per the information provided by manufacturers) were included in the study.
- **Conformity with prevailing cooking practices:** Rural households have traditionally been cooking on front-feeding tradi-

tional cookstoves, which do not require much fuel processing. Moreover, most of the rural households do not have access to regular and reliable electricity. Hence, ICS models that required processed fuels such as pellets or chopped wood of particular sizes, or electricity to recharge the batteries of inbuilt fans were not considered for this study. To explore how households perceived and adopted stoves which required them to significantly change their traditional cooking behaviour, one top loading gasifier ICS model was included in the test. While fulfilling all other selection criteria, this stove required users to prepare the fuel by cutting it into small pieces, load the complete fuel amount required for the cooking process before firing the stove (instead of constantly adding fuel during the cooking process), and load the stove from the top instead of the front.

- **Thermal efficiency:** The Bureau of Indian Standards (BIS) in its proposed standard for portable solid bio-mass cookstoves<sup>1</sup> prescribes 25% as the minimum thermal efficiency for natural draft cookstoves. For this study, only ICS models with a minimum thermal efficiency of 25% were considered.

1. [http://www.bis.org.in/sf/med/MED04\(1157\)C.pdf](http://www.bis.org.in/sf/med/MED04(1157)C.pdf)

- **Price range:** The objective of the study was to identify appropriate ICS technologies that are affordable for most rural households. This study therefore included only ICS models that are priced below INR 2,000. With few exceptions, most major natural draft ICS models fall into this category.

### 2.1.3 Sampling

Systematic random sampling was used for the selection of households for the household survey as well as for participation in the user acceptance test. The household survey was also used to explore the willingness of households to participate in the subsequent six-week user acceptance test. Households for the user acceptance test were selected randomly from all the households willing to participate. Table 4 provides the sample details and distribution of households across the study locations.

Name of Company	Cookstove Model	Cookstove Type	Price (INR)	Thermal Efficiency
Grameen Greenway Infra	Greenway Smart Stove	Portable	1,250	25
Servals	Woodstove	Portable	1,600	31
Samuchit	Sampada Gasifier Stove	Portable	1,700	26
iSquareD	Chulhika	Portable	2,000	30
Envirofit	M5000	Portable	1,799	30
Samuchit	Bharatlaxmi	Fixed	750	25

All the above data were provided by cookstove manufacturers. The Efficiency data were based on third party lab certifications.

		Distribution of Households Across Study Locations	
		Household Survey	User Acceptance Survey
Location			
Bihar	Kunda	50	30
	Khaira	50	30
Uttar Pradesh	Bumkaha	50	30
	Isapur	50	30
West Bengal	Lakshmikantpur	60	30
	Dakshinbarasat	60	30
Total no. of Households		320	180

## 2.2 Household Survey

A household survey was conducted to gain a better understanding not only of the socio-economic scenario but also of the prevailing cooking practices in the study locations. The household survey collected data on income, occupation, education, household assets, common health issues and details on cooking practices (see annex 2).

The household survey was conducted using questionnaires that had been translated into the local languages (Hindi in Bihar and Uttar Pradesh; Bengali in West Bengal). The survey team was given in-depth questionnaire training by survey experts; the questionnaires were piloted in the field before being finalised. The survey questionnaires were designed to be read out, and the responses were recorded in a specific data collection format.



Picture 2: A Woman Using Improved Cookstove in Bihar



Picture 3: Women Using Improved Cookstove in Uttar Pradesh

## 2.3 User Acceptance Test

In this phase of the study, a comprehensive user acceptance test was conducted to assess the feedback on different stove models based on a one week trial phase per stove. The test was conducted over a period of six weeks.

### 2.3.1 Distribution and Rotation of Improved Cookstoves

The distribution of ICS was conducted in several steps. Initially, households were categorised based on food habits (vegetarian/non-vegetarian) and important social boundaries (religion/caste). This was necessary considering that ICS models were to be handed over from households to households and some household groups were not comfortable using a stove from outside their own group. Villagers who were vegetarian did not like to cook on stoves that had previously been used for non-vegetarian food. Furthermore, within certain castes, it was considered unacceptable to use stoves which had been used by members of other castes.

In a second step, the cookstoves were distributed according to a distribution matrix (see table 5 and figure 1); this matrix negated any potential bias from the fact that households might be less comfortable using the very first ICS that they receive. Each household received its set of stoves in a predetermined order that varied from case to case.

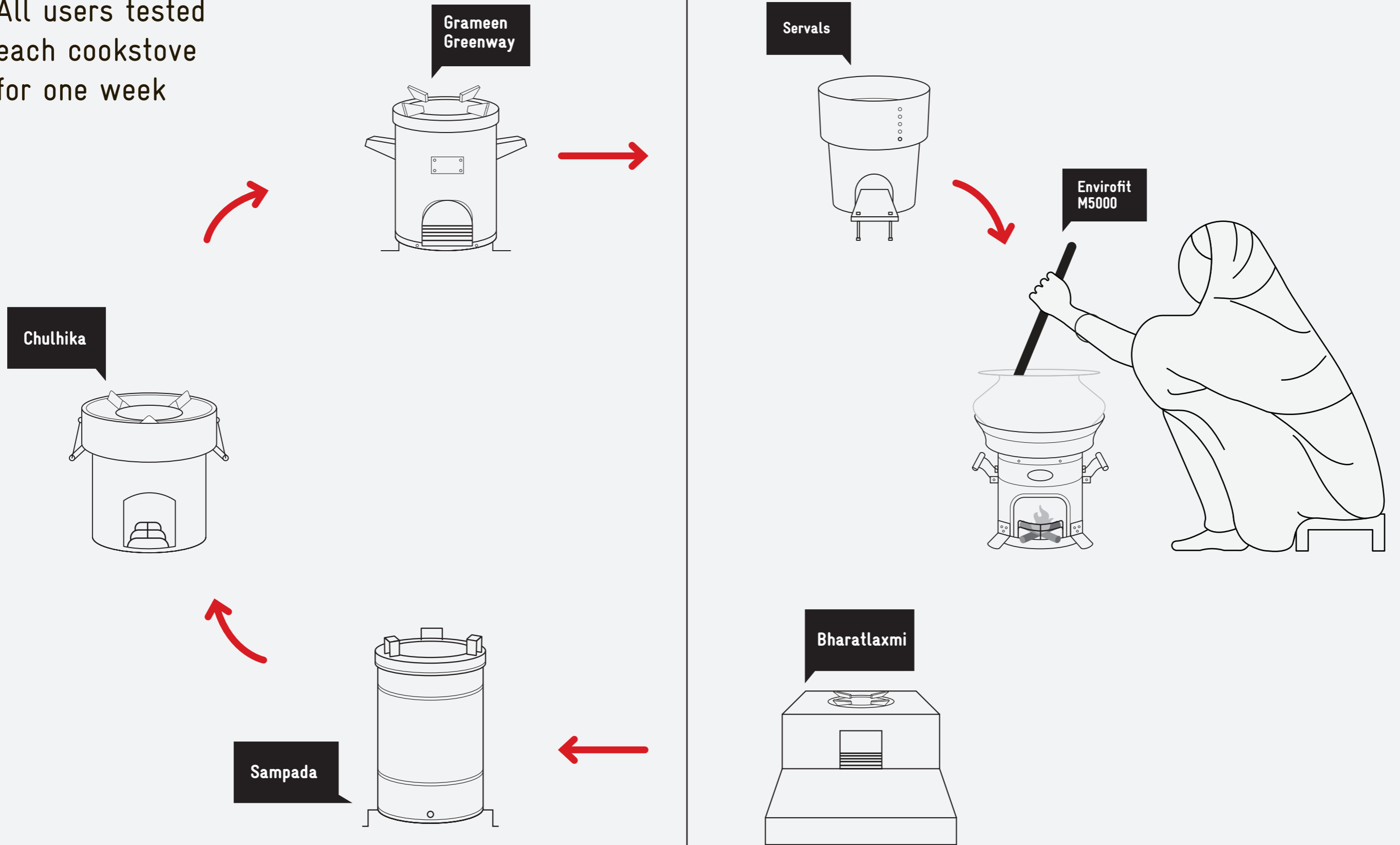
The fixed ICS model was tested in the last week of the user test, as it needed to be constructed in the households. Had the distribution of the fixed ICS been staggered (as was the case with the portable ICS), there was a risk that the users who liked the fixed ICS might continue to use them instead of switching to the next portable model that they were supposed to use. The other option would have been to construct the fixed ICS and break it after the test. However, this option was rejected as it was assumed that some households might have not allowed this, particularly if they had liked the fixed ICS.

Households	H1	H2	H3	...	...	...	H30
Week 1	M1	M2	M3	...	...	...	M5
Week 2	M2	M3	M4	...	...	...	M1
Week 3	M3	M4	M5	...	...	...	M2
Week 4	M4	M5	M1	...	...	...	M3
Week 5	M5	M1	M2	...	...	...	M4
Week 6	Fixed ICS	Fixed ICS	Fixed ICS	...	...	...	Fixed ICS

Housholds - H1, H2, H3... ; Different Models of Cookstoves - M1, M2, M3...

Figure 1 The User Testing Methodology

All users tested each cookstove for one week



### 2.3.2 User Training

The user acceptance test was initiated with a joint workshop for all households participating in the study. During the workshop, the participants received a detailed briefing on the objective and context of the test. The briefing included the households' role and responsibility as participants in the study. The workshop included training by the respective cookstove manufacturers in the proper use of ICS. The prices of ICS models were not revealed to the participating households to avoid any bias that might have arisen from this information.

For monitoring and data collection, two full-time field coordinators were appointed at each study location. At least one of the two coordinators was female to allow for closer interactions with the mostly female cooks. The field coordinators could also be contacted by participating households by phone or in person to answer any questions during the testing period.

### 2.3.3 Weekly Feedback Interviews

Interviews based on questionnaires were used as the main tool to capture the user experience and feedback on the performance of different cookstove models. The weekly questionnaire (see annex 3) explored the users' direct perception of ICS models in comparison to their traditional cookstove(s). It collected perception data on the following parameters: consumption of fuel, ease of cooking, smoke emission, aesthetics, durability, taste of cooked food, time taken to cook.

## 2.4 Final Feedback from Users

To ensure a reflected comparative assessment of all stoves, a final feedback from users was collected through a final round of questionnaire-based interviews; Focus Group Discussions (FGDs) were held to collect additional qualitative data. User preferences were furthermore triangulated through an auction of used cookstoves at the very end of the user testing cycle.

### 2.4.1 Feedback Questionnaires

At the end of six weeks of user testing, a comprehensive feedback was collected, using feedback questionnaires, on all the cookstoves used by the households. While the weekly questionnaires only collected data on the performance of ICS in comparison to traditional cookstoves, this time households were asked to rank all ICS models based on the following parameters:

- Ease of cooking
- Fuel consumption
- Smoke emissions
- Safety
- Aesthetics
- Durability

Please see annex 3 for the questionnaire used in the study.

Cookstove  
Ranking  
Parameters



### 2.4.2 Focus Group Discussions (FGDs)

The main objective of the FGDs was to gain a contextual understanding of user preferences and cooking practices. A trained moderator led the FGDs, exploring the context of user preferences, enquiring about suggested changes required in the cookstove designs and engaging users in open discussions on related issues.

The FGDs involved groups of 10 users and lasted between 60-90 minutes. For this study, 18 FGDs were conducted; all were recorded on video and later transcribed.

### 2.4.3 Auctions

Cookstove auctions were organised to triangulate the overall preferences of users for different ICS models and to obtain a basic idea about the willingness of a household to pay for the stoves. As fixed cookstoves could not be easily removed from households, only the portable models were auctioned. As a token of appreciation for participating in the study, all the participating households were given the fixed ICS free of charge. In total, six auctions were held. The auctioning started with a price point provided by the auctioneer for each cookstove model. If none of the households was willing to buy a particular cookstove model at this price, the price was further reduced by a fixed amount. This process was repeated until all the cookstoves were sold. However, there was a minimum price point of INR 100 (not revealed to the participating households) for each cookstove model. The initial price points were almost equal to the market price of the different models.


The auction and the related interaction were recorded on video to get a better understanding of the underlying decision-making processes.

## 2.5 Limitations of the Study

The findings of this user acceptance test are subject to the following limitations:

- As the study aims to focus on users' preferences, data on many parameters such as fuel consumption, smoke emission and durability are perception data only. A scientific efficiency/emissions/durability test might provide different results for the actual performance of the ICS models.
- The price point data from the auction does not reflect actual price perception or willingness to pay for a 'new' (unused) ICS model and hence were not used for drawing any inferences on the amount users are willing to pay. The participants were aware that the cookstove had already been used. Furthermore, many study participants were of the view that the cookstoves should be given at a much lower price or even free to the households which had participated in the study.

- 1 Ease of cooking 
- 2 Consumption of fuel 
- 3 Emission of smoke 

- 4 Safety 
- 5 Aesthetics 
- 6 Durability 

## 3

## Findings

The insights gained from the field surveys and tests are summarised and presented in three different categories. While 'The Socio-economic Context' explores prevailing factors that have an influence on cooking behaviour and stove choice, 'Traditional Cooking Practices' focuses on the existing cooking system and its perceived challenges. Users' perception of ICS and their feedback on ICS are covered in the final section.



## 3.1 Socio-economic Context

Cooking habits and needs depend to a great extent on the socio-economic context of a certain social group or geography. In order to better understand the socio-economic factors in context of cooking and indoor air pollution, a comprehensive analysis of socio-economic data was undertaken.

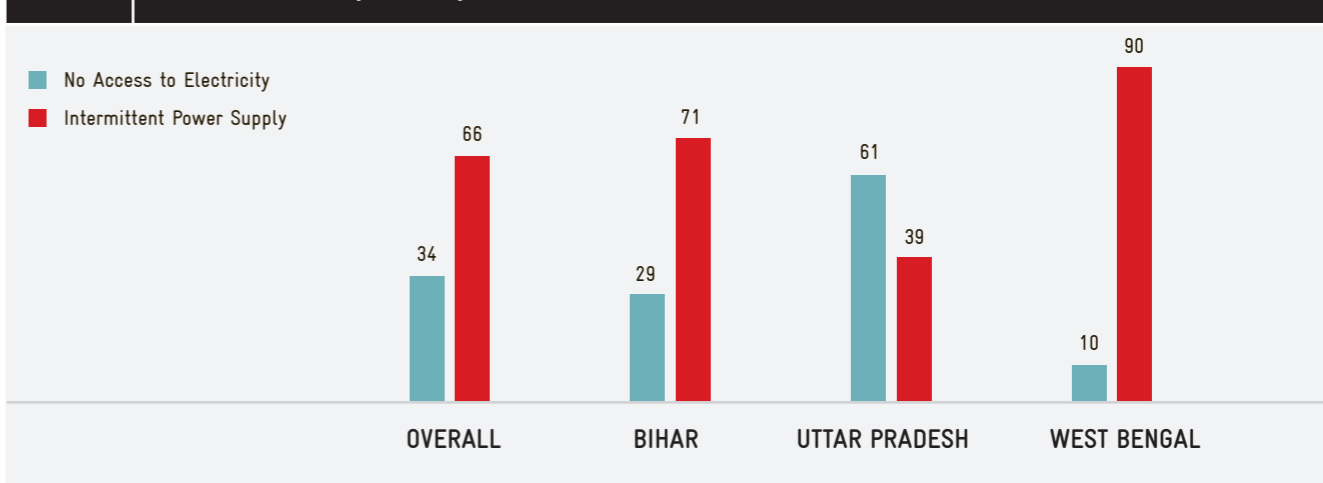
The household profile in the study area was very similar to the average rural household in the respective states. The average household size ranged between 5 and 6 members. Farming or farming-related activities were the main sources of income. Men were mostly the earning members, however in very poor households or households without agricultural land, women also worked on farms for supplementing the household income. However, in higher caste households, women were often not allowed to work on farms. In most cases, women depended on male household members for key economic decisions: a factor which could have high relevance when it comes to the decision to purchase an ICS.

The majority of villagers resided in houses with thatched roofs (see chart 10 on page 19 and picture 4 on page 22). Most of the houses had an open courtyard inside the family compound, which was used for multiple purposes including cooking in the dry seasons<sup>2</sup>. The majority of households had electricity connections (see Chart 4), but very few had a continuous and reliable supply of electricity. They received electricity on average for 4 to 5 hours, but the timing of electricity supply was unpredictable.

Therefore, options for cooking energy were limited to LPG and solid biomass. However, overall LPG penetration was less than 12 percent. Apart from these general findings, the following cooking-specific socio-economic factors were identified:

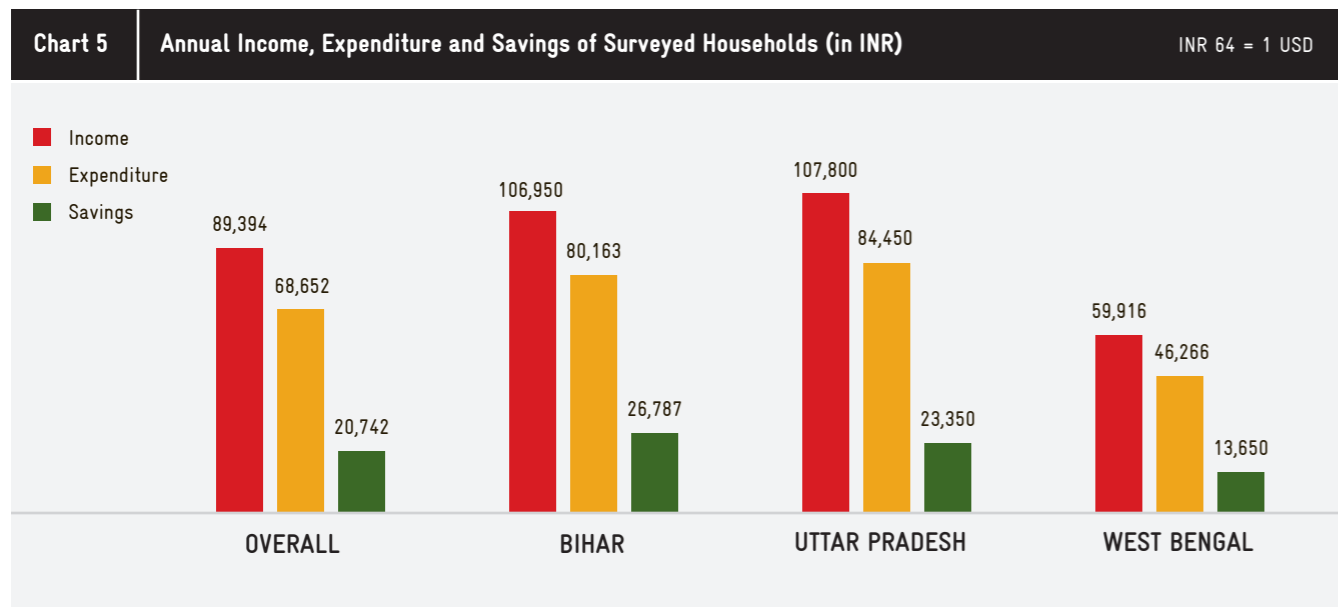
- **Purchasing an ICS constitutes a significant investment for a rural household.** The average monthly household saving (see chart 5) was INR 1,700, while the price of an ICS ranges between INR 1,700 and INR 2,000. Purchasing an ICS in cash therefore requires most households to spend all of their monthly savings. Households were mainly saving for education, medical emergencies and marriage expenditures; saving for the purchase of consumer durables or expensive household items remained very rare. These were mainly purchased without longer planning whenever any additional surplus money was available. Despite the fact that 85% of households had a bank account, they did not apply for loans for their financing needs due to lack of awareness about banking products or perceived difficulties in getting bank loans. Purchasing an ICS on a bank loan<sup>3</sup> did therefore not seem possible without effective interventions to generate awareness about bank products.
- **Education levels were found to be low in most households; interventions on awareness creation and behaviour change regarding IAP and ICS will have to take this into account.** Even though most households had

Chart 4 Access to Electricity of Surveyed Households (in %)

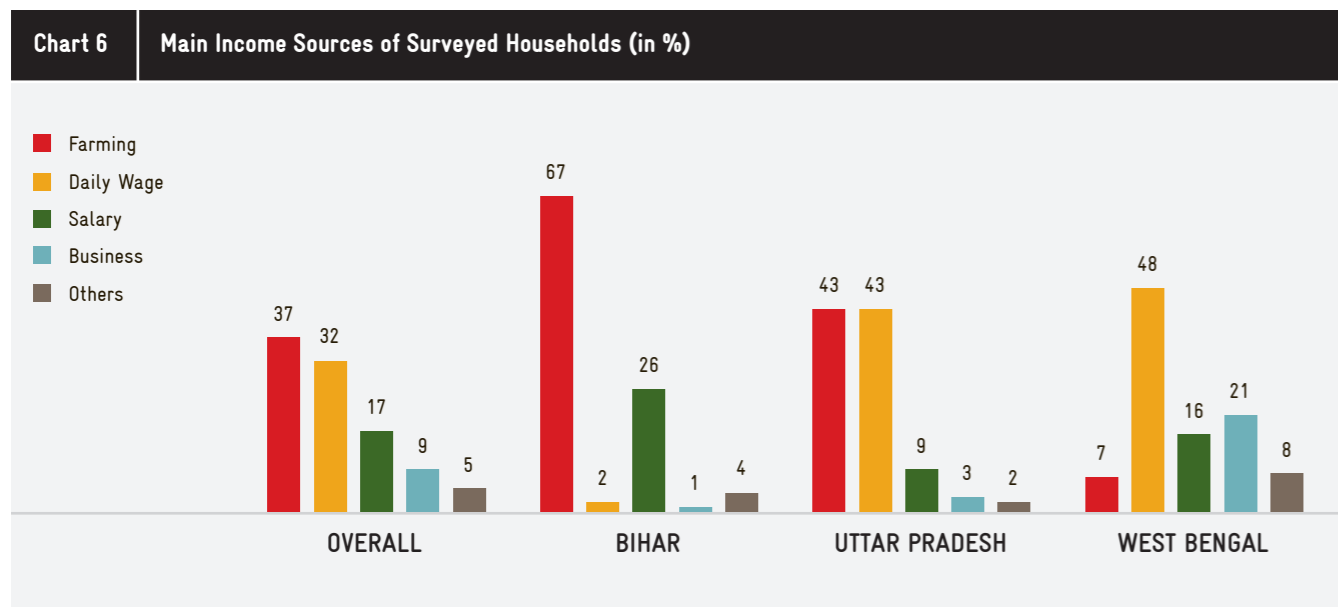


Total number of respondents (n) = 320, Bihar = 100, Uttar Pradesh = 100, West Bengal = 120

2. India has three seasons: winter (November to March), summer (April to June) and the rainy season, i.e. monsoon (from August to November). Winter and summer are dry, while the four monsoon months experience frequent rainfall, forcing households to switch to indoor cooking and resort to stored fuels. Fuel collection and the preparation of cow dung cakes come to a halt during the monsoon.
3. There are very limited options for getting financing for the purchase of cookstoves due to the small size of the loan required. However, people can avail loans for consumption or other financial requirements such as for education, agriculture etc.



Total number of respondents (n) = 320, Bihar = 100, Uttar Pradesh = 100, West Bengal = 120



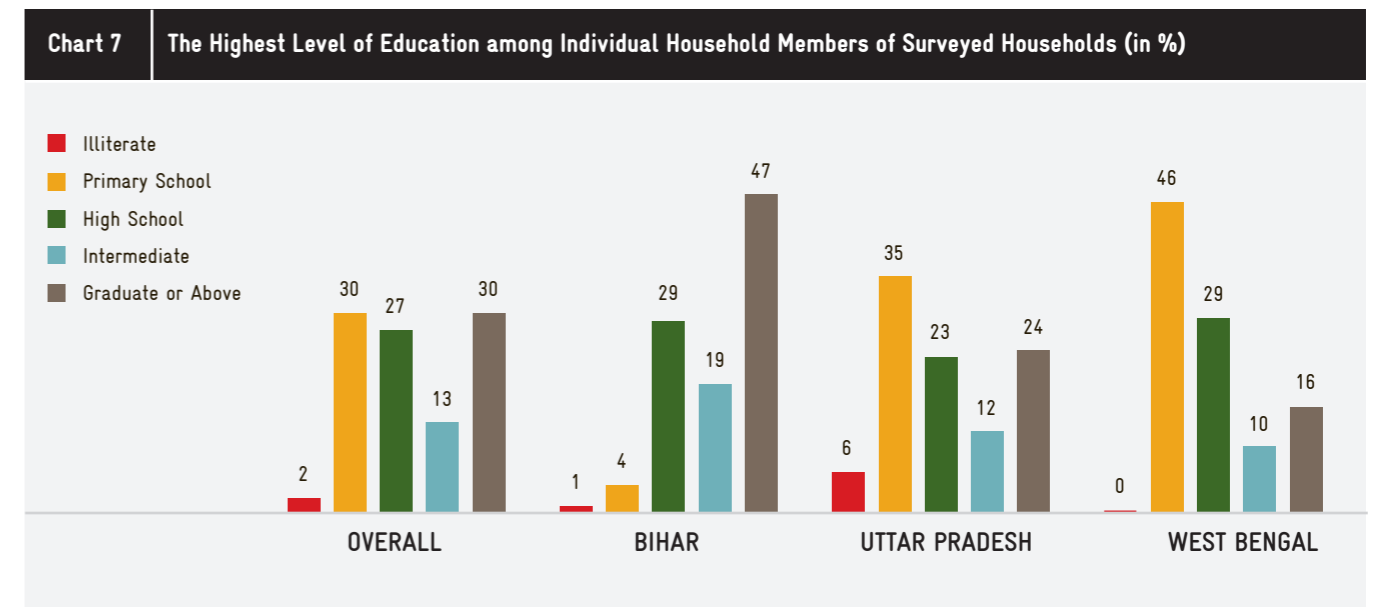
Total number of respondents (n) = 320, Bihar = 100, Uttar Pradesh = 100, West Bengal = 120

at least one member with basic school education of 6-10 years, almost 60% of the households did not have even a single member who had continued higher education beyond this level (see chart 7). Most of the educated members belonged to the younger generation of the family. Furthermore, the rural female literacy rate was very low in the selected states. Limited education levels can have serious implications on the efforts and approach required for creating awareness on IAP and inducing behaviour change for ICS. Future interventions in this field will have to take appropriate measures to take this into account, e.g. by choosing simple language and integrating communication materials for illiterates.

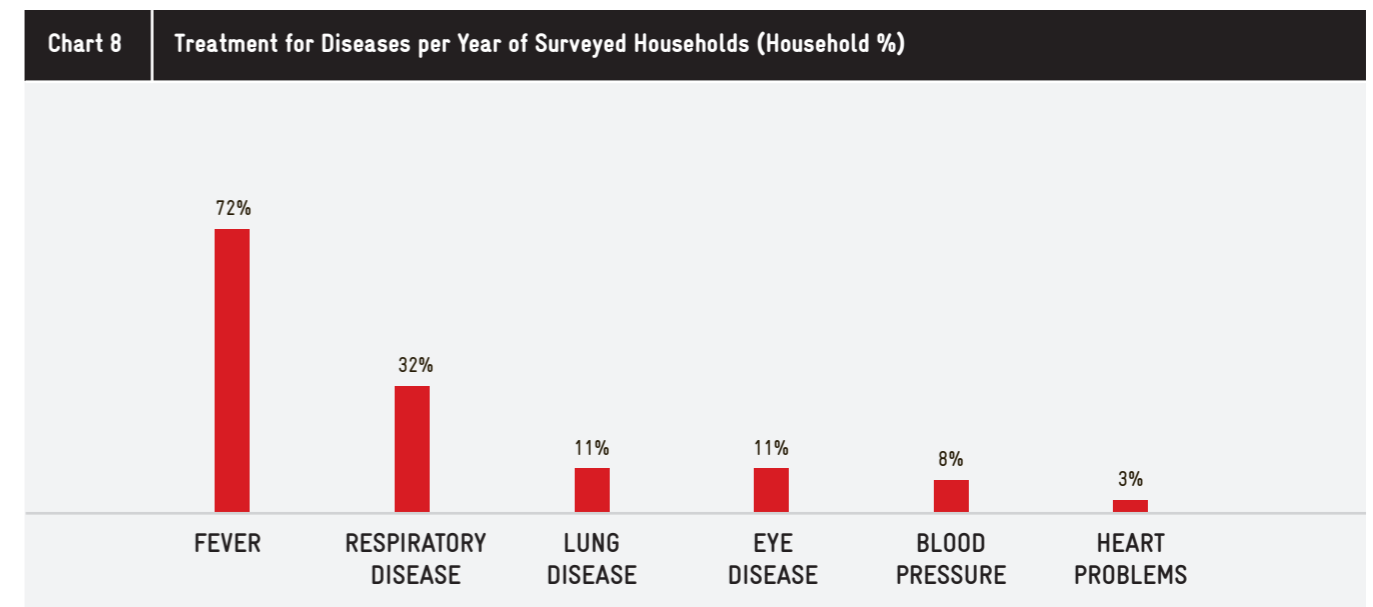
- **Diseases which could be partly attributed to IAP such as respiratory diseases, eye problems, as well as cardio-vascular diseases were very common.** Total medical expenditures added up to about 7% of the overall household income (see chart 8).

### 3.2 Traditional Cooking Practices

Traditional cooking practices in rural areas across all locations reflected several striking similarities. Users cooked sitting on the ground with cookstoves of less than 1.5 feet (45 centimetres) height as this height allowed for easy cooking (stirring, handling of pots) in a squatting position. The fuel mix was depending on the availability of different crop residues, firewood and cow



Total number of respondents (n) = 320, Bihar = 100, Uttar Pradesh = 100, West Bengal = 120

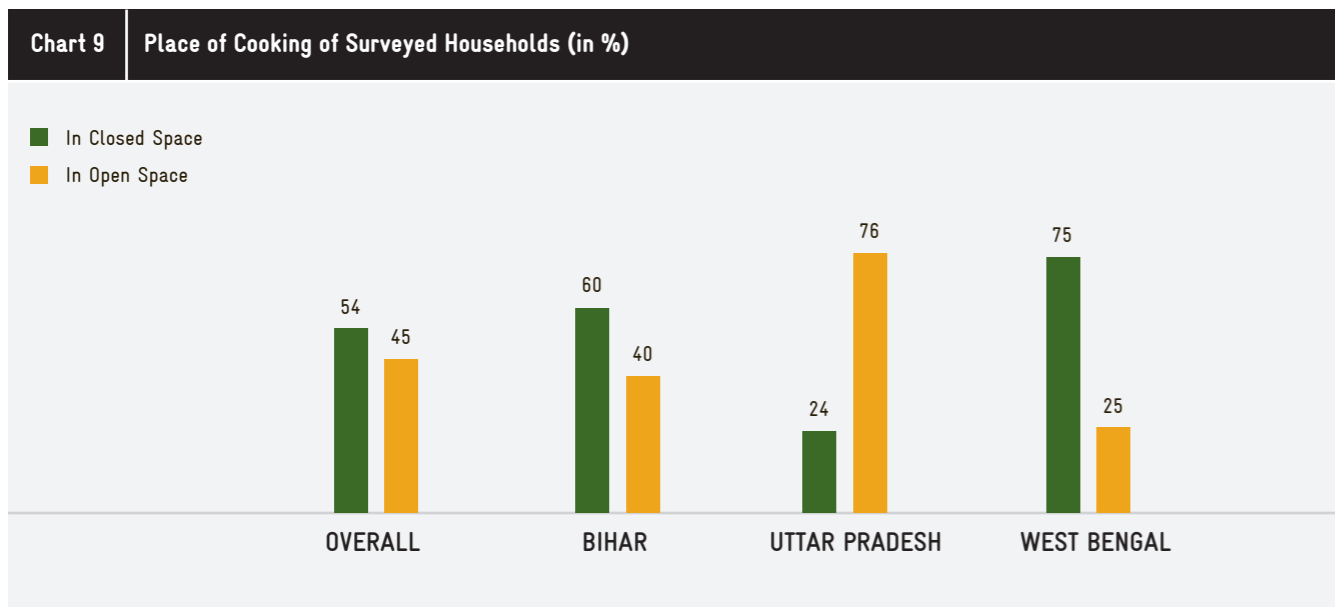


Total number of respondents (n) = 320, Bihar = 100, Uttar Pradesh = 100, West Bengal = 120

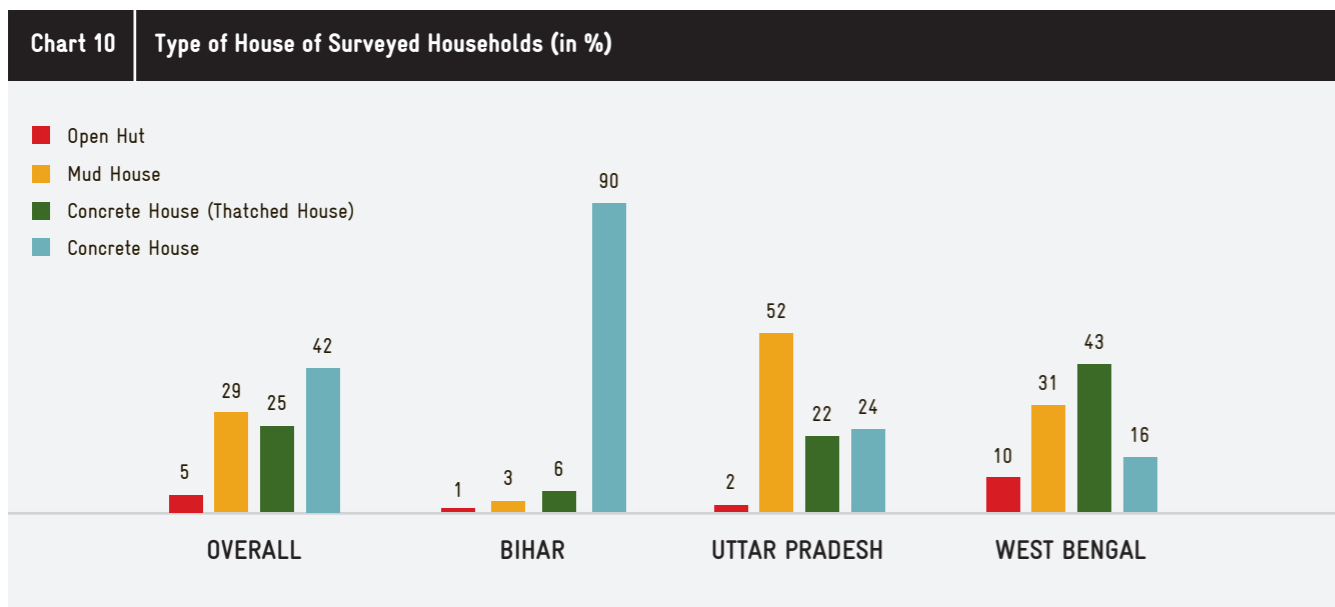
dung. The utensils (see chart 3 on page 6) that were used for cooking were quite similar across the states.

Our analysis highlighted the following key findings:

- **Virtually all households used traditional cookstoves made of brick and/or mud as their primary cookstoves.** ICS were not used at all. Each household used at least 2-3 fixed traditional cookstoves, some of which had only one burner, while others had two. Since households cooked in different places as per their requirements, the traditional cookstoves were built in all potential cooking places.
- **Households did not spend any money on their existing traditional cooking systems.** All traditional cookstoves were constructed using locally available materials; apart from using their own labour and time to collect stove materials and construct the stoves, households did not spend any money on stove construction.
- **In Bihar and West Bengal, most households were regularly cooking in closed spaces.** These were not necessarily dedicated kitchens; households used space available in the living room or even the bedroom for cooking. A significant number of households also cooked regularly in open spaces either inside the compound of their house (such as a courtyard) or outside. The house type and architecture were major factors that determined whether a household cooked in a closed or open space. Most mud houses with traditional designs included a courtyard for



Total number of respondents (n) = 320, Bihar = 100, Uttar Pradesh = 100, West Bengal = 120



Total number of respondents (n) = 320, Bihar = 100, Uttar Pradesh = 100, West Bengal = 120

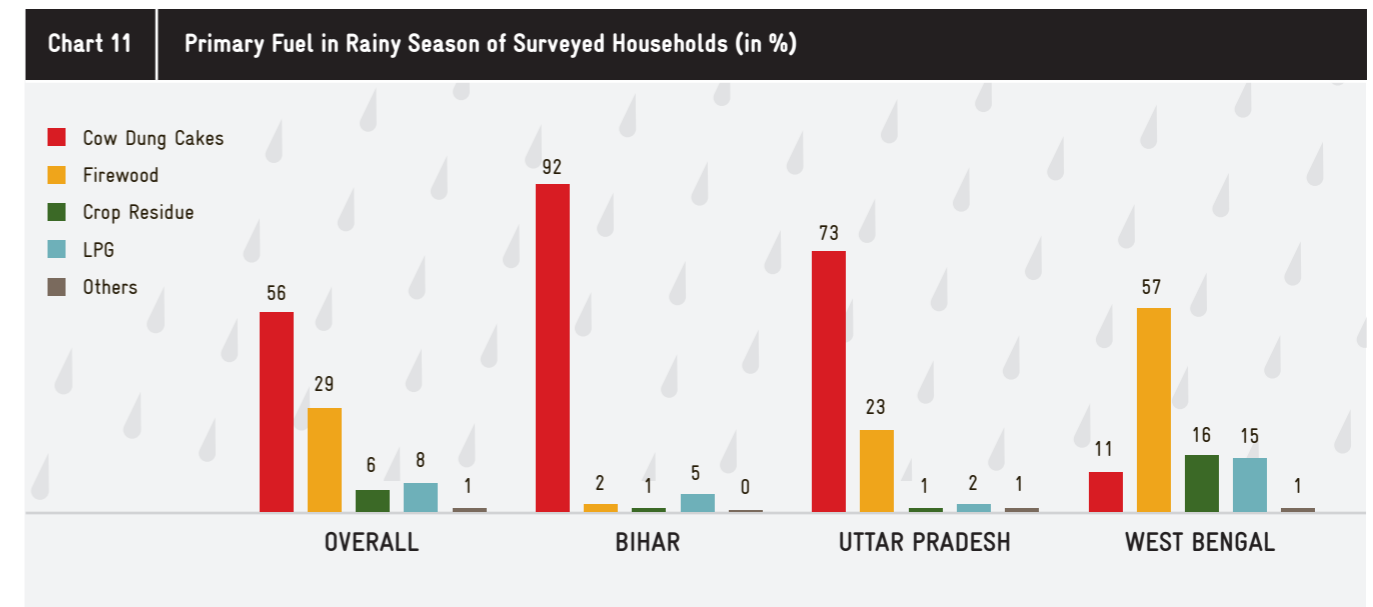
open cooking. Many concrete houses of more recent design did not include courtyards<sup>4</sup>. For example, most people in Uttar Pradesh cooked in open spaces as most of the houses were mud houses with traditional architecture while in Bihar the majority cooked inside as most people resided in concrete houses.

- **Cooking places varied throughout the year.** Courtyards inside the home compound were often the preferred place for cooking in the dry season, as they were more spacious than a dedicated kitchen. Courtyards also provided more natural light and fresh air as they were uncovered. However,

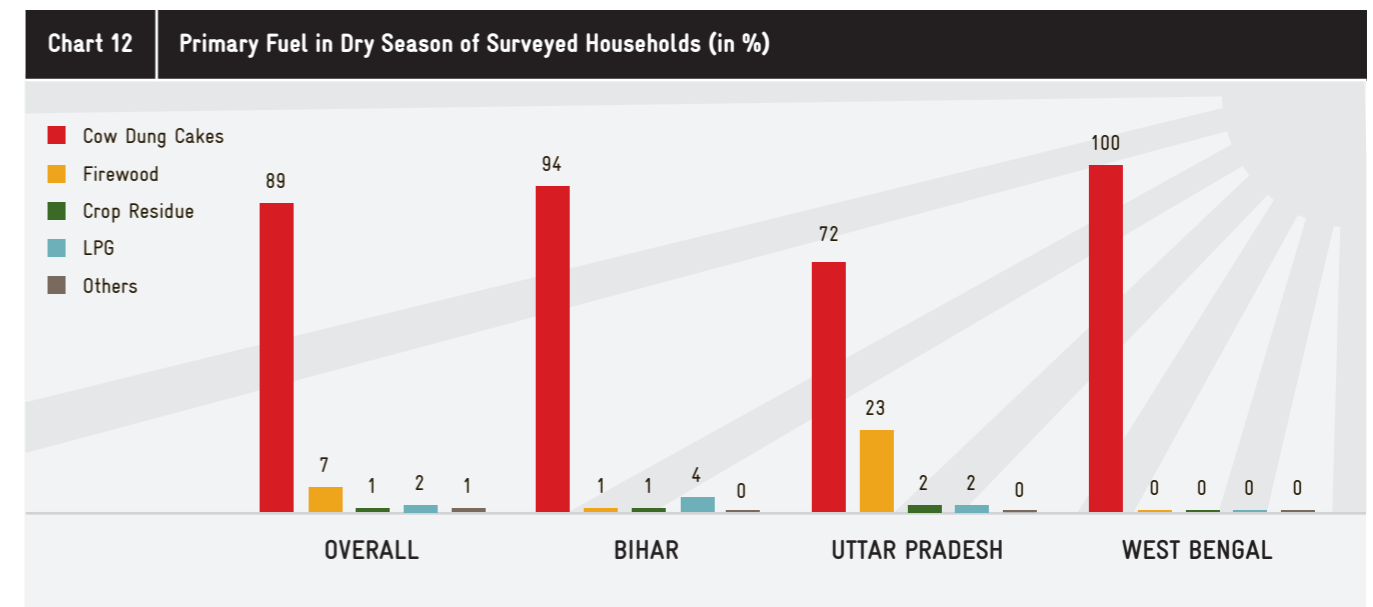
in the rainy season, most of the cooking was shifted to closed spaces with living rooms or even bedrooms often being turned into makeshift kitchens. This factor is of significance as many households pointed out their interest in portability of ICS models.

- **LPG did not play a major role for every day cooking.** LPG stoves were mainly used as secondary cookstoves and could only be found in about 12% of all households. They were often used for preparing snacks or quick meals, e.g. for unannounced guests or on similar occasions when something needed to be heated up quickly.

4. Most traditional courtyards inside the house had a provision for a covered cooking space that was open from three sides. This enabled households to cook even in the rainy season. Most newly designed concrete houses either did not have a courtyard inside the house or the courtyard did not facilitate cooking in the rainy season.



Total number of respondents (n) = 320, Bihar = 100, Uttar Pradesh = 100, West Bengal = 120



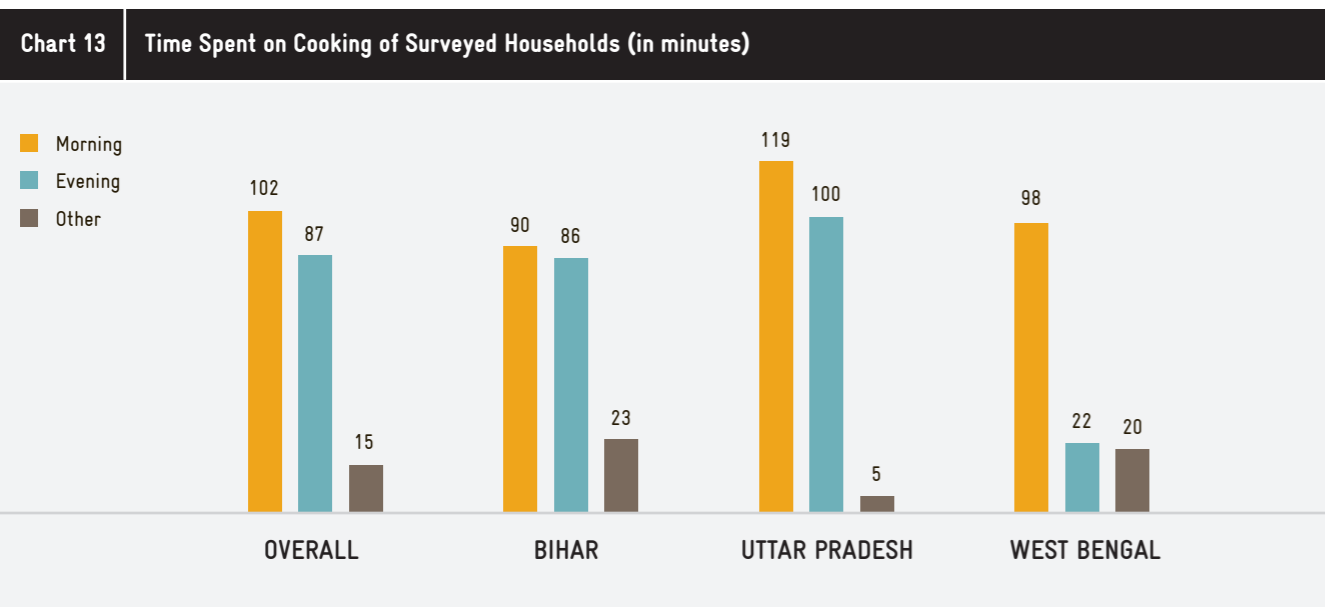
Total number of respondents (n) = 320, Bihar = 100, Uttar Pradesh = 100, West Bengal = 120

- **Households used a very diverse fuel mix with cow dung and fuelwood being the most important fuels; fuel patterns varied greatly throughout the year.** All households used cow dung either as the primary or secondary fuel (see chart 12). However, fuel-uses varied greatly across the three states. In Bihar and Uttar Pradesh, the most popular and commonly used fuel was cow dung<sup>5</sup>, while in West Bengal most households primarily used firewood. Households often did not ensure proper fuel quality; even moist fuels and materials of poor combustion quality were regularly used in the fuel mix.

The choice of fuel changed significantly in the rainy season when dry fuels were scarce. Cow dung cake was difficult to produce under humid conditions, as it required dry land and sunlight. Therefore most households that primarily use cow dung in summer, start using other fuels such as firewood and crop residue, during the rainy season. In Bihar, most households prepared cow dung cake in advance and stored it for the rainy season. Their fuel-use pattern therefore did not change much during the monsoon. However, it changed significantly in West Bengal as cow dung was not available. In West Bengal, all household used cow dung in summer but switched to other fuels in the rainy season (see

5. In all the three states, cow dung cakes are made using collected cow dung. The collected cow dung is mixed with crop residue (husk or chaff) and then manually converted into flat cakes. These cakes are then dried in sun and used for cooking





Total number of respondents (n) = 320. Bihar = 100, Uttar Pradesh = 100, West Bengal = 120

chart 11 and 12). The average cow dung consumption was in the range of 1,200-1,500 pieces per month. Firewood/crop residue consumption was in the range of 80-90 kg per month during the rainy season.

- **Land holdings and occupation of a household significantly influenced its fuel choices.** Households engaged in agriculture and livestock farming had easy access to adequate amounts of cow dung and crop residue. In West Bengal, which had relatively smaller land holdings, most household either collected cow dung or purchased cow dung cakes from other households with livestock in the village.
- **Hardly any of the households in Bihar and Uttar Pradesh spent money on cooking fuels, while most households in West Bengal spent around INR 275 per month to purchase fuel from the local market.** Only 8% of all surveyed households in Bihar and Uttar Pradesh paid for their cooking fuel. The main fuel for households in Bihar and Uttar Pradesh was cow dung cake which was produced directly by the respective household from its own cattle, as part of the daily routine. In the rainy season, some of the households started to use more and more firewood and crop residue, which was also not purchased, but collected from nearby orchards or from common village land.
- In West Bengal, however, more than 70% of all households had to purchase their cooking fuels, as they did not get enough freely available cow dung or crop residue and often did not have direct access to local firewood sources<sup>6</sup>.

An average of INR 275 per month was spent, primarily to purchase firewood and cow dung cakes. The average monthly consumption of firewood in West-Bengal was significantly higher than in the other states. Therefore, ICS could constitute a reasonable solution to reduce fuel consumption and associated monetary expenditures for households in West Bengal.

- **Most households spent about 1 ½ hours per day on fuel procurement.** This includes collection of firewood, crop residue, and preparation of cow dung cakes. In Bihar and Uttar Pradesh, households spent time mostly on collecting cow dung and making cow dung cakes. In West Bengal, households spent about the same amount of time on cow dung collection and collection of firewood.
- **While staple foods were similar across the states, local dishes and cooking practices varied greatly.** The basic food items across all states were rice, chapattis (flat wheat breads), dal (cooked lentils) and vegetables. Households also made tea and boiled/heated milk apart from their staple food. Apart from these basics, other food items and the way they were prepared varied significantly. While between Bihar and Uttar Pradesh there was no major variation in cooking practices and food items, cooking practices and food preparation were very different in West Bengal. Almost half of the households in West Bengal cooked meat (chicken/mutton) or fish regularly along with the staples. For preparing non-vegetarian food, most households fried the meat/fish, which required intense heat inputs. Many

6. Access to free firewood depends on the availability of firewood on common public land nearby or in forest areas. Not all villages have such resources that can provide enough firewood for the household.

traditional cookstoves allow the feeding of large quantities of fuel due to their large combustion chambers and therefore can ensure the required heat intensity. Tea, which only requires the stove to be lighted for 10-15 minutes, was also more often prepared in households in West Bengal than in the other states. Users pointed out that preparing tea on traditional stoves was a hassle as lighting a traditional stove was rather time consuming.

- **Most of the cooking was taking place in the morning.** Around 80% of the households cooked twice a day while about 20% cooked three times a day. Households spent more time on cooking in the morning (on average: 100 minutes) than in the evening (on average: 90 minutes). This was mainly because the food cooked in the morning included breakfast and lunch (see chart 13).

Even though the absolute difference in cooking time between morning and evening seems small, further exploration during group discussions revealed that the households actually perceived the cooking time in the evening to be significantly shorter. Cooking in the morning was usually done on a traditional cookstove with two burners and on an additional single-burner cookstove to ensure that all food items could be prepared at the same time. Almost all households emphasised that the morning cooking had to be done very quickly, as

male members needed to go out early for work. Some households also cooked during the day, between the morning and evening cooking. However, this was usually limited to boiling tea or milk, or preparing snacks for guests.

- **Households perceived limitations of their traditional cookstoves and often benchmarked them against LPG.** Households provided comprehensive information about the problems associated with the traditional cookstoves they were using. The most common problems (see chart 14) included smoke emissions and the need for organising/collecting fuel. Collecting fuel was often considered a challenge; finding dry fuel or drying moist fuel, as well as proper fuel storage could be time-consuming and tedious.

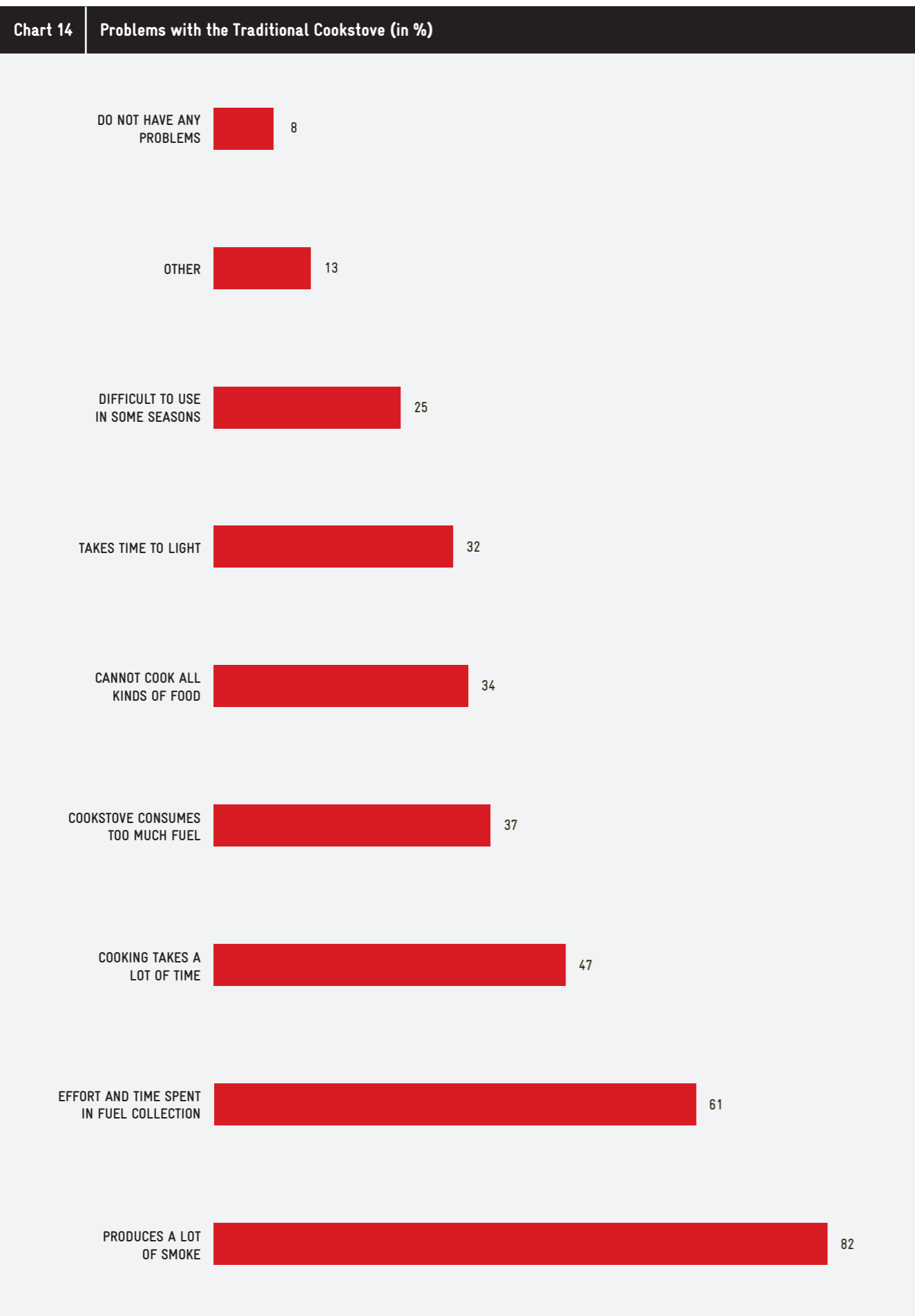
Cooking on traditional cookstoves was also perceived to be a time-consuming process. Many households complained in particular about the time required to light traditional cookstoves. Another major issue was the inability to control the flame. In terms of lighting and controlling the flame, most households compared the performance of traditional cookstoves with the more desirable LPG cookstoves. It was apparent that even if a household did not own or use an LPG stove, household members were very well aware of the features and benefits of cooking with LPG.



Picture 4: A Hut in West Bengal



Picture 5: A Thatched-roof House in Bihar



Total number of respondents (n) = 320. Bihar = 100, Uttar Pradesh = 100, West Bengal = 120

### 3.3 Perception of Improved Cookstoves

Virtually all stove users used ICS for the first time and enthusiastically shared their cooking experiences. The six weeks of cooking on these very different stoves made users notice and highlight several dimensions of ICS features and cookstove designs. Overall, ICS were perceived superior to traditional cookstoves. However, the feedback also highlighted some areas for potential improvement and provided interesting insights that could prove highly valuable for all stakeholders in the clean cooking sector.

- Cooking was perceived easier with ICS than with traditional cookstoves.** Stove users highlighted that the ICS were easy to light and there was no need to blow air constantly for the flame to be strong. They also appreciated the fact that fuel did not need to be fed or adjusted frequently during cooking. Across the locations, cooking was perceived to be easier with portable cookstoves (with the exception of the Sampada stove; see annex 1) than with the fixed cookstove model Bharatlaxmi. Many stove users in West Bengal found cooking with Bharatlaxmi as difficult as with traditional stoves; some even rated cooking on traditional stoves (which were ranked at the bottom of user preference in overall comparisons) as easier than cooking with the Bharatlaxmi. The stove users' negative experiences with the Bharatlaxmi were due primarily to the handling of fuel and to the small combustion chamber quickly filling up with ash and fuel residue.
- Stove users appreciated the reduced fuel consumption by ICS.** Users were impressed by the fuel saved when using ICS (see chart 15.2). The majority believed that fuel consumption was significantly reduced. A surprising exception was the Sampada gasifier stove which was

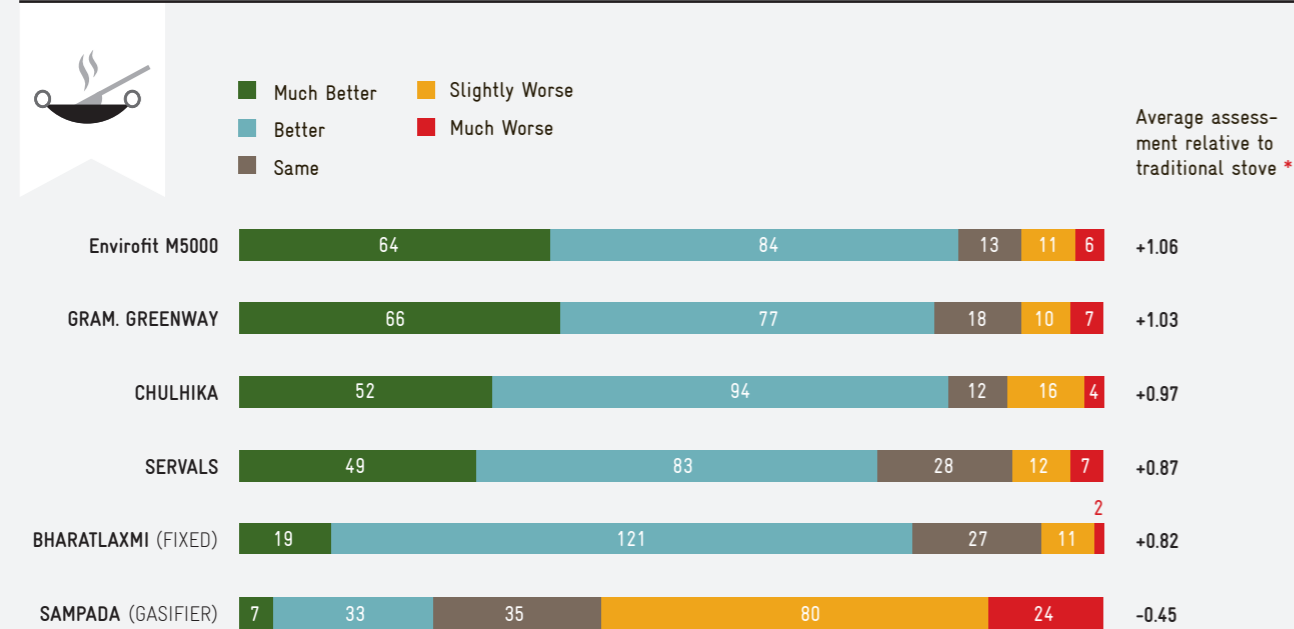
perceived as consuming even more fuel than a traditional cookstove. Users highlighted that the Sampada stove had a big combustion chamber and required all of the fuel for one cooking session to be loaded in one go before lighting the stove. Users perceived it as wasteful that there was no way to remove any fuel once the cookstove was lighted.

- Stove users perceived that ICS produced less smoke than traditional cookstoves; however, very often the reduction was not perceived 'significant'.** Most households agreed that ICS did reduce smoke but this was obviously not significant enough to rate the ICS very high on this parameter. Stove users seemed to benchmark the smoke reduction ability against that of LPG. Stove users stated that smoke was not completely eliminated as was the case with LPG.
- Due to the availability of multiple burners, traditional cookstoves were often perceived to cook faster than a single ICS with only one burner.** The only area where traditional cookstoves were seen to be superior to ICS was the perceived ability of the traditional stove to cook faster (see chart 15.4). Qualitative interviews and FGDs suggested that the households were comparing the total time taken to prepare a complete meal on a traditional cooking system which can include multiple stoves and burners (allowing several dishes to be cooked at the same time), to the time taken by the single-burner ICS which only allowed cooks to prepare each dish individually one after the other. It became clear that most households would require at least two portable stoves to be able to prepare the most common dishes as quickly as with a traditional cooking system.

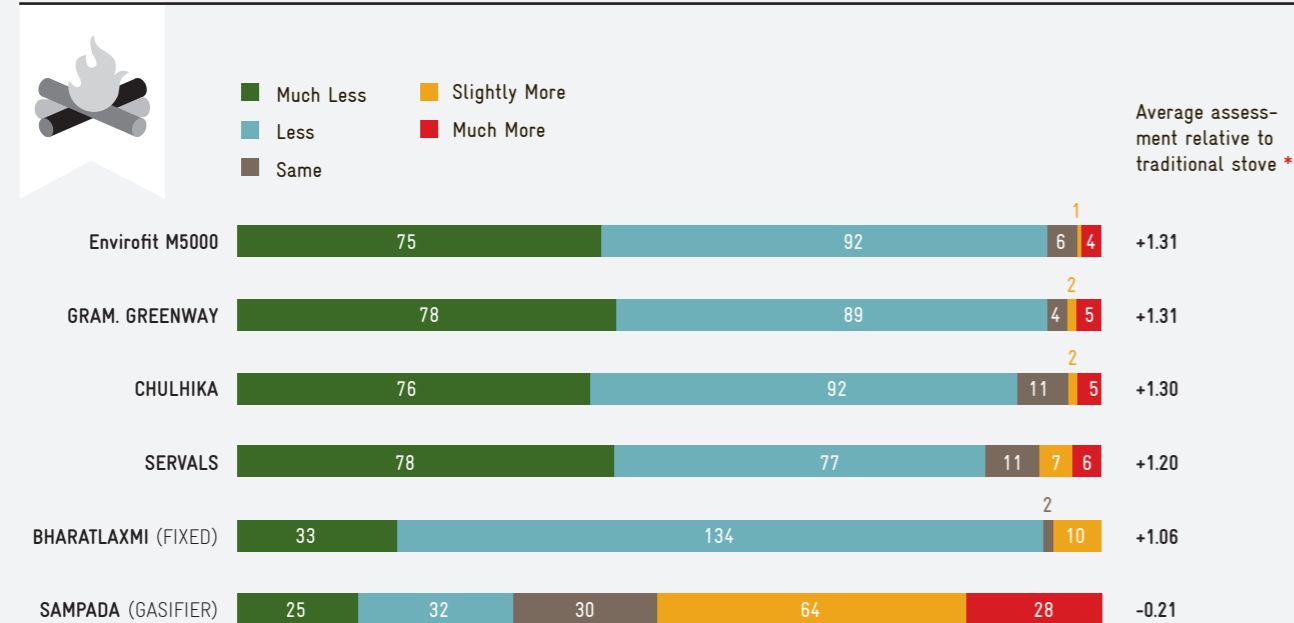
**Chart 15 Comparison of Improved Cookstoves with Traditional Cookstoves**

The cookstoves were rated on a 5-point scale: much better, better, same as traditional, worse, much worse than traditional. These scales were quantified assigning +2 for much better than traditional; +1 for better than traditional; 0 for same as traditional; -1 for worse than traditional; and -2 for much worse than traditional. The average assessment score was calculated adding all the quantified scores for a cookstove and then by dividing by the number of households.

**Chart 15.1 Ease of Cooking**

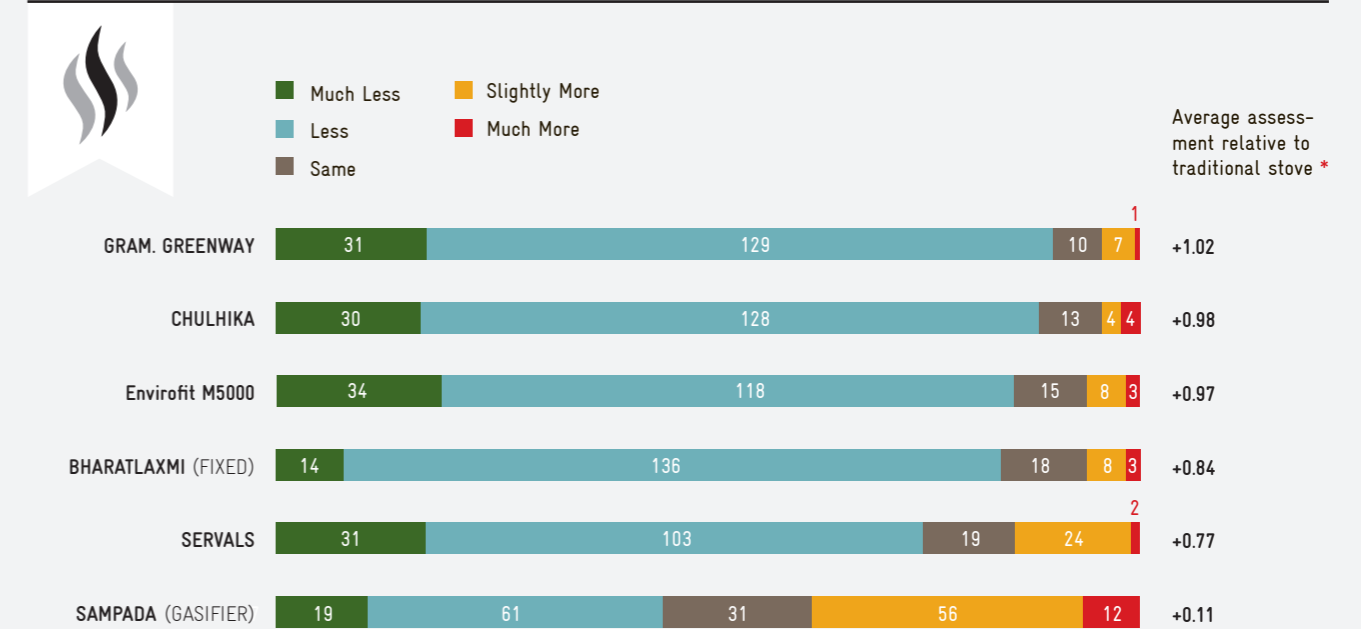


**Chart 15.2 Fuel Consumption**

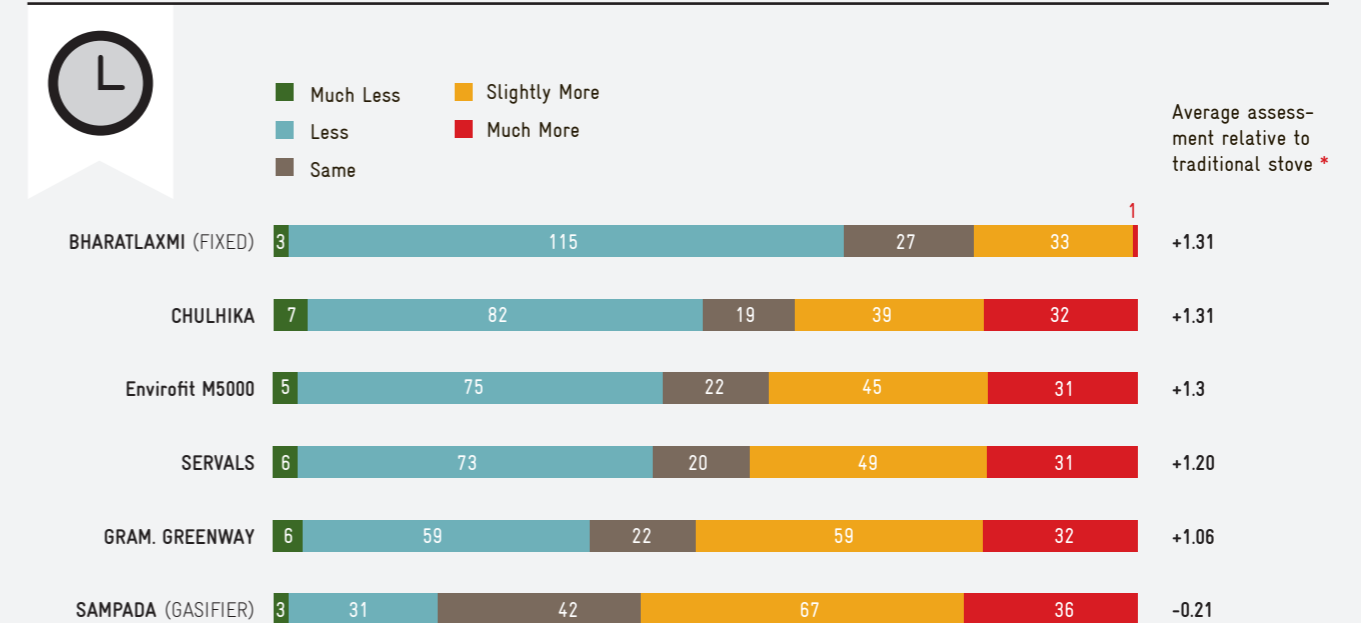


Total number of respondents (n) = 180. Bihar = 60, Uttar Pradesh = 60, West Bengal = 60

**Chart 15.3 Smoke Emission**



**Chart 15.4 Cooking Time**



Total number of respondents (n) = 180. Bihar = 60, Uttar Pradesh = 60, West Bengal = 60

• **One stove does not fit all: stove preference varied significantly between households.** Households were asked to rank all stove models according to their overall preference. Surprisingly, there was no clear favourite model. It was evident that while some people liked a particular model, others disliked it for one reason or another. Nevertheless, all stove users were able to give convincing arguments in favour of their particular choice. This highlights the fact that preferences can vary greatly when it comes to cooking technologies. Overall, the Chulhika stove received the highest average rankings among all stoves. On average, it scored 5.3 out of possible maximum score of 7.0 and was the top-rated ICS model in Uttar Pradesh and West Bengal. However, in Bihar it was only ranked fourth, as users preferred design, sturdiness and performance of other ICS. Similarly, the fixed stove model Bharatlaxmi was ranked 5th in West Bengal and Bihar respectively, while it was rated second best in Uttar Pradesh. While not the preferred option in Bihar and Uttar Pradesh, traditional cookstoves were ranked 2<sup>nd</sup> in West Bengal, as users still found them better than most ICS for their ease of use and

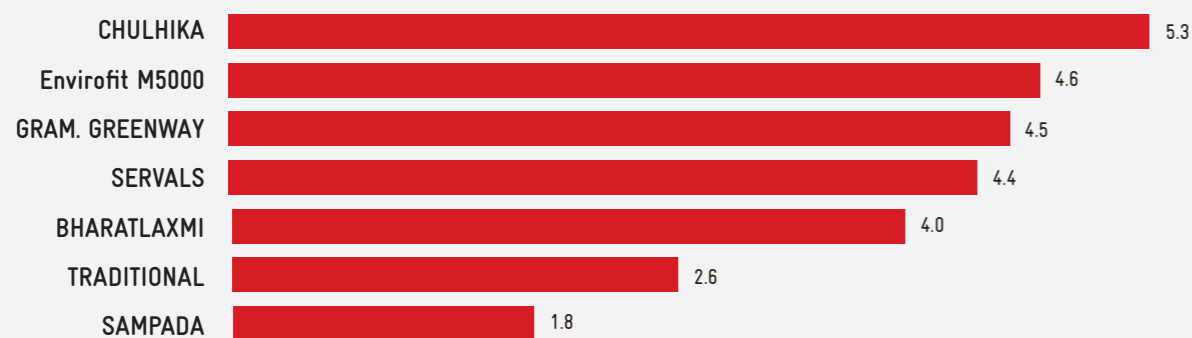
better suitable to cook non-veg food that required more intense heat (see Annex 1).

The variation in overall preferences was often influenced by strong opinions regarding one specific feature of a particular ICS models. The FGDs and interviews revealed that stove users who liked specific features of a particular model, also rated the other features of the same model more favourably. Similarly, when stove users strongly disliked some specific features of an ICS model they rated the other features poorly as well. For example, the Grameen Greenway ICS was praised for its design in Bihar, where the attractive design was virtually the first characteristic cited by all stove users in FGDs; these users proceeded to rate this ICS highly on other parameters as well (see Annex 1, for more details of user feedback on each ICS). In another case, stove users who ranked the Sampada gasifier ICS low on their list of preferences because of poor ease of use and safety (see Annex 1), rated this cookstove poorly on many other features as well.

**Chart 16** Ranking of Cookstoves

Households ranked different ICS models along with traditional cookstoves based on different parameters, as well as on overall performance. A score of 7 was assigned whenever a household gave the top ranking to a cookstove model, 6 if ranked 2<sup>nd</sup>, 5 if ranked 3<sup>rd</sup>, and so on. The model ranked at the bottom was assigned a score of 1. The average ranking score was calculated by adding all the scores and dividing the total by the number of households.

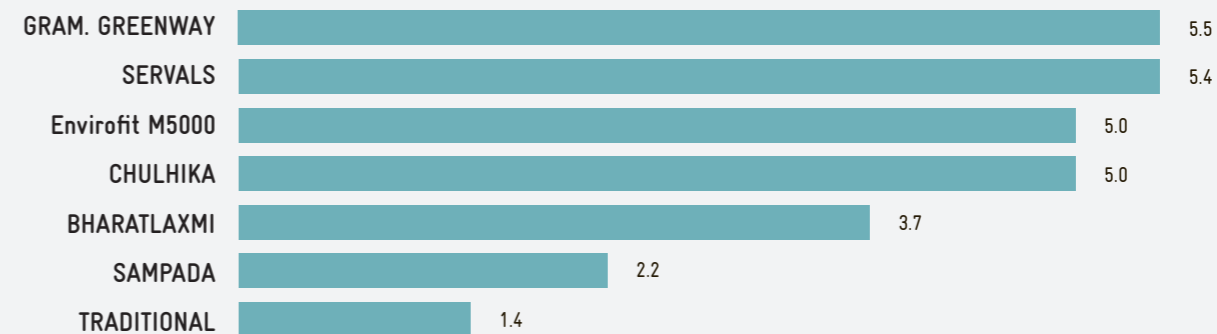
**Chart 16.1** Overall Ranking of ICS Models



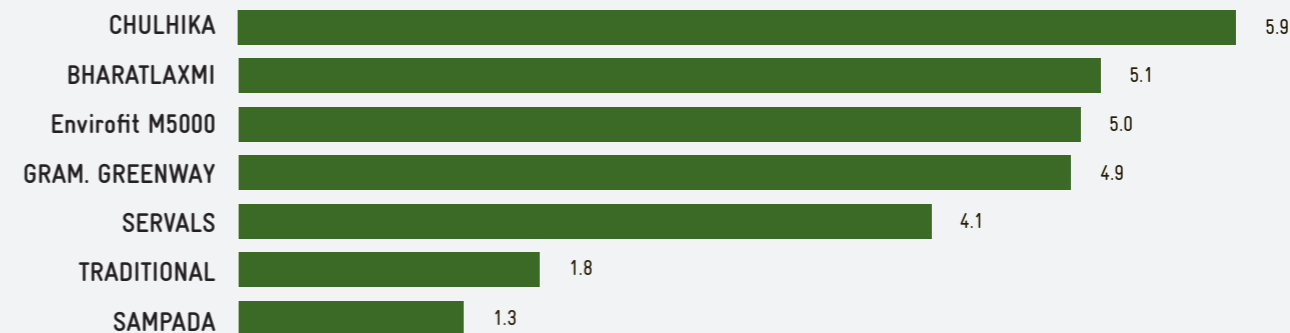
Total number of respondents (n) = 180. Bihar = 60, Uttar Pradesh = 60, West Bengal = 60

Households ranked different ICS models along with traditional cookstoves based on different parameters, as well as on overall performance. A score of 7 was assigned whenever a household gave the top ranking to a cookstove model, 6 if ranked 2<sup>nd</sup>, 5 if ranked 3<sup>rd</sup>, and so on. The model ranked at the bottom was assigned a score of 1. The average ranking score was calculated by adding all the scores and dividing the total by the number of households.

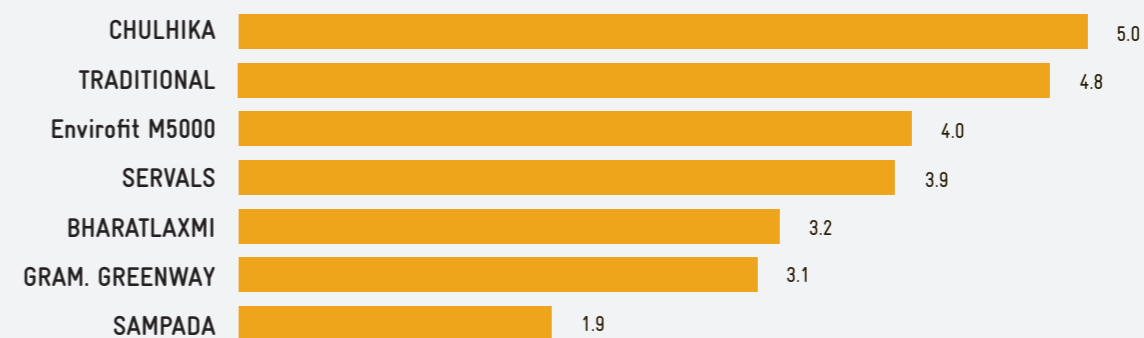
**Chart 16.2** Bihar



**Chart 16.3** Uttar Pradesh



**Chart 16.4** West Bengal



Total number of respondents (n) = 180. Bihar = 60, Uttar Pradesh = 60, West Bengal = 60



Picture 6: Woman in West Bengal Cooking on the M5000 cookstove

- **Rural cooks do not base their stove preference on reduced smoke emissions and biomass consumption alone.**

Portability, aesthetics, and the ability to accommodate different types of utensils played a very important role. An analysis of stove users' preferences suggested that most users expected ICS models to be more fuel-efficient and emit less smoke than traditional cookstoves. As stated earlier, virtually all stove users agreed that ICS models have these characteristics. However, an analysis of the main drivers for particular models being highly rated revealed the following as important features along with **reduced fuel consumption and reduced smoke:**

- a. **Portability:** Portability was perceived to be one of the most important features. The portability of ICS enabled stove users to cook wherever required at a particular time of year, something that was not possible with the fixed traditional cookstove. Many stove users even wanted to be able to move the cookstove while it was lit. The strong preference for portability also highlighted several design issues such as the design of the handle

as well as stove weight and sturdiness, which can significantly influence portability.

- b. **Aesthetics and design:** The look and overall design of ICS was its distinguishing feature. Stove users were inclined to go for a 'good looking' cookstove with an appealing design. Users who bought an ICS in the auction frequently cited the attractive design as the key feature that had motivated them to buy a particular model.
- c. **Ability to accommodate utensils of different sizes:** Stove users cook with different types of utensils, such as small vessels for making dal, big open vessels for vegetables, which are almost 2-3 times bigger than the vessels used for cooking dal. These utensils not only varied in size but also in design; some had a large flat base while others were rounded. Most dishes such as vegetables, dal and chapattis required frequent stirring and/or inspection. Stove users frequently removed the utensil covers and checked the dishes; while making chapattis, stove users removed the flat pan from

the burner and put the chapatti in the combustion chamber. It was therefore important for the utensil to sit well on the cookstove and for the cookstove itself to be stable. A stove's ability to accommodate different types and sizes of utensils was an important factor in helping a household decide in favour of a particular type of stove.

- **ICS were considered good secondary cookstoves for specific cooking tasks.** The cooks used different types of cookstoves for different cooking needs. ICS models were considered good for quick cooking, e.g. small meals, snacks and tea. Stove users were also more likely to use ICS for cooking in the evening or for less than six family members. The portability of the ICS was a very attractive feature for many stove users, as it allowed them to easily cook a small meal and to heat water or milk at any convenient place. Traditional cookstoves were perceived best suited for cooking full meals and large quantities of staple dishes. Cooking small snacks and making tea required filling and firing up the big traditional cookstove with a substantial amount of burning fuel usually left in the combustion chamber. This was either left to burn completely or saved for later use: something that stove users found bothersome. ICS were considered a great fit for this purpose.
- **Households expressed the need for specific improvements of ICS.** More than 50% of the households participating in the study switched back to their traditional cookstove for a few times every week. This indicates that there were certain needs that were not fully met by the existing ICS models. The following points were raised with regard to the main areas for improvement:
  - a. **Ability to accommodate more fuel types:** Most households used a diverse fuel mix made of cow dung, crop residue and wood of different sizes. Most of the stove users complained that none of the ICS models allowed them to use their regular fuel mix with ease. The small size of the combustion chambers and fuel openings were also seen as problematic. The small combustion chambers quickly filled up with ash and

the small openings did not allow larger wood logs to be inserted easily.

- b. **Ability to accommodate all types of common utensils:** Many stove users complained about the utensils not being stable on the ICS. While some ICS models such as the Chulhika, Bharatlxmi and Envirofit 5,000 did offer better stability, the households indicated a general need for improvement.
- c. **Stove material:** Some stove users expressed concern about the material used for the stove body. Cookstoves with metallic bodies were perceived to be unsafe: the stove body gets very hot while cooking and thus poses a risk to the user and to small children. In Bihar and Uttar Pradesh, some stove users highlighted the fact that they had to wait for 15-30 minutes before they could clean the cookstove after cooking, as the body remained very hot. Cleaning a stove immediately after having cooked is a common practice in these two states. Many users did not like the use of plastic for the handle. Some users believed that a stove with a plastic handle is not suitable for cooking for religious festivals or for people who observe certain religious practices. They believed that cookstoves (traditional or ICS) need to be purified by cleaning with water or applying cow dung and plastic cannot be purified in the same way.
- d. **Cooking time:** More than 70% of all stove users complained about the slow cooking with some of them claiming that the overall cooking time was more than the overall time spent on cooking with a traditional stove. They perceived that it took more time to prepare a dish on ICS than on a single-burner traditional cookstove. They believed that the small burner and small chamber saved fuel but also slowed down the cooking process. Most of these users demanded a bigger combustion chamber and some demanded the option of a double-burner stove. In FGDs, whenever a two-burner ICS was mentioned, it was the preferred option for virtually everyone who was present.

## 4

## Implications

The findings of this study underline the necessity of understanding user preferences if ICS models are to be widely adopted. In this section, we summarise the key implications of the study for different stakeholders.

## 4.1 For Manufacturers

Manufacturers play a very important role in provision of clean cooking energy as they are responsible for appropriate technology development and product design. The study of user preferences provided a nuanced feedback on cookstove design and on the performance of different models. ICS manufacturers may consider the following insights gained from user feedback.

- **The development and field testing of ICS with two burners should be expedited.** Many stove users were of the opinion that ICS models with only one burner were not a good replacement for their two-burner traditional stoves. Manufacturers should develop and introduce new two-burner ICS models to cater for this demand.
- **ICS should be designed with bigger combustion chambers.** Several stove users disliked the small combustion chambers of the ICS models, pointing out that the small chambers filled up quickly with ash and fuel residue; they would prefer a larger chamber. Manufacturers should factor this feedback into the development of new models or modify the existing line of products.
- **Manufacturers should develop ICS that provide a significantly higher smoke reduction even when used with fuels other than firewood.** Stove users appreciated the ICS for smoke reduction, but often did not find reductions to be significant enough, as they benchmarked the performance of ICS against that of LPG stoves. The fuel mix with a very high share of cow dung might also play a role in high levels of smoke emissions. ICS should be designed to better cater to these types of fuels.

- **Manufacturers should focus on offering a range of ICS models with different features, fuel capabilities and designs.** The study findings established that stove users did not prefer any one particular model. Their preferences for ICS models varied as per their requirements, fuel use and individual taste. Manufacturers may consider offering a range of solutions from which stove users can select the ones most suited to their needs and preferences.

## 4.2 For Distributors

In India, ICS models are being increasingly disseminated by dedicated distributors who source from manufacturers and then take the responsibility for market development and distribution. The following insights from the study will help distributors in generating better demand and acceptance for the ICS products they offer.

- **Products should be selected on the basis of fuel use, the socio-economic context and user preferences.** A proper selection of ICS technology based on local fuel use and on the socio-economic context will help distributors in achieving better consumer satisfaction and in eventually increasing the demand for ICS. Ideally, product selection should be based on pilots, following which the most popular products should be rolled out on a large scale.
- **Providing a range of products can generate more demand.** As stove preferences may vary significantly from household to household, even within the same village or



Picture 7: Smoke from Cooking Coming out from a Hut in West Bengal



socio-economic group, distributors can increase demand by offering a larger range of products. Preferences are driven by several factors and a broader product offering has a better chance of satisfying individual preferences.

- **Awareness and user training are key to stove adoption.** Our findings suggest that many households underestimate the ill-effects of cooking on traditional cookstoves and do not actively look for better cooking alternatives. Rural cooks often understand the basic problems associated with traditional cooking but still do not know about alternative cooking options or do not value the ICS's benefits enough to spend money on them. Awareness raising campaigns and intensive user trainings can help to increase the adoption of ICS.

### 4.3 For Government and Development Agencies

The list of clean cooking energy stakeholders includes government institutions such as MNRE (GOI), state nodal agencies in charge of promoting clean technologies, philanthropic organisations, multilateral and bilateral agencies and civil society organisations. Based on the findings of this study following key implications can be derived for these stakeholders. They could consider these implications while designing and developing support schemes and programmes.

- **Selection of clean cooking technologies should incorporate user preferences and be based on the local context.** The study suggests that the sustained adoption of ICS will depend largely on user acceptance and the selection of appropriate technologies. Any intervention aimed at creating sustained adoption should include a pilot to identify ICS that are suitable to fuel uses, cooking practices and user preferences. These pilots must provide an option for users to provide feedback on different technologies and designs that are being considered for dissemination. These pilots should be conducted at regional and sub-regional levels, as user preferences and technology suitability may change significantly in different geographies.
- **ICS with two burners should gain more importance.** As the findings of the study highlights the need for ICS models with two burners, government, research and donor agencies should proactively consider supporting the development of these models. This must also entail the development of related quality and performance standards by government and regulatory bodies to ensure quality product development.
- **More focus on increasing awareness about IAP and ICS is needed.** Most households did not understand the health-threatening impact of IAP from traditional cookstoves and hence did not feel the compelling need for alternatives. Mass campaigns that generate awareness of IAP and the benefits of cleaner technology can help create demand. Unfortunately, due to the lack of resources and the high costs involved with implementing such campaigns, clean cooking entrepreneurs are often not able to actively create awareness on IAP and ICS. The Government and donor agencies can support the sector by implementing mass awareness campaigns. Other campaigns such as for eradication of polio and promoting hygiene (campaigns for promoting hand washing, discouraging open defecation) have already been proven helpful in increasing awareness and in inducing behaviour change.
- **Knowledge creation among manufacturers and distributors should be facilitated.** Manufacturers and distributors need to know the market and understand the preferences of different user groups in order to offer better products and services. However, creation of such knowledge requires resources which are beyond the means of individual market players. Governments, donors and philanthropic organisations can help the sector by supporting research to understand consumer preferences and to identify different consumer segments in different parts of India.
- **More data on stove efficiency and emissions under field conditions are required.** This study is based entirely on user perception of ICS performance and can therefore not make any reliable statements on actual smoke emissions and efficiency. However, users' perception of limited smoke reductions suggest significant differences between stove performance in the field and performance in controlled lab tests, in particular in the context of varying fuel mixes and cooking behaviour.

There is an urgent need to measure technical ICS performance such as stove efficiency and emissions under actual-use conditions, to complement the user-focused findings of this study. Donor and government agencies can plan conducting such studies across the country to understand technology performance under field conditions.



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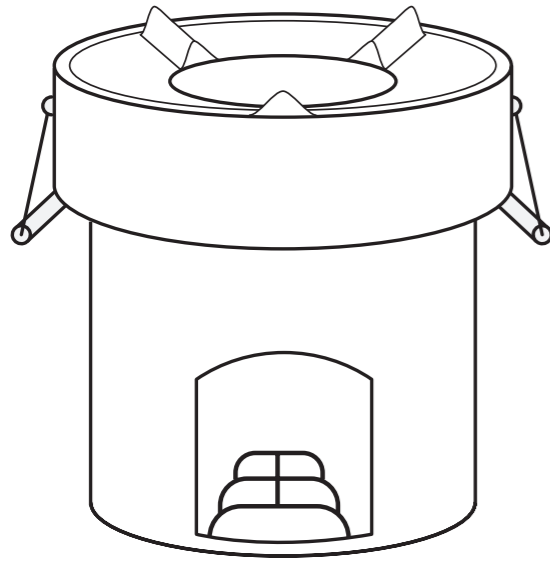
# Annexures

## Annex 1: Feedback on each Cookstove Model

This section provides details of the performance of ICS models based on different parameters and how they compare with other ICS models. User feedback has been analysed to calculate the overall rankings of different ICS models and to assess their performance compared with the performance of traditional cookstoves.



## Chulhika



OVERALL SCORE

5.3/7\*

## STATE WISE SCORE

WEST BENGAL 5.0/7\*

UTTAR PRADESH 5.9/7\*

BIHAR 4.9/7\*

## TOP REASONS WHY USERS LIKED IT\*\*

- **Ability to reduce fuel consumption:** More than 80% of the users cited reduced fuel consumption as one of the main reasons for liking the cookstove.
- **Reduced smoke emission:** Almost half of the users said that they liked it because it reduced smoke emission.
- **Strong and sturdy cookstove design:** Around 25% of the stove users liked the sturdiness of the cookstove and explicitly mentioned it as one of the main features of the stove.
- **Portability:** Many users (more than 20%) found this cookstove very easy to move from one place to another.
- **Ability to accommodate large utensils; less blackening of utensils:** Around 20% of the users said that this cookstove accommodated large utensils easily and did not blacken utensils while cooking.

## TOP REASONS WHY USERS DISLIKED IT\*\*

- **Small combustion chamber:** More than 20% of the users highlighted that the chamber was too small. The small chamber meant that users had to clean the ash produced too frequently during the cooking process, especially when they used cow dung cakes.
- **Not suitable for all types of fuel:** Around 15% of the people complained that the cookstove was not suitable for all types of fuel. Users also highlighted that the opening for fuel did not allow them to use thick pieces of wood or 'enough' cow dung cakes easily.

\* A score of 7 was assigned whenever a household gave the top ranking to a cookstove model, 6 if ranked 2<sup>nd</sup>, 5 if ranked 3<sup>rd</sup> and so on. The model ranked at the bottom was assigned a score of 1. The average ranking score was calculated by adding up all ranking scores and dividing the result by the number of households.

\*\* In descending order starting with the reason most frequently cited.

## User-ranking - Chulhika

West Bengal Uttar Pradesh Bihar Overall

## OVERALL



## STURDINESS



## AESTHETICS AND DESIGN



## SAFETY



## SMOKE EMISSION



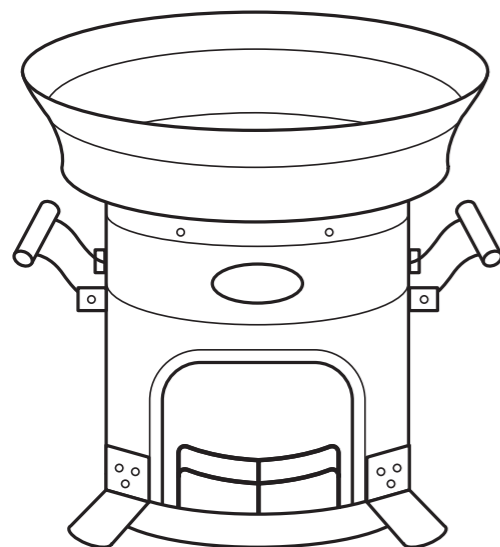
## FUEL CONSUMPTION



## EASE OF USE



## Envirofit M5000



OVERALL SCORE **4.6/7\***

## STATE WISE SCORE

WEST BENGAL 4.0/7\*

UTTAR PRADESH 5.0/7\*

BIHAR 5.0/7\*

## TOP REASONS WHY USERS LIKED IT\*\*

- **Ability to reduce fuel consumption:** Almost 60% of the users appreciated the reduced fuel consumption.
- **Reduced smoke emission:** Approximately one third of the users said that it reduces smoke emission.
- **Attractive design:** Around 25% of the users liked it for its attractive design.
- **Portability:** Almost 20% of the users liked the stove because it could be moved from place to place.

## TOP REASONS WHY USERS DISLIKED IT\*\*

- **Small combustion chamber:** More than 30% of the users complained that the combustion chamber was too small.
- **Not suitable for all types of fuel:** Around 15% of the people said that the stove was not suitable for all types of fuel. They reported having problems when using rice husk and cow dung cakes.

\* A score of 7 was assigned whenever a household gave the top ranking to a cookstove model, 6 if ranked 2<sup>nd</sup>, 5 if ranked 3<sup>rd</sup> and so on. The model ranked at the bottom was assigned a score of 1. The average ranking score was calculated by adding up all ranking scores and dividing the result by the number of households.

\*\* In descending order starting with the reason most frequently cited.

## User-ranking - Envirofit M5000

West Bengal Uttar Pradesh Bihar Overall

## OVERALL



## STURDINESS



## AESTHETICS AND DESIGN



## SAFETY



## SMOKE EMISSION



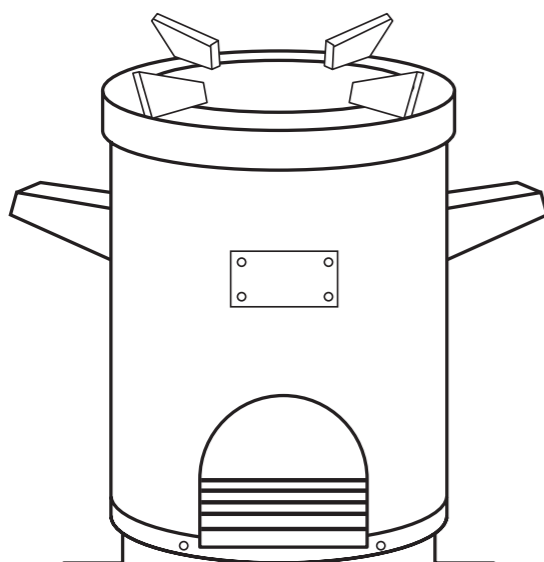
## FUEL CONSUMPTION



## EASE OF USE



## Greenway



OVERALL SCORE **4.5/7\***

## STATE WISE SCORE

WEST BENGAL 3.1/7\*

UTTAR PRADESH 4.9/7\*

BIHAR 5.5/7\*

## TOP REASONS WHY USERS LIKED IT\*\*

- **Ability to reduce fuel consumption:** Almost 60% of the users appreciated the reduced fuel consumption.
- **Reduced smoke emission:** More than 40% of the users said that the stove's ability to reduce smoke emission is one of the reasons why they liked it.
- **Attractive design:** More than 30% of the users liked the attractive design and sleek look.
- **Portability:** More than 25% of the users liked its light weight and its portability.

## TOP REASONS WHY USERS DISLIKED IT\*\*

- **Small combustion chamber:** More than 40% of the users said that the cookstove chamber was small and therefore not suitable for many types of fuel such as thick firewood, cow dung cakes, etc.
- **Not suitable for big utensils:** Almost one third of the users complained about the small burner and the difficulty of accommodating big utensils on it.

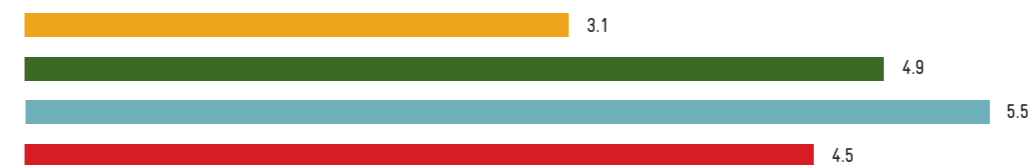
\* A score of 7 was assigned whenever a household gave the top ranking to a cookstove model, 6 if ranked 2<sup>nd</sup>, 5 if ranked 3<sup>rd</sup> and so on. The model ranked at the bottom was assigned a score of 1. The average ranking score was calculated by adding up all ranking scores and dividing the result by the number of households.

\*\* In descending order starting with the reason most frequently cited.

## User-ranking - Greenway

West Bengal Uttar Pradesh Bihar Overall

## OVERALL



## DURABILITY



## AESTHETICS AND DESIGN



## SAFETY



## SMOKE EMISSION



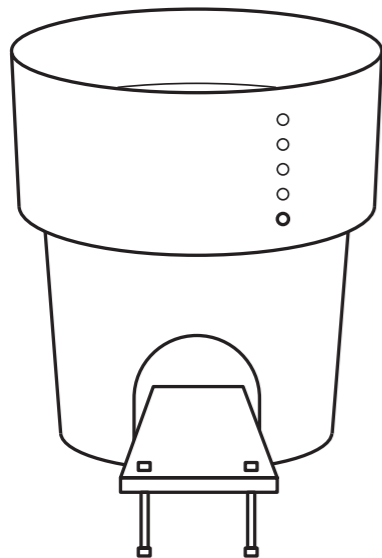
## FUEL CONSUMPTION



## EASE OF USE



Servals



OVERALL SCORE **4.5/7\***

STATE WISE SCORE

WEST BENGAL	3.9/7*
UTTAR PRADESH	4.1/7*
BIHAR	5.4/7*

TOP REASONS WHY USERS LIKED IT\*\*

- **Ability to reduce fuel consumption:** More than 60% of the users liked the stove because of its ability to reduce fuel consumption.
- **Reduced smoke emission:** As many as 40% of the users appreciated the reduced smoke emission.
- **Attractive Design:** Many households liked the design. The girdle-like support for the utensil on top of the cookstove was especially liked by some households.
- **Less blackening of utensils:** More than 20% of the households liked it because utensils blackened less.

TOP REASONS WHY USERS DISLIKED IT\*\*

- **Too heavy and difficult to move:** More than 30% of the users complained about the cookstove being too heavy and not easy to move. They also pointed to the lack of handles in this model.
- **Small combustion chamber:** Many households wanted a bigger combustion chamber.

\* A score of 7 was assigned whenever a household gave the top ranking to a cookstove model, 6 if ranked 2<sup>nd</sup>, 5 if ranked 3<sup>rd</sup> and so on. The model ranked at the bottom was assigned a score of 1. The average ranking score was calculated by adding up all ranking scores and dividing the result by the number of households.

\*\* In descending order starting with the reason most frequently cited.

User-ranking - Servals

West Bengal Uttar Pradesh Bihar Overall

OVERALL



DURABILITY



AESTHETICS AND DESIGN



SAFETY



SMOKE EMISSION



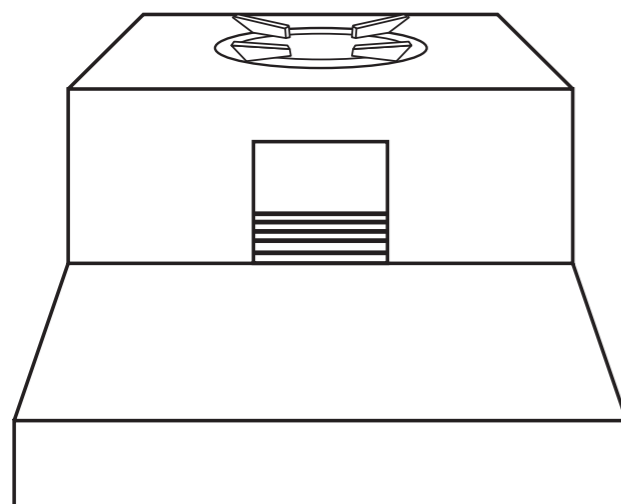
FUEL CONSUMPTION



EASE OF USE



## Bharatlaxmi (Fixed Cookstove)



OVERALL SCORE **4.0/7\***

## STATE WISE SCORE

WEST BENGAL 3.2/7\*

UTTAR PRADESH 5.1/7\*

BIHAR 3.7/7\*

## TOP REASONS WHY USERS LIKED IT\*\*

- **Reduced fuel consumption** – More than 85 % of the users highlighted the reduced fuel consumption in comparison to the traditional cookstoves.
- **Reduced smoke emission** – Majority of the users mentioned reduced smoke as one of the reasons for liking this cookstove.
- **Ability to accommodate various types of fuel** – Almost 30 per cent users across the location explicitly praised Bharatlaxmi cookstove for its ability to accommodate various types of fuel. The design of this cookstove, very similar to that of the traditional cookstoves, allowed people to use firewood, cow dung cake, rice husk and other crop residues. People also liked the fact that it was able to comfortably accommodate different size of firewood.
- **Ability to accommodate different size of utensils** – The cookstove accommodated different size of the utensils and the utensils were stable on it. People managed dishes to be cooked in the utensils without worrying about the instability of the utensils on the cookstove.
- **Easy to cook 'chapatti'** – Some users liked the ease of cooking chapattis on this cookstove.

## TOP REASONS WHY USERS DISLIKED IT\*\*

- **The small combustion chamber** – Almost 30 % of users did not like the small combustion chamber as it used to get filled up quickly by the ashes of burnt cow dung cakes, crop residue and firewood. This was more problematic for people using cow dung cakes. Almost all households who used only cow dung cakes as fuel complained of this; cow dung cake ashes used to fill it up very quickly.
- **The fuel opening is too small** – Some users (around 20 %) said that they did not like the opening for putting fuel in the cookstove. The opening was too small and designed in such a manner that did not allow thick wood pieces.
- **It has only one burner** – Some users complained that this cookstove has only one burner.

\* A score of 7 was assigned whenever a household gave the top ranking to a cookstove model, 6 if ranked 2<sup>nd</sup>, 5 if ranked 3<sup>rd</sup> and so on. The model ranked at the bottom was assigned a score of 1. The average ranking score was calculated by adding up all ranking scores and dividing the result by the number of households.

\*\* In descending order starting with the reason most frequently cited.

## User-ranking - Bharatlaxmi

West Bengal Uttar Pradesh Bihar Overall

## OVERALL



## DURABILITY



## AESTHETICS AND DESIGN



## SAFETY



## SMOKE EMISSION



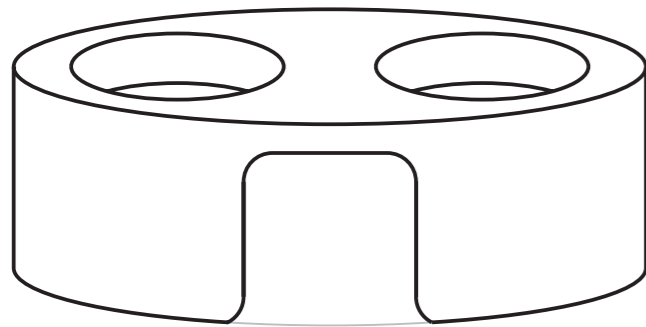
## FUEL CONSUMPTION



## EASE OF USE



## Traditional cookstoves



OVERALL SCORE

2.6/7\*

## STATE WISE SCORE

WEST BENGAL 4.8/7\*

UTTAR PRADESH 1.8/7\*

BIHAR 1.4/7\*

## TOP REASONS WHY USERS LIKED IT\*\*

- **Two burners/fast cooking:** Almost every household stated that the two-burner traditional cookstove (which is normally used by every household, in addition to the single-burner traditional cookstove) is the default option for quick cooking. They all resorted to the two-burner traditional cookstove when they needed to cook for large groups or needed to cook fast.
- **Ability to accommodate all kinds of fuel:** The households universally acknowledged that the traditional cookstoves with big chambers and big openings for fuel are comfortable to handle with all types of fuel.
- **Ability to control the flame:** In comparison to ICS, almost all the households stated that they were able to better control the flame by controlling the fuel input or by manipulating the fuel (pulling out/extinguishing a few sticks, if not needed).

## TOP REASONS WHY USERS DISLIKED IT\*\*

- **Too much smoke:** More than 90% of the households said that smoke emission is a concern while cooking on traditional cookstoves.
- **Fuel consumption and arranging the fuel:** Most households complained that the traditional cookstove consumes 'a lot of' fuel and it is a challenge to arrange dry and quick-burning fuel in the rainy season.
- **Lack of portability:** These cookstoves cannot be moved from one place to another.
- **Not good for snacks or quick meals:** Many households highlighted the fact that the traditional cookstove takes too much time to light and is not suitable for making quick meals.

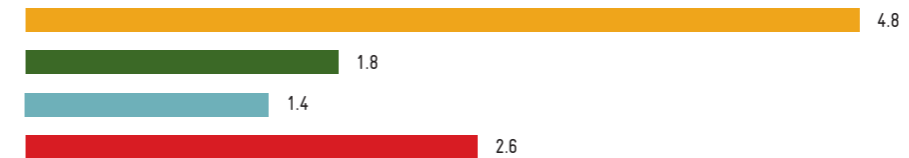
\* A score of 7 was assigned whenever a household gave the top ranking to a cookstove model, 6 if ranked 2<sup>nd</sup>, 5 if ranked 3<sup>rd</sup> and so on. The model ranked at the bottom was assigned a score of 1. The average ranking score was calculated by adding up all ranking scores and dividing the result by the number of households.

\*\* In descending order starting with the reason most frequently cited.

## User-ranking - Traditional cookstoves

West Bengal Uttar Pradesh Bihar Overall

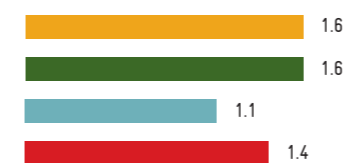
## OVERALL



## DURABILITY



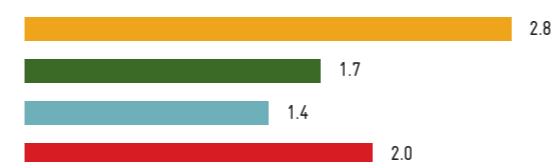
## AESTHETICS AND DESIGN



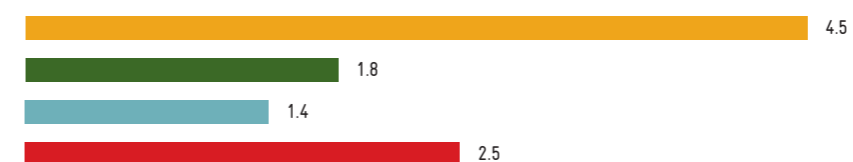
## SAFETY



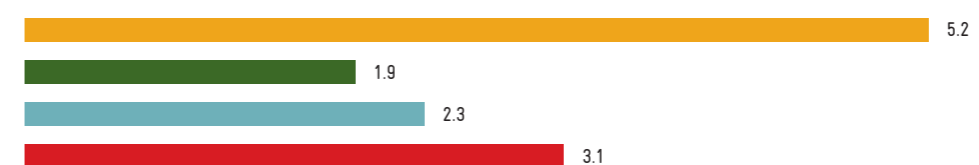
## SMOKE EMISSION



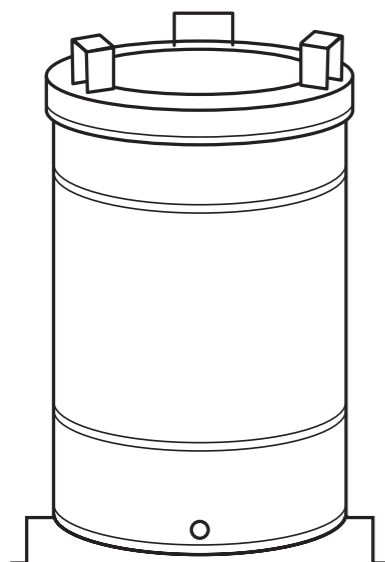
## FUEL CONSUMPTION



## EASE OF USE



## Sampada



OVERALL SCORE **1.8/7\***

## STATE WISE SCORE

WEST BENGAL 1.9/7\*

UTTAR PRADESH 1.3/7\*

BIHAR 2.2/7\*

## TOP REASONS WHY USERS LIKED IT\*\*

- **Ability to reduce fuel consumption:** 20% of the users appreciated the reduced fuel consumption. However, more than 40% said that the stove consumes more fuel than a traditional cookstove.
- **Good flame:** Approximately 10% of the users said that the cookstove easily produced a strong flame.
- **Attractive design:** Some people found the design very attractive.

## TOP REASONS WHY USERS DISLIKED IT\*\*

- **The cookstove is too high:** More than 45% of the users found the cookstove to be too high. Since most of the users cook while sitting on the ground, the stove was too high for them to be able to stir the food or even to inspect the food being cooked.
- **Consumes too much fuel:** More than 40% of the users said that the stove consumes more fuel.
- **Utensils are not stable:** Almost one third of the users said that the utensils are not stable on this cookstove.
- **Difficult to move:** Many users complained about lack of handles and said that the stove was difficult to move.
- **More smoke:** Around 25% of the users did not like it because it emitted more smoke than traditional cookstoves.

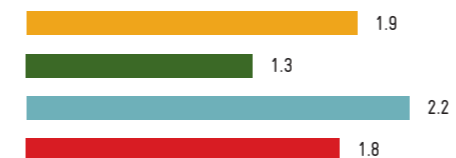
\* A score of 7 was assigned whenever a household gave the top ranking to a cookstove model, 6 if ranked 2<sup>nd</sup>, 5 if ranked 3<sup>rd</sup> and so on. The model ranked at the bottom was assigned a score of 1. The average ranking score was calculated by adding up all ranking scores and dividing the result by the number of households.

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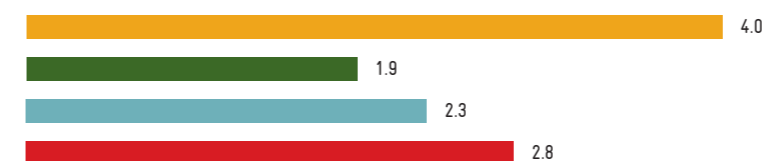
## User-ranking - Sampada

West Bengal Uttar Pradesh Bihar Overall

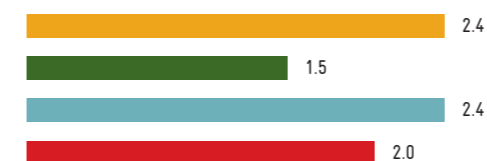
## OVERALL



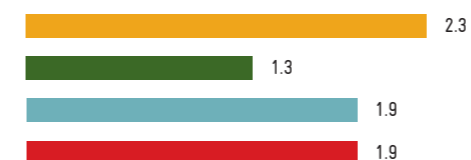
## DURABILITY



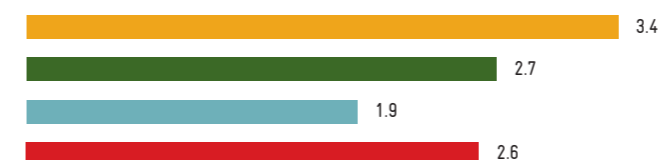
## AESTHETICS AND DESIGN



## SAFETY



## SMOKE EMISSION



## FUEL CONSUMPTION



## EASE OF USE



## Annex 2: Household Survey Questionnaire

This questionnaire was translated into local language and was administered using digital data collection devices.

**Note to the data collector/interviewer:** The survey is part of the study that aims to gain insights into the users' preferences towards different cookstoves as well as factors that may affect the adoption of different cooking technologies. You should explain the purpose of the study as well as any other questions that the household members ask regarding the study or the data collection process. In case the household members have more questions you give them the contact details of your supervisor or manager for more information. Please do not promise any monetary rewards for participating in the survey and in case household members demand a reward, make it clear that there will not be any. You should also mention that the data collected through the questionnaire will not be used for any other purpose than above mentioned study.

<b>Questionnaire/Household ID:</b> .....		
The data collector should fill the details about the village and his / her own contact details for records. Every questionnaire must have this section properly filled and signed before the start of the survey.	Village	
	District	
	Date of interview	
	Name of the surveyor / data collector	
	Mobile Ph:	
	Signature of the data collector	

Question	Remarks	
1. Name of the household head (enter the name in clear hand writing)		
2. Gender of the household head	Male (1)	Female (2)
3. Age of the household head		
4. Address / contact details for household		
5. Contact number for household / household head (skip the next question if the respondent did not provide any landline or mobile contact number)		
6. Is the given contact number the number of this household /family member or neighbor/friend?	Household (1)	Neighbor / friend (2)
7. Name of the respondent (if household head is the respondent skip this question and next 3 questions)		
8. Gender of the respondent (to be skipped if respondent is household head)	Male (1)	Female (2)
9. Gender of the respondent (to be skipped if respondent is household head)	Male (1)	Female (2)

Question	Remarks						
10. Contact number (please write 00, if respondent does not have a contact number)							
How many members are in this household? (only include members who permanently live here and exclude family members who stay somewhere else most of the time)							
11. Adult male (please enter the number of male members)							
12. Adult female (please enter the number of female members)							
13. Male below 18 years (please enter the number of male below 18 years)							
14. Female below 18 years (please enter the number of female below 18 years)							
15. Please tell us how many members of this household have any income?							
16. What is the highest level of education that any household member has got? (please see the code and enter the response accordingly)  Enter one answer only.	Illiterate	1					
	Can read and write	2					
	Primary School (up to class 5)	3					
	10 <sup>th</sup> Pass	4					
	Intermediate	5					
	Graduation	6					
	Masters	7					
	Professional (engineer, doctor, lawyer, etc)	8					
What are the major income sources for this household? (Please select only one option for each category, for example select only one source for primary and so on)							
	Agriculture	Daily Wage	Daily Shop-keeping / Small Business	Labour, Fields, Others	Private Salaried Job	Govt. Salaried Job	
17. Primary	1	2	3	4	5	6	
18. Secondary	1	2	3	4	5	6	
19. Tertiary	1	2	3	4	5	6	
20. How many acres of land do you cultivate? (Please enter the response in numbers, enter '000' in case the household does not cultivate)	_____ Acres						





Question	Remarks	
50. In your house do you use fixed or portable electric light (electric light, solar light or battery based homelight etc)?	Yes (1)	No (2)
51. If yes, do you use these lights for more than 4 hours per day?	Yes (1)	No (2)
52. Is your house warm enough all year round without heating?	Yes (1) – skip next question	No (2)
53. If no - do you have purpose built heating device or heating stove?	Yes (1)	No (2)
54. Do you use an appliance such as refrigerator or cooling box to keep cooked food in your house most of the time?	Yes (1)	No (2)
55. Is your house cool enough all year round without cooling?	Yes (1) – skip next question	No (2)
56. If no - do you use an air cooling device such as electric fan or air conditioner?	Yes (1)	No (2)
57. Please let us know if your household has access to electricity through grid, battery, solar energy. (Note to surveyor: You need to discuss all the options given before ticking the final response – only one response! These options should be read out and explained to the respondent. Tick only one response)	No access to electricity at all	0
	Access to third party battery charging only /Household uses battery based devices and charges battery from other places.	1
	Access to stand-alone electrical appliance (eg solar lantern, solar phone charger) / Household uses these devices and charges using the inbuilt chargers.	2
	Own limited power access for multiple home applications (eg Solar Home Systems or power-limited off-grid)	3
	Has electricity connection but the electricity supply is not regular and adequate.	4
	Reliable AC connection available for all uses	5
58. Please let us know if you use any mechanical device for milling (rice, flour), water, grinding, pressing, de-husking of grains, drilling etc. (Note to surveyor: You need to discuss all the options given before ticking the final response. These options should be read out and explained to the respondent. Tick only one response)	No household access to tools or mechanical devices.	0
	Simple mechanical devices are available.	1
	Mechanical advantage devices that help in getting jobs done easily and safely.	2
	Powered mechanical devices available for some household tasks	3
	Powered mechanical devices available for most household tasks	4
Mainly purchasing mechanically processed goods and services.	5	

Question	Remarks	
59. Have you sought loan from any bank / organization/individual?	Yes	1
	No (if no, please skip the next questions)	2
60. Where or to which institution did you go for a loan? (Tick as many as applicable)	Government Bank	1
	Private Sector Bank	2
	Micro-finance Institution	3
	SHG	4
	NGO	5
	Money lenders (who charge interest)	6
	Others	7
61. Do you save the extra money / cash that you gather with you?	Yes	1
	No	2
62. Please tell us who decides about the financial matters (regarding purchase, expenditure, saving, etc.) in this household? (Tick only one)	For marriage of family members	1
	For medical treatment	2
	For education of family members	3
	For buying land	4
	For building toilets	5
	For house	6
	For purchase of ornaments	7
	For purchase of television	8
	For purchase of LPG	9
	For purchase of mobile phone	10
	For purchase of solar lights	11
	For purchase of improve cookstoves	12
	For purchase of motorcycle	13
Any other (please provide the details)	_____	
63. How do you save your money? (Tick as many as applicable)	Government Bank	1
	Private Bank	2
	SHG	3
	Cooperative Bank	4
	Any other institution that provides interest	5

Question	Remarks					
	Keep in cash at home	6				
	Buy gold / ornaments and keep at home	7				
	Others	8				
64. Please tell us who decides about the financial matters (regarding purchase, expenditure, saving etc) in this household? (Tick only one)	Household head	1				
	Myself	2				
	My spouse	3				
	My father / father in law	4				
	My mother / mother in law	5				
	My kids (son or daughter)	6				
	Others	7				
Please tell us where you cook your daily food in different seasons? (Note to surveyor: We assume that surveyed might be cooking in more than one location in each season, and we want to capture the information accordingly. Read out all options and ask separately for each season and tick one for each location. When they only use one location, only tick "Most times" in the mentioned location)						
	In separate kitchen	In other closed room inside house	In kitchen outside house	In other closed room outside house	In courtyard / open space inside house	Open space outside house
<b>Rainy Season</b>						
65. Most times	1	2	3	4	5	6
66. Some times	1	2	3	4	5	6
<b>Winter</b>						
67. Most times	1	2	3	4	5	6
68. Some times	1	2	3	4	5	6
<b>Summer</b>						
69. Most times	1	2	3	4	5	6
70. Some Times	1	2	3	4	5	6
71. How many times do you cook daily? (Tick only one)	Once					
	Twice					
	Thrice					
	More than three times					
How much time do you spend on cooking every day? Please tell us the time spent every time you cook in a day? (Note to surveyor: Please enter the response in minutes)						
72. Morning (in minutes)						

Question	Remarks		
73. Evening (in minutes)			
74. Other than morning and evening (in minutes)			
Please let us know which cookstoves you have in your house?			
Please read the cookstove code carefully and enter the responses in the space provided?			
<b>Code for Cookstoves:</b>			
<b>0</b> - Open fire / three stone fire	<b>4</b> - Improved cookstove one burner	<b>8</b> - LPG cookstove one burner	
<b>1</b> - Traditional potter cookstove one burner	<b>5</b> - Improved cookstove two burner	<b>9</b> - LPG cookstove two burner	
<b>2</b> - Traditional potter cookstove two burner	<b>6</b> - Kerosene cookstove	<b>10</b> - Other	
<b>3</b> - Portable traditional cookstove	<b>7</b> - Electric cookstove		
	a. Cookstove Code	b. How many	c. Average Price of each cookstove
75. Cookstove 1			
76. Cookstove 2			
77. Cookstove 3			
78. Cookstove 4			
Please let us know which cookstoves you use in different seasons? (Not to surveyor: We want to know the preference for different cookstove in different seasons in case a household uses more than one cookstoves. Please use the code from previous questions to fill the responses.)			
79. Primary	a. Rainy	b. Winter	c. Summer
80. Secondary			
81. Tertiary			
82. Primary Fuel	83. Secondary Fuel	84. Tertiary Fuel	Name of the Fuel (Cow Dung - 0, Firewood - 1, Husk - 2, Leaves - 3, Other Agriculture Residue - 4, LPG - 5, Kerosene - 6, Charcoal - 7, Coal - 8, Briquette - 9)
			Monthly consumption in unit (mention unit) (A)
			Purchased quant (mention units) (B)
			Purchase price per unit (C)
			Collected quantity (in unit) (D)
			Time spent in collection in hours per visit (E)
			Money spent in collection (F)
			How often do you collect in a month (enter number only) (G)
			Collection by male / female (H)

Question			Remarks
Please tell us about the different fuels that use for cooking in winter season			
85. Primary Fuel	86. Secondary Fuel	87. Tertiary Fuel	Code for fuels: (Cow Dung - 0, Firewood - 1, Husk - 2, Leaves - 3, Other Agriculture Residue - 4, LPG - 5, Kerosene - 6, Charcoal - 7, Coal - 8, Briquette - 9)
			Monthly consumption in unit (mention unit) (A)
			Purchased quant (mention units) (B)
			Purchase price per unit (C)
			Collected quantity (in unit) (D)
			Time spent in collection in hours per visit (E)
			Money spent in collection (F)
			How often do you collect in a month (enter number only) (G)
			Collection by male / female (H)
Please tell us about the different fuels that use for cooking in summer season			
88. Primary Fuel	89. Secondary Fuel	90. Tertiary Fuel	Name of the Fuel (Cow Dung - 0, Firewood - 1, Husk - 2, Leaves - 3, Other Agriculture Residue - 4, LPG - 5, Kerosene - 6, Charcoal - 7, Coal - 8, Briquette - 9)
			Monthly consumption in unit (mention unit) (A)
			Purchased quant (mention units) (B)
			Purchase price per unit (C)
			Collected quantity (in unit) (D)
			Time spent in collection in hours per visit (E)
			Money spent in collection (F)
			How often do you collect in a month (enter number only) (G)
			Collection by male / female (H)
Let us know what are the dishes you prepare daily? (Please tick)			
91. Morning	92. Evening	93. Other than Morning & Evening	
			Rice (1)
			Dal (2)
			Chapatti (3)
			Boiled vegetables (4)
			Fried Vegetables (5)

Question			Remarks
			Chicken (6)
			Mutton (7)
			Fish (8)
			Tea (9)
			Boiling milk/water (10)
			Others (99)
Please let us know what are your major concerns / problems / comments about your cooking experience? (Do not read out options to respondent) (Tick all applicable)			
94. Main Cook-stove	95. Secondary Cookstove (if used)	96. Tertiary Cookstove (if used)	
1	1	1	I do not have any problem.
2	2	2	The cooking process takes a lot of time.
3	3	3	The cookstoves give a lot of smoke.
4	4	4	I have to spend a lot of time on fuel collection.
5	5	5	I have to travel long distances to collect fuel.
6	6	6	The cookstove consumes a lot of fuel.
7	7	7	The cookstove does not allow me to cook all kindS of foods that I want.
8	8	8	The cookstove takes a lot of time in lighting.
9	9	9	It is difficult to control the fire in my existing cookstove.
10	10	10	It is difficult to cook on the cookstove in some seasons.
			Others _____
If you have to improve your cookstove or make a better cookstove, what features would you have in your cookstove? (Do not read out all the options. Put (1) in for all options/features cited. Otherwise enter '0')			
97.			Less smoke
98.			Less consumption of fuel
99.			Ability to control fire
100.			Easy to light
101.			Ability to accommodate multiple type of fuel
102.			Ability to accommodate multiple type of vessels
103.			Should be more durable
104.			Should be portable

Question	Remarks	
105.	Should be aesthetically appealing	
106.	Faster cooking	
107.	To cook more kinds of foods	
108.	Should be like LPG	
109.	More burners	
110.	Others	
111. How do you feel about the safety of cooking facilities in your household?	Very safe	
	Ok - but would like to improve	
	Rather dangerous	
	Very dangerous	
	Don't know	
112. We are conducting a study, in which we would be giving improved cookstoves to households in this village to use for cooking and to receive feedback from these households on the cooking experience on these cookstoves. This study will be of 6-7 weeks duration and during this period you will use 5 portable and one fixed cookstove for one week each. Every week you would be given a different model of cookstove and you will be requested to give feedback on your experience. At the end of the period, you will have a group meeting to discuss about all the cookstoves.  You will not be required to pay any money for the cookstoves that you will use. One of these stoves will be a fixed stove installed in your kitchen. After the study you can keep this stove free of cost.  All the participating households in the study will receive a gift as a token of appreciation and the households with best cooperation and participation in the study will get extra rewards.  In this study, the selection of the participating households will be done through a lottery. Do you want to participate in the lottery and eventually take part in the study if you get selected in the lottery?	Yes	1
	No	2

### Annex 3: Weekly Feedback

Weekly feedback data was collected using a translated version of this questionnaire.

Question	Remarks				
Village name					
Household ID					
Date					
Cookstove model					
1. How do you rate this cookstove for ease of cooking, in comparison with the traditional cookstoves?  Why:	Much Better	Better	Same	Slightly Worse	Much Worse
2. How do you rate this cookstove for fuel consumption in comparison with the traditional cookstoves?	Much Less	Less	Same	More	Much More
3. In your opinion, how do you rate the smoke emission from the cookstove in comparison with the traditional cookstoves?	Much Less	Less	Same	More	Much More
4. How does the food cooked on this cookstove taste in comparison with the traditional cookstoves?	Much Better	Better	Same	Slightly Worse	Much Worse
5. How do you rate the durability of the cookstove in comparison with cookstove?	Much Better	Better	Same	Slightly Worse	Much Worse
6. Is this cookstove easy to move from one place to another while it is lighted?	Yes	No			
7. How do you like the design and look of the cookstove in comparison with traditional cookstove?	Much Better	Better	Same	Slightly Worse	Much Worse
8. How much time on average did you spend on cooking your food daily in comparison with traditional cookstove?	Much Less	Less	Same	More	Much More
9. Time taken to cook the food in minutes	Morning	Evening	Others		
10. Does this cookstove accommodate all of your regular cooking utensils?	Yes	No			

Question	Remarks					
11. Do you have any difficulty in lighting the cookstoves?	Yes	No				
12. Are you able to regulate the heat/flame of the cookstove?	Yes	No				
13. Please tell us the two features that you liked of this cookstove?	1	2				
14. Please tell us the two features of this cookstove that you did not like?	1	2				
15. Any other feedback on your cooking experience?						
16. Stove appearance (to be observed, not to be asked)	Broken	Partly Broken	Not Broken	Regularly Used	Seldom Used	Not Used
17. Any other observations:						

### Annex 4: Ranking Card

The ranking cards based on the following format were developed and translated in to local languages. The final designed card had picture of each model of the ICS for easy identification and recall.

Question	Remarks				
	Greenway Smart Stove	Servals Woodstove	Envirofit M5000	Sampada Gasifier Stove	Bharat Laxmi
Ease of Cooking					
Consumption of Fuel					
Emission of Smoke					
Food Quality					
Safety					
Aesthetics					
Durability					









# Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

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