

# Indoor Air Pollution in India

*User acceptance of improved stoves in Uttar Pradesh, Bihar and West-Bengal*

*Bonn International Cooking Energy Forum, June 27<sup>th</sup>, 2013*

*Gaurav Mehta & Vinay Jaju*



# Agenda

- Indoor Air Pollution and cooking practices in India
- User Acceptance Study Overview
- Research and Findings
- Way Forward

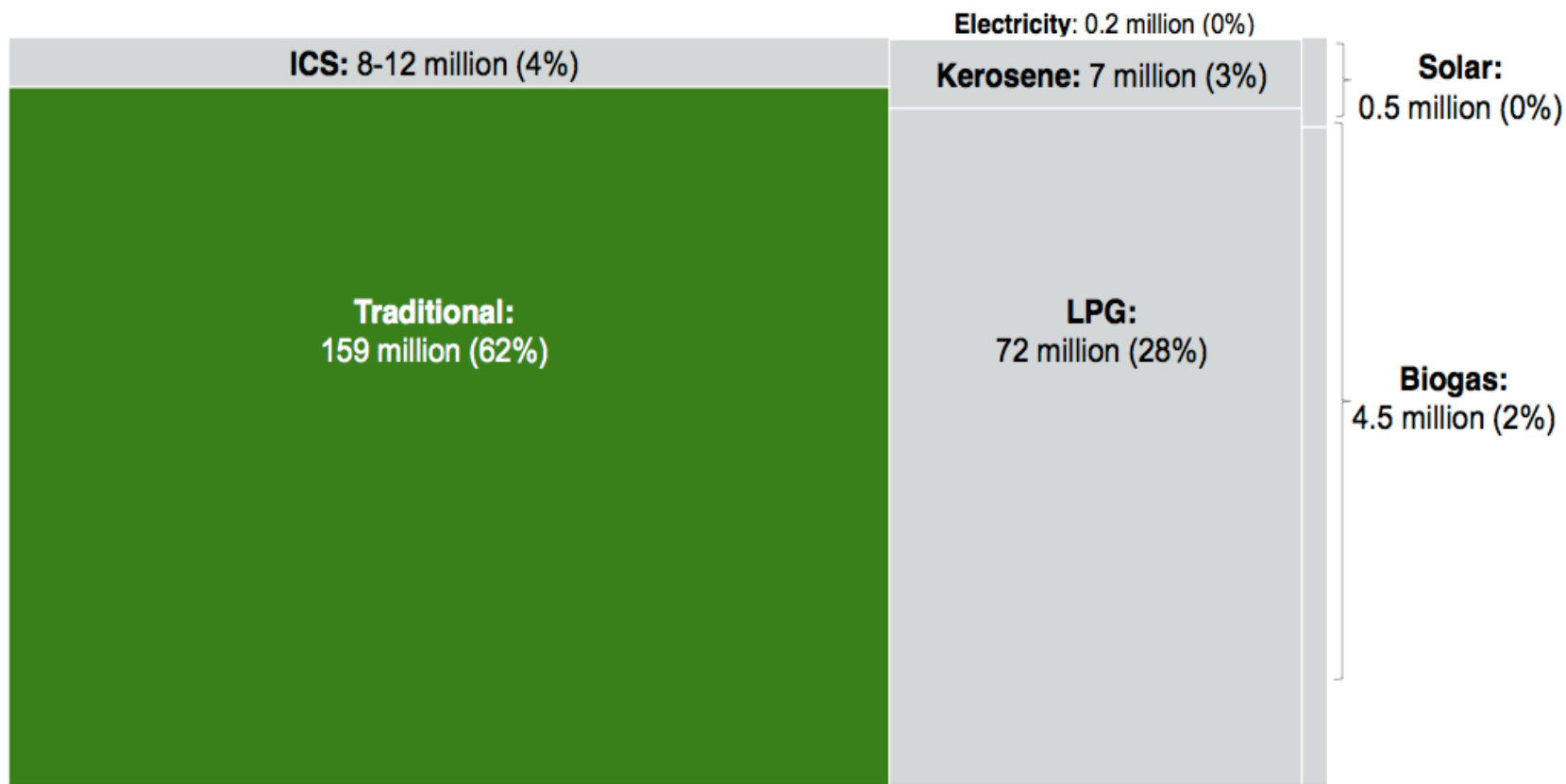


# India contributes to nearly 0.5m deaths due to Indoor-Air Pollution (IAP) per annum

- Almost 900 million people in India depend on traditional biomass for cooking energy.
- More than 90% of the above mentioned households use traditional inefficient cookstoves.
- As per WHO, 488,200 deaths per year in India can be attributed to IAP.
  - In India 400 million people are exposed to negative impacts of IAP (GACC, 2013).
  - Inefficient cookstoves lead to women spending 5-8 hours in cooking daily (GACC, 2013).



# Improved cookstoves have achieved an extremely limited penetration so far (c. 4%)



**Solid fuel**  
~170 mn HH (~67%)











**Modern fuel**  
80 mn HH (~31%)

**Renewable fuel**  
5 mn HH (~2%)



# Food habits and dishes significantly vary from one state to another

## “Food zone” classification in India

Zone	Staple food	Accompaniments	Key cooking activities	Equipment	Heat intensity
<b>North</b> 	<ul style="list-style-type: none"> <li>• <b>Thick rotis</b> (tandoori rotis, naan, paratha)</li> </ul>	<ul style="list-style-type: none"> <li>• Meat</li> <li>• Vegetables</li> <li>• Dairy products</li> </ul>	<ul style="list-style-type: none"> <li>• Baking</li> <li>• Boiling</li> <li>• Frying</li> </ul>	<ul style="list-style-type: none"> <li>• Kadhai</li> <li>• Tava</li> <li>• Smoke oven</li> </ul>	
<b>Central</b> 	<ul style="list-style-type: none"> <li>• <b>Thin rotis</b> (roti and chapati)</li> </ul>	<ul style="list-style-type: none"> <li>• Dal</li> <li>• Lentils</li> <li>• Vegetables</li> </ul>	<ul style="list-style-type: none"> <li>• Baking</li> <li>• Boiling</li> <li>• Frying</li> </ul>	<ul style="list-style-type: none"> <li>• Tava</li> <li>• Kadhai</li> </ul>	
<b>East</b> 	<ul style="list-style-type: none"> <li>• <b>Rice</b></li> </ul>	<ul style="list-style-type: none"> <li>• Fish</li> <li>• Meat</li> <li>• Vegetables</li> </ul>	<ul style="list-style-type: none"> <li>• Frying</li> <li>• Grilling</li> <li>• Steaming</li> </ul>	<ul style="list-style-type: none"> <li>• Pots</li> <li>• Kadhai</li> <li>• Smokehouse</li> </ul>	
<b>West</b> 	<ul style="list-style-type: none"> <li>• <b>Thick rotis</b> (chapati, millet rotis)</li> </ul>	<ul style="list-style-type: none"> <li>• Vegetables</li> <li>• Lentils</li> <li>• Seafood</li> <li>• Dairy products</li> </ul>	<ul style="list-style-type: none"> <li>• Baking</li> <li>• Boiling</li> <li>• Frying</li> </ul>	<ul style="list-style-type: none"> <li>• Tava</li> <li>• Kadhai</li> </ul>	
<b>South</b> 	<ul style="list-style-type: none"> <li>• <b>Rice</b></li> <li>• <b>Dosa</b> (rice pancake)</li> </ul>	<ul style="list-style-type: none"> <li>• Dal</li> <li>• Lentils</li> <li>• Vegetables</li> <li>• Dairy products</li> </ul>	<ul style="list-style-type: none"> <li>• Boiling</li> <li>• Frying</li> <li>• Steaming</li> </ul>	<ul style="list-style-type: none"> <li>• Pots</li> <li>• Tava</li> <li>• Kadhai</li> </ul>	

# There are significant challenges in ICS adoption

## Demand

- Poor awareness about IAP
- High upfront cost and lack of access to finance
- Diverse fuel mix and usage pattern

## Supply

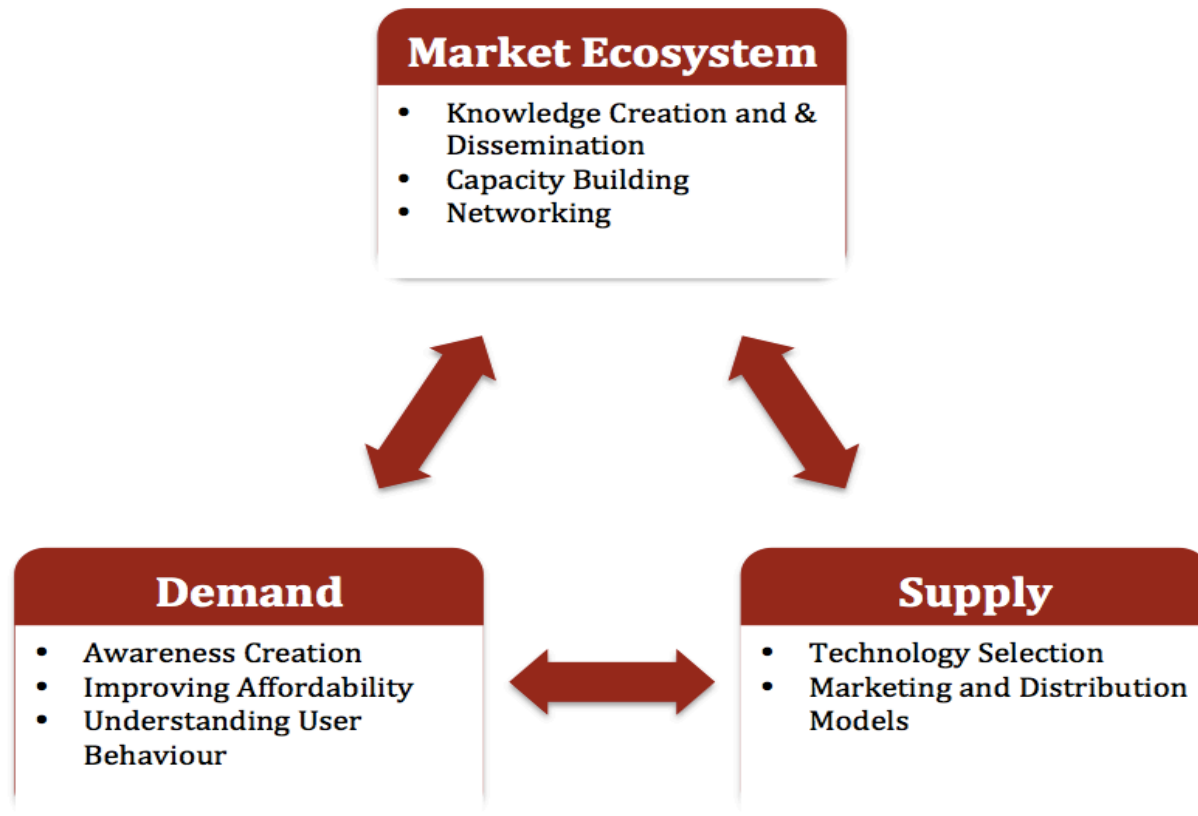
- Lack of appropriate stove technologies
- Technology centric dissemination strategy
- Lack of economically viable business models

## Market Ecosystem

- Inadequately developed ecosystem



# The GIZ approach is focused around evaluating all three dimensions



# Project Dharma and Switch ON are working with GIZ

*ONergy - Switch ON is a hybrid social enterprise creating an ecosystem for deployment of complete energy solutions across East India, and creating a linkage between energy access, income generation and community development. Switch ON (Environment Conservation Society) is the not for profit arm that creates an ecosystem to facilitate last mile access to energy and promote livelihoods through rural energy entrepreneurship by training, capacity building and supporting / facilitating innovation.*

*Gajam India Pvt Limited (GIPL) / Project Dharma is a social enterprise that aims to create sustainable livelihoods by creating entrepreneurs, who provide socially impactful products to consumers at the base of the pyramid at an affordable cost. The organisation aims to create 100,000 rural entrepreneurs by 2020 and have a significant 5 key social cause of Indoor-Air-Pollution, Access to Energy, Access to safe drinking water, health/hygiene and malnutrition*





# Agenda

- Facts around Indoor Air Pollution
- ***User Acceptance Study Overview***
- Research and Findings
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# We designed a user acceptance test to better understand the barriers to adoption

## The Context

- Technology centric dissemination strategies have not worked.
- Understanding user preferences in the geographical and socio-economic context is critical for better adoption.

## Objectives

- Identification of the better suited ICS on the basis of user preferences, local resources and cooking.
- Understanding consumer preferences for different types of technologies.



# We selected 3 states with a low LPG penetration

	Uttar Pradesh	Bihar	West Bengal
Population	199 mn	103 mn	91 mn
Household Size	5.7	5.4	4.5
Major Fuels Used	Firewood, Cow Dung Cakes	Firewood, Cow Dung Cakes	Firewood, Cow Dung Cakes
LPG Penetration	<20%	<15%	<20%



# A simple methodology was designed to test a variety of stoves for user testing across the different geographies

- The Acceptance Test Study Design consisted of
  - A baseline survey (320 Households)
  - Testing of cookstoves (180 households)
  - Comprehensive feedback using quantitative and qualitative research tools
  - Auction of Used Cookstoves
- Two locations from each states were selected.
  - 50 households were randomly selected for baseline, 30 (out of 50) selected for user testing.
- A rotation matrix was used to negate the effect, if any, of the order in which the household received the cookstoves.

HHs	H1	H2	H3	..	H29	H30
<b>Wk 1</b>	M1	M2	M3	M1		M5
<b>Wk 2</b>	M2	M3	M4	M2		M1
<b>Wk 3</b>	M3	M4	M5	M3		M2
<b>Wk 4</b>	M4	M5	M1	M4		M3
<b>Wk 5</b>	M5	M1	M2	M5		M4
<b>Wk 6</b>	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed



# A cross section of ICS with different technologies were selected

- Each household used every cookstove model for a week.
- 5 portable and 1 fixed ICS cookstove selected for the study. Selection criteria were:
  - Efficiency and Emission Test Data
  - Suitability to local fuel use
- Each household compared these ICS models to other ICS models as well as against the traditional cookstoves they have been using.
- User Feedback collected through detailed questionnaires and 10 Focus Group Discussions.
- Auctions were conducted to triangulate the user preferences.
  - Used cookstoves were auctioned at discounted prices.

## Selected ICS Models



**Bharat Laxmi**



**Chulika**



**Envirofit M5000**



**Gram. Greenway**



**Sampada**



**Servals**

# Agenda

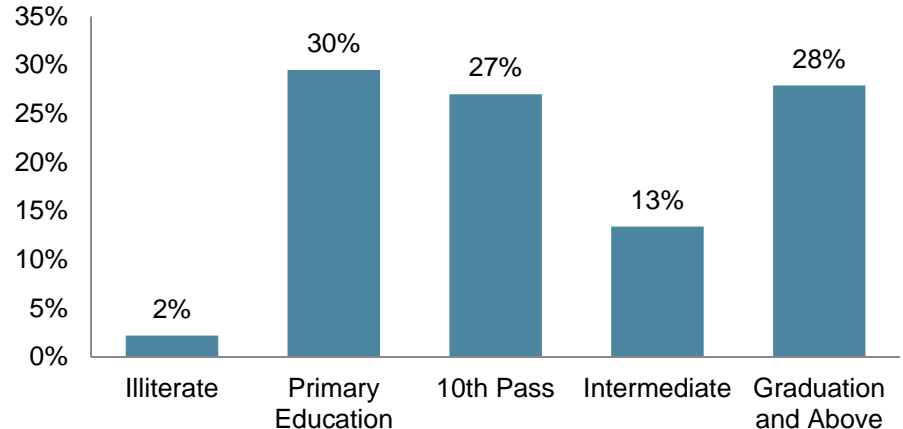
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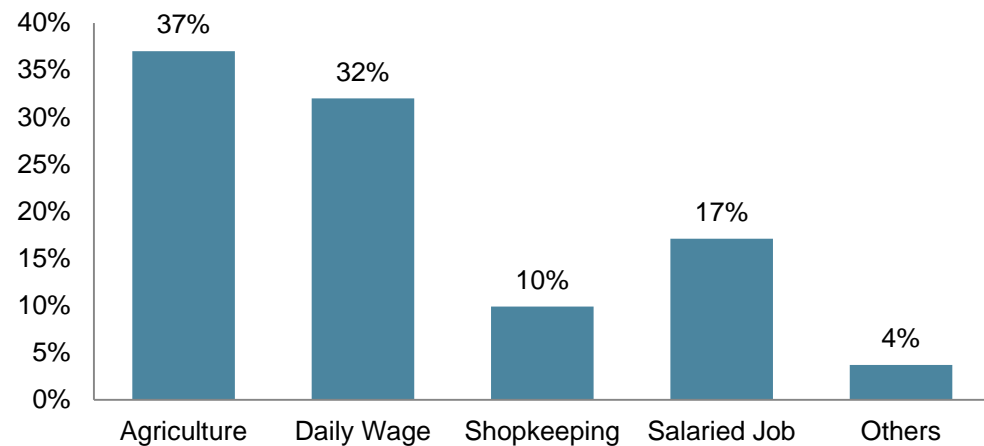
# Socio-Economic profile of participating HHs

- The average household size was 6.7
- Almost all (98%) HHs have at least one member who received primary education.
- The average stated monthly income is approximately INR 7.5 K. (105 Euro). At least 25% HHs were earning less than INR 4k (57 Euro).

Highest Education Level in each Household



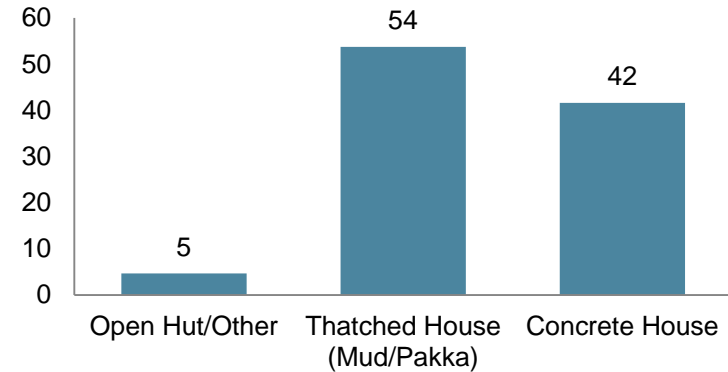
Primary Source of Income in Households



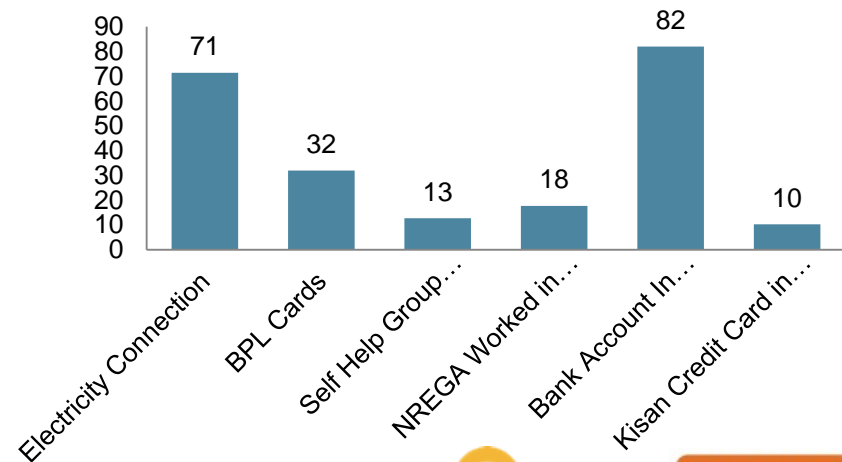
# Socio-Economic profile of participating HHs

- 99% household are living in their own houses.
- Around 80 % of these households save money for future.
- 85% of the households save in bank savings account.
- The three main purposes for savings are
  - Education
  - Medical Treatment
  - Marriage

Percentage of Houses of Each Type



Access to Different Services and Govt Benefits

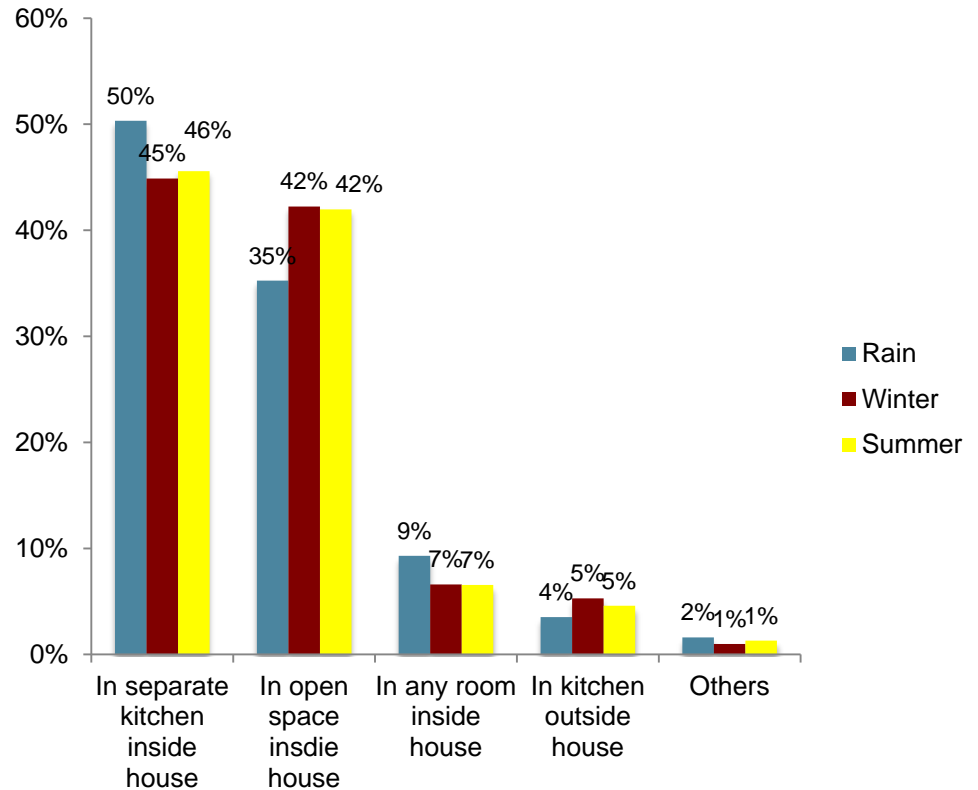




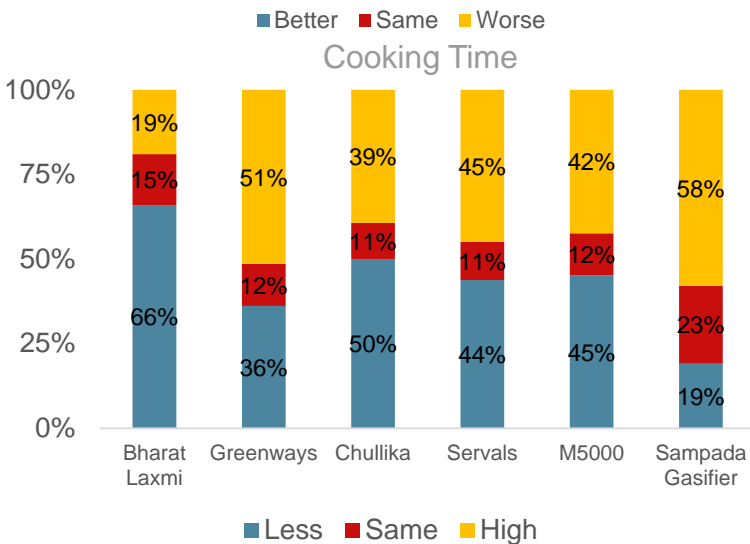
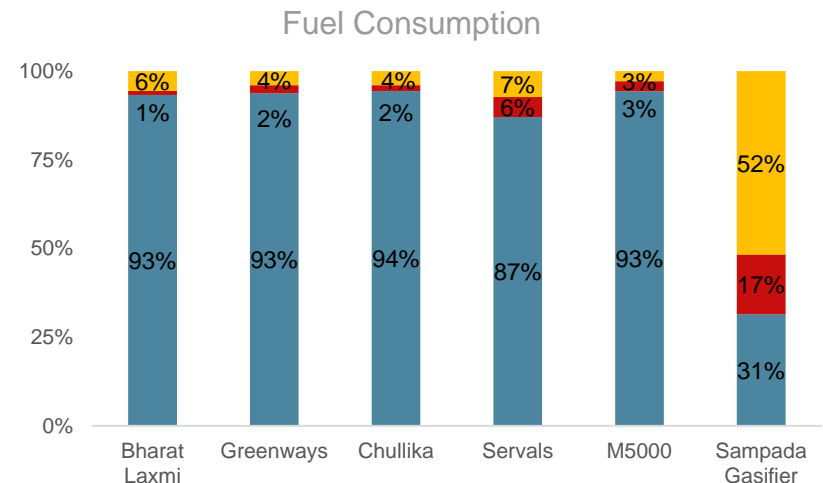
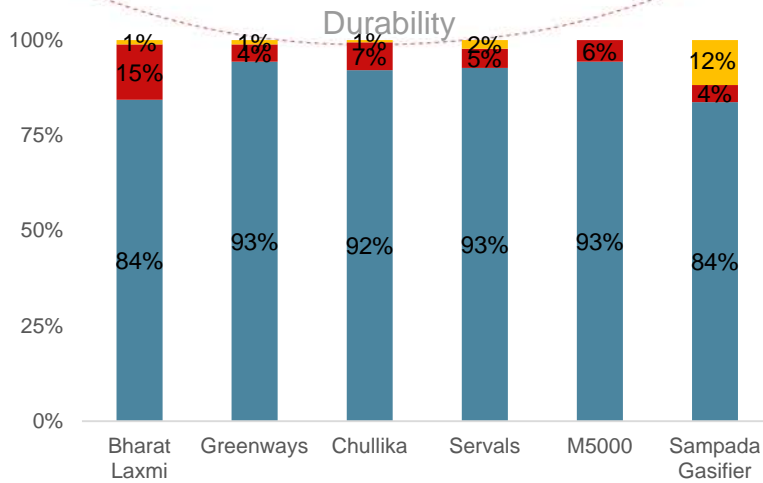
# Cooking Practices

- 78 % of the households cook twice a day while 20% cook three times a day.
- All the households have traditional cookstoves and more than 95% of HHs use the traditional cookstove as their primary cookstoves.
- 12 of the HHs have LPG cookstoves.
- Firewood and Cow Dung cakes are the main fuels for most of the HHs.

Cooking Place



# Efficacy of ICS vs. traditional cookstoves

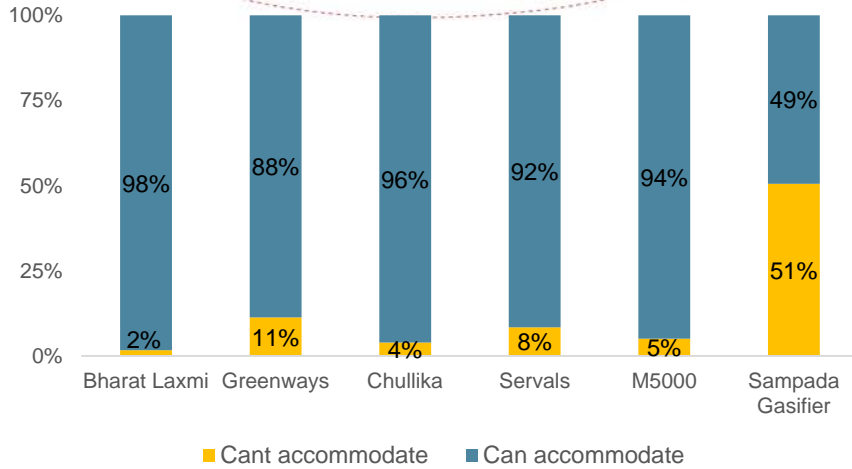


- The time taken to cook was found to be lesser than the traditional cookstoves
- We however believe that on ground the actual usage of these cookstoves was lower, hence the finding may be on grounds of a single burner comparison

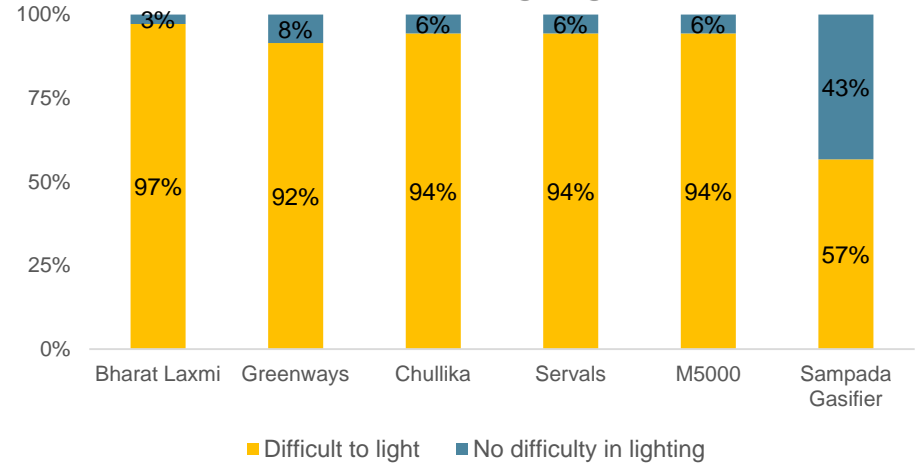


# Usability of ICS vs. traditional cookstoves

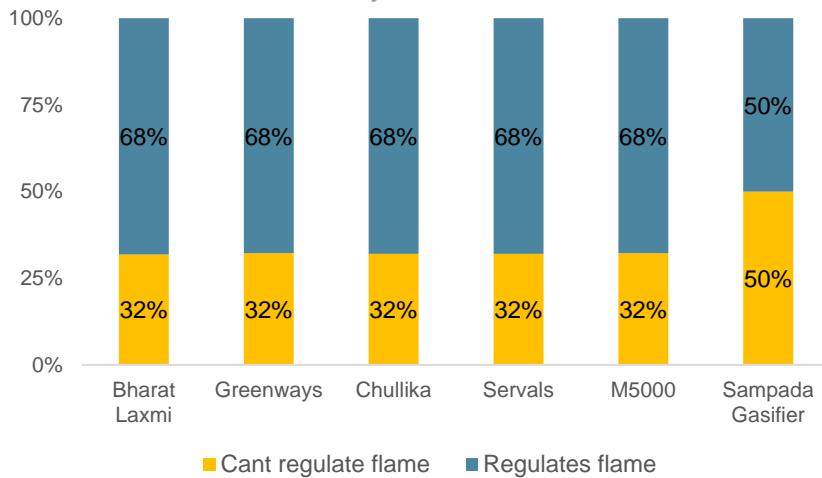
## Ability to put all utensils



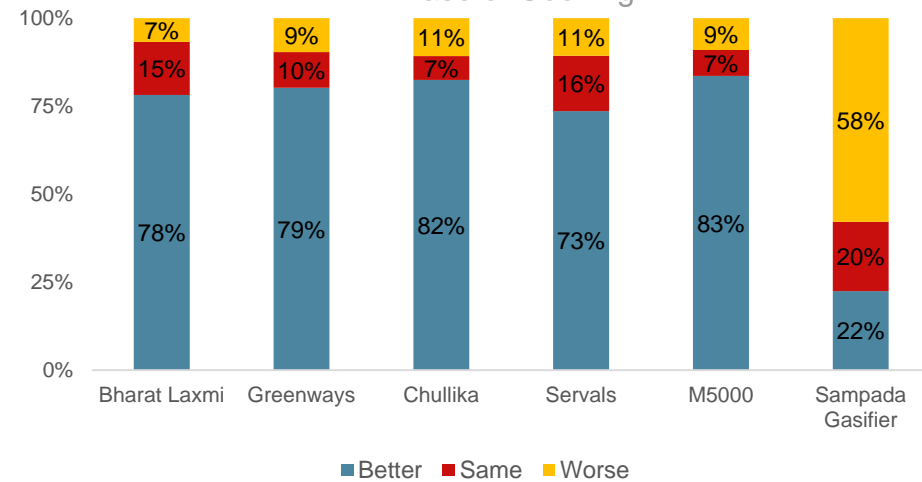
## Issues in lighting



## Ability to control fire

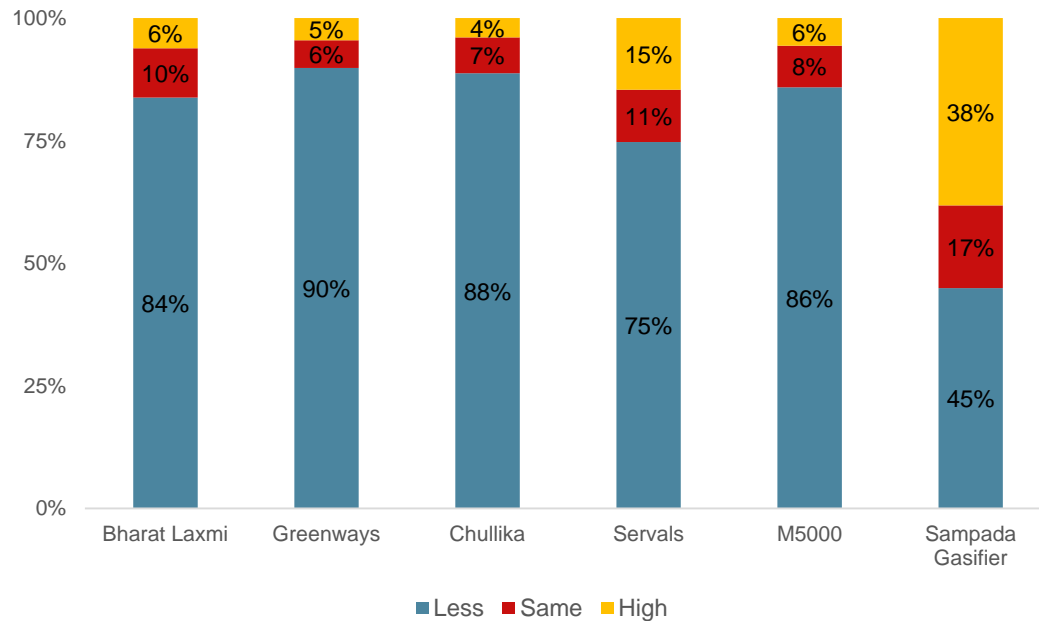


## Ease of Cooking



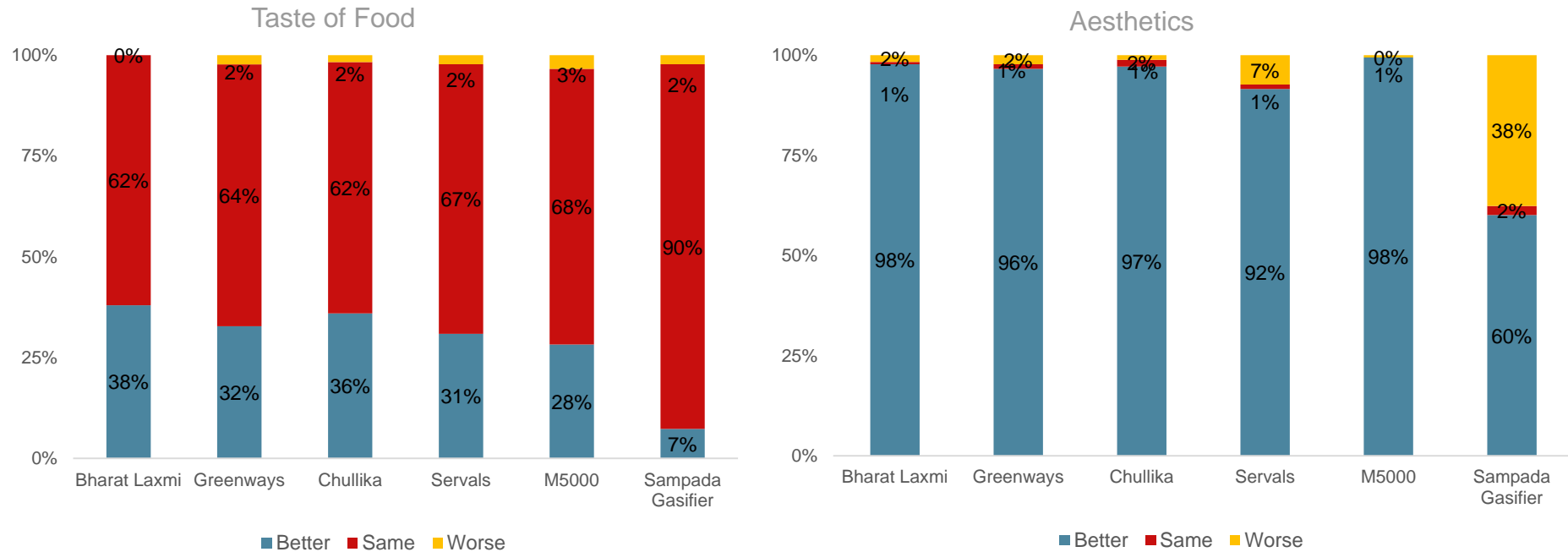
# Health: perceived smoke emissions of ICS vs. traditional cookstoves

Smoke Emissions compared to traditional



- The smoke emissions were felt to be lower for the ICS.
- Though not articulated, most users felt the health benefit from the ICS.

# Preference: ICS vs. traditional cookstoves



- The taste of food was mostly found to be at par with the traditional cookstove.
- The aesthetics of most of the ICS were appreciated by nearly all users.



# ICS - What did the users like?

## Portability

- All users loved the ease of moving the cookstove from one place to another.
- The ability to move the cookstove while it is lighted was sought by many users in all the cookstove after they used the cookstove that allowed them do so.

## Aesthetics

- All ICS models were rated almost universally more aesthetically pleasing in comparison to Traditional Cookstoves.
- Many users wanted to buy them as a gift because they looked really nice.

## Low Consumption of Fuel

- The fuel consumption was lower. Most felt that it was on account of smaller size of combustion chamber.

## Low Smoke and Soot Emission

- The ICS did not cause any blackening of clothes and utensils thus creating lesser work for the house wives.

# ICS – The need for improvements

## Faster Cooking

- The ability to cook faster was one of the most desired improvements in the ICS.
- Many participating households did not cook on ICS in morning as overall cooking took more time in comparison to the two burner traditional cookstoves.
- User believed that the small combustion chamber is the reason for slower cooking. They wanted a bigger chamber.

## Better Fuel Accommodation

- Users complained about the difficulty in using different types and different sizes of fuel.
- The smaller chamber and the small mouth for fuel loading were not liked.
- Users highlighted variation in performance when using different fuel types.

## Ease of Cooking

- Users responded in the surveys about their ability to cook with all types of utensils. However, a detailed exploration in FGDs suggested large utensils were difficult to accommodate.
- Users highlighted difficulty in stirring the food as many utensils (large ones) were not properly balanced.

# ICS – The need for improvements

## Safety

- The metallic bodies of the cookstoves remain hot for quite sometime. Users perceived it as dangerous for small kids.
- Some users reported accidental mild burn because of the metal handles.

## Design Materials

- A segment of users believed that use of plastic restricts them from using these cookstoves in religious functions or cooking for religious purposes.

## Others

- Users often benchmarked performance and features of ICS against LPG.
- No smoke vs. low smoke



# What drives the consumer ranking?

- Binary Logistic Regression was done with overall ranking as the independent variable and ranking on different features as the dependent variables.
  - Confidence Level – 90%
  - Hosmer Lemenshow test for model fitness
- The model was good fit for **four** of the cookstoves but was inconclusive for the **two** cookstoves.
- There was a good fit for the top and the last ranked cookstove.
- The key variables that drove the overall ranking of the top ranked and last ranked cookstoves are :
  - Top Ranked: Safety, Aesthetics, Durability
  - Last Ranked: Taste of food, Aesthetics

# What drives the consumer ranking?

- The aesthetics, durability, taste of food and safety were the major drivers
- The findings for all cookstoves are as below:

Cookstove	Hosmer Lemenshow (at 90% CI)	Variables	Ranked in Top 3
Bharat Laxmi	0.00	Safety, Aesthetics, Durability	34.6%
Greenways	Not Significant	-	45.8%
Chullika	0.066	Safety, Aesthetics, Durability	76.5%
Servals	0.061	Fuel Used, Smoke Emitted, Taste of Food, Aesthetics, Durability	52.5%
M5000	Not Significant	-	49.7%
Gasifier	0.079	Taste of Food, Aesthetics	4.5%

# Next steps and Way forward

- Post Review of the consumer preferences we will look at:
  - Demand generation from an integrated market development approach
    - Focused awareness and marketing campaigns
    - Easy and affordable access to finance for willing customers
    - Increasing the outreach of the ICS products by a cost effective and efficient distribution network





***Thank you for your attention***

