A Study on Variation in Perceptions and Preferences for Cooking Fuel Choice and Cooking Methodologies in Samastipur District of Bihar, India

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Executive Summary

The current study aimed at understanding the perception of households with respect to availability and choice of clean fuel options alongside mapping the value chain of different stakeholders on the supply side. In the present study, clean fuel implies Liquified Petroleum Gas (LPG) as at the moment it is the only clean fuel option that is available in rural India in general and rural Bihar in particular. Major findings of the study are as follows:

- Majority households (61.8 per cent) are dependent on casual labor (agriculture and non-agriculture) as the main source of their income. More than three-fourth (81.8 per cent) of the respondents are landless, followed by marginal farmers (11.2 per cent).
- Average annual income of the surveyed households was about Rs. 67,709.26 in the last year. Expenditure on food and medical expenses account for majority of expenses incurred by the households. Such expenses along side paying monthly instalments for loans in some cases, households are not left with much scope to shift to improved cooking fuel due to financial costs associated with the switch.
- All the respondents use firewood for cooking. Moreover, in several cases villagers depend on a mix of LPG and firewood for cooking. There was hardly any household entirely dependent on LPG for their cooking. However, there were many households that used only firewood as they did not have an LPG connection.
- Firewood is easily available and is free of cost which makes it the preferred choice. Although households are aware about the health benefits of LPG, they are forced to depend on firewood because of high cost of LPG, delay in refill delivery and bureaucratic hassles in taking connection and receiving subsidy.
- Since the LPG distributors are located outside the village so villagers have to wait for a bulk order to receive their refill, otherwise they need to travel several kilometers to the warehouse of the distributor to collect the refill.
- Women in the households are well aware about LPG and its associated benefits. For majority of the women, LPG means that they will not have to go outside for the collection of firewood and also be exposed to less pollution. However, most of the females are not empowered enough within their households to influence decision making as a result despite their preference, they cannot ensure that their households shift to clean fuel.
- Subsidies provided by the government to promote the shift to cleaner fuels does not seem to be enough. This is because the traditional poverty ratio method fails to detect the true extent of deprivation. Under the multidimensional poverty method, two-third of the households are multidimensional poor.
- Only one respondent reported that someone had introduced an improved and less polluting cookstove in the village who belonged to a non-government organization (NGO). The improved cookstove used electricity as fuel. However, the cookstove failed to gain any success because of electricity cost as well as intermittent electricity supply.
- With the proliferation of LPG connection due to Ujjwala Yojana, several market players in terms of cookstove sellers and repair shops, LPG distributors and informal intermediaries have cropped up in the district of Samastipur.
- Cookstove sellers and repair shops not only sell cookstove and other accessories related to LPG, they also provide repair services. In many cases, they are also informal providers of the gas.
- Informal intermediaries are those that either provide gas informally or takes the responsibility of ensuring that the refill reaches the customers. This further adds to the cost of LPG for the households.

1. Introduction

1.1 Background and Context

Indoor air pollution from traditional biomass burning contributes to serious health problems, particularly cancer and respiratory infections. The time required for biomass collection can preclude formal employment outside the household for women, and the cost of purchasing biomass can weigh heavily on household budgets where formal biomass markets exist. Moreover, a growing body of literature suggests that incomplete combustion products and black carbon from traditional biomass burning have a significant contribution to climate change. As per the report of the World Health Organization (WHO), smoke inhaled by women from unclean fuel is equivalent to burning 400 cigarettes in an hour. In addition to this, women and children have to go through the drudgery of collecting wood.

It is in this regard that the prospect of LPG as a cooking fuel gains importance. Being a clean fuel, LPG can create significant improvement in the health parameters of people especially in the rural households who are pre-dominantly dependent on solid fuels for cooking (*Gould C. and Urpelainen J. 2018*). In this regard, the Government of India has been taking several steps so as to incentivise the use of LPG as a cooking fuel. These are as follows:

- *Pradhan Mantri Ujjwala Yojana:* This scheme was launched by the Government of India in the year 2016. BPL families are being provided a financial support of INR 1600 per LPG connection. Since, more often than not, it is the female member of the household who does the cooking, so under the scheme the connection is issued in the name of the woman of the household. Under this scheme, the consumers are also provided interest free loans for the purchase of LPG gas stove and LPG refill from oil marketing companies (OMCs).
- *National Biomass Cook Stoves Initiatives:* National Biomass Cook Stoves Initiative (NBCI) was launched by the Ministry of New and Renewable Energy (MNRE) on December 2, 2009 with the primary aim to enhance the use of improved biomass cook stoves. One of the main problems with the use of biomass fuel for cooking is incomplete combustion. Improved biomass cook stove is a combustion device which burns biomass fuel more efficiently with reduced emissions and offers cleaner cooking energy solutions.
  The initiative aims at setting up testing, certification and monitoring facilities and strengthening R&D programmes. The aim is to design and develop the most efficient, cost effective, durable and easy to use device. And also identify ways and means for the development and expansion of the deployment of improved biomass cook stoves being developed and promoted by various organizations, NGOs, entrepreneurs and industries in the country.

1.1.1 Issues hampering the widespread usage of LPG by households in rural areas

Despite several initiatives being launched by the government, households in rural areas continue to use solid fuels for cooking. In fact, it has been found in several studies that significant number of households in rural areas having LPG connection continue to use solid fuels for cooking.

Several factors lead to such a phenomenon. Even though, rural households have increasingly positive perception of LPG as a clean cooking fuel, cost of LPG connection and fuel is hindering the widespread use of LPG (*Gould C. and Urpelainen J. 2018*). In addition to the cost, long waiting time to get LPG refills, negative perceptions regarding tedious application process, and concern regarding distance of distributor centres are also important impediments (*Petroleum Planning and Analysis Cell. 2016*). Same set of factors have been identified by other studies (*Das D. and Srinivasan R. 2012; Patel S., Khandelwal A., Leavey A. and Biswas P. 2016; Joshi J. and Bohara A. 2017*).

Similarly, on the supply side, lack of financial support and failure in the development of a robust supply chain (*Shrimali G., Slaski X., Thurber M. and Zerriffi H. 2011*) are some of the factors that hamper the

universal usage of LPG. With regard to government policy, there are some issues. For instance, under the Ujjwala Yojana, the government provides subsidy of INR 1600 per connection which is roughly 50 per cent of the total cost, and even though the government is offering interest free loan on the rest of the amount, it continues to remain an expensive option for a number of rural households.

Similarly, the supply of LPG has not been able to keep up with the demand, in fact, the demand supply gap has been rising overtime, in addition to increased import dependency. One of the main reasons for supply side bottlenecks is small number of LPG distributors in the country. The three oil marketing companies (OMCs), IOC, BP, and HP together have 23,737 LPG distributors which means one distributor is serving a population of more than 11,000.

Another problem with the Ujjwala Yojana is the 15 km stipulation for rural LPG distributors under which, beyond the boundary of 15 km, a distributor needs permission from district administration for delivering the LPG cylinder (*"Distribution handicaps a hurdle for Centre's LPG Ujjwala scheme," by Shine Jacob: Business Standard: July 12, 2019*). As a result, distributors charge delivery fees from consumers beyond 15 km which further adds to the cost of LPG for the end consumer.

Factors like lack of awareness, low educational levels, affordability, willingness to pay, and problems with inter as well as intra company transfer of consumers further adds to the constraints thus preventing the universal usage of clean cooking fuel in rural India.

1.2 Objectives

In this backdrop, the current study attempts to map the perception and preferences of rural households to choose cooking fuel options and the associated constraints. The proposed study also delves into the challenges and opportunities available with the local entrepreneurs working in the realm of providing clean cooking options to households in Samastipur district of Bihar. There are two focus areas of the present study:

1. Understanding the variation in perceptions and preferences for cooking fuel, cooking methodologies, and issues related to cooking.
2. Challenges and opportunities for local social entrepreneurs to develop and disseminate cleaner cooking options among local population.

1.3 Research Questions

For the present study, mixed method approach comprising qualitative and quantitative methods has been adopted. Qualitative methods have been used to arrive at and/or validate external factors and to explore the various dimensions of information about the various cooking fuels available, factors affecting the cooking fuel choice, perception of households regarding indoor air pollution, value chain mapping, and challenges and opportunities for social entrepreneurs. Quantitative methods have been used to capture information on the key indicators of the study and for testing the significance of findings. The tabulation below presents an elaborate description of the domains that constitute the study focus and the corresponding indicators and tools used to capture data.

Thematic Area	Area of Inquiry	Respondent Category	Research Instrument
Socio-Economic Characteristics and Area Profile	• Age. • Gender. • Religion and Caste. • Education. • Principal Activity of the HH. • House structure. • Household Income. • Source of cooking fuel. • Source of lighting. • Poverty Status. • Asset Ownership. • Health Status of HH Members.	• Households	• Structured household questionnaire
Cooking Fuel Option Mapping	• Type of cooking fuel being used by the households. • Type of cooking stoves being used (fixed or portable). • Place of cooking (indoor or outdoor or both).	• Households	• Structured household questionnaire • Household Mapping • Focus group discussions (FGDs)
Factors Affecting Choice of Fuel	• Whether LPG is available as a cooking option. • Factors because of which households are using solid fuels in addition to the LPG. • Factors because of which the households are using only solid fuel for cooking despite the availability of LPG.	• Households • Individuals (gender wise segregation)	• Structured household questionnaire • Focus group discussions (FGDs)
Challenges in Switching	• Reasons because of which the households are unable to adopt LPG as a cooking fuel. • Reason why HH is unable to shift to improved cook stoves.	• Households	• Structured household questionnaire • Focus group discussions (FGDs)

	• Reasons because of which the households are unable to completely shift to LPG for cooking.		
Cooking Methodologies	• Cooking method applied by the household like baking, frying, steaming etc. • Type of utensils used for cooking like pressure cooker etc.	• Households	• Focus group discussions (FGDs)
Perception Mapping of Households	• Awareness among households about the problem of indoor air pollution that arises from the use of solid fuels for cooking. • How much importance do the households attach to the health risks associated with indoor air pollution? • How much say women in the house have regarding the cooking fuel choice as they are the ones who actually do the cooking.	• Households • Individuals (gender wise segregation)	• Structured household questionnaire • Focus group discussions (FGDs)
Value Chain Mapping	• Mapping different stakeholders in the LPG cooking fuel value chain including distributors, refill traders etc. • Understanding the cost dynamics of different stakeholders. • Value addition at different levels and risk involved. • Understanding the role and relationship of important stakeholders involved in the entire value chain. • Price spread analysis (how the price is distributed from source to the end user).	• LPG Cylinder suppliers. • Informal LPG refilling traders. • LPG stove suppliers. • Improved biomass stove suppliers. • LPG stove repair and accessories traders.	• Transect walk • Interventions (service and activities) mapping • In-depth interviews
Challenges and Opportunities for Social Entrepreneurs. Supply chain mapping.	• Cost associated with improved cook stove manufacturing.	• NGOs and entrepreneurs developing	• Transact Walk • Interventions (service and activities) mapping • In-depth interviews

	• Type of biomass cook stoves available (fixed and portable type; natural and forced draft type). • Type of material being used for making improved cook stoves. • Availability of NBCI test centres for checking the quality of cook stoves. • Access to testing facilities. • Challenges being faced by such entrepreneurs in terms of finance, marketing, and after sale services. • Opportunities available for such entrepreneurs.	improved cook stoves. • Improved cook stove suppliers (gas stove using solid fuels). • Test centres for determining the quality of the cook stoves.	

2. Approach and Methodology

2.1 Geographical Locale of Research

Samastipur district is one of the districts of North Bihar. It is a part of Darbhanga division and is spread over an area of 2624.82 sq. kms. The district is bounded on the north by the Bagmati river which separates it from Darbhanga district, on the west by Vaishali and some part of Muzaffarpur districts, on the south by the Ganges, and on the east by Begusarai and some part of Khagaria districts.

Agriculture is the main economic occupation of the district and about 83 per cent of the total working population depends on it. The district at present comprises of four sub-divisions**.** The district headquarters is connected to all block headquarters by all-weather roads. Infrastructure wise, Samastipur is relatively better off. It is the Divisional Headquarters of the North Eastern railway. The district has direct train link with Patna, Kolkata, Delhi, Dhanbad, Jamshedpur and other places of importance. So the district is ideal for not only studying demand side bottlenecks but also supply side bottlenecks related to clean fuel usage.

As per the report of the Ministry of Petroleum and Natural Gas[1], there are 1799 LPG distributors in Bihar as of April 2019. However, according to the same report the number of LPG connections in the state is 22,829,000 which means one distributor is serving12,690 households which is higher than the national average.

Another assessment report[2] by Ministry of Petroleum and Natural Gas has identified six barriers to widespread use of LPG for cooking in Bihar. These barriers include, distance of distribution centres, tedious application process, long waiting time for LPG refill, long waiting time for LPG connection, high recurring cost, and high initial cost. However, the year in which the report was released happens to be the year in which the Government of India eventually launched Ujjwala Yojana. So it will be interesting to see how successful the government scheme has been in overcoming the mentioned barriers.

2.2 Evaluation Framework

Mixed methods approach has been used in the study. Under this approach, the outputs of qualitative exercises have been merged with quantitative data. Qualitative tools have been used to validate the quantitative data, and also in developing an understanding on various dimensions and factors that affects the two focus areas of the study. The biggest strength and utility of participatory techniques lies in their ability to generate significant qualitative information on aspects like awareness, benefits and access. It includes a range of activities with common thread, sharing of knowledge and experience, recognizing and encompassing different perspectives. It offers the opportunity to go beyond mere consultation and promote the active participation of communities/stakeholders in the issues and interventions that shape their lives.

A total of 605 households were covered under the quantitative household survey. Block and village wise distribution of the sample households are presented below in table 1.

[1] *"Read Reckoner: Oil Industry Information at Glance,"* 2019 report from the Petroleum Planning and Analysis Cell; Ministry of Petroleum and Natural Gas

[2] *"Assessment Report: Primary Survey on Household Cooking Fuel Usage and Willingness to Convert to LPG,"* 2016 report from Petroleum Planning and Analysis Cell; Ministry of Petroleum and Natural Gas

Table 1: Block wise households covered

Block	Village	Number of HH Covered
Samastipur	Punas	30
	Raghunadhpur Bela	30
	Mushapur	30
	Bejha Dih	30
	Hakimabad	30
Warishnagar	Sari	32
	Chak Milki	30
	Moglani Chak	30
	Sadipur	30
	Kishunpur	30
Rosera	Thahar Basarhia	31
	Jahangirpur	30
	Harpur	30
	Mohiuddi Nagar	30
	Chak That	30
Bithan	Parkauli	31
	Lad Kapasia	30
	Ujan	31
	Bardauni	30
	Jagmohra	30
Total		605

In addition to the household survey, qualitative exercises including focus group discussions, in-depth interviews, transect walk, and intervention mapping was also carried out.

Table 2: Quantitative and qualitative sample distribution and coverage

Study Tool	**Target Respondent**	**Coverage**
Structured household questionnaire	Households	605 Households
Focus group discussions (FGDs)	Households	2 FGDs per block; Total 8 FGDs
In-depth interviews	Entrepreneurs, and traders	13 interviews
Household Mapping	Households	Mapping of each sample HH on factors like, location of cookstoves, cooking fuel being used at the time of survey etc.
Transect Walk	Entrepreneurs, and traders	In each of the 20 villages
Interventions (service and activities) mapping	Entrepreneurs, and traders	In each of the 20 villages

2.3 Analysis Plan

Data collection was conducted through computer assisted personal interview (CAPI) technology with the use of hand-held computer tablet devices supervised by a technical team. Following the survey, data was cleaned with the aim to check for logical-consistency although several possible errors to data collection were already dealt with through the very use of CAPI (e.g. through validations, range checks,

etc.). In addition to this, regular monitoring of the work completed and data uploaded was also done. CAPI based data collection has several advantages over paper based data collection. The CAPI guides an enumerator through the skip pattern in the questionnaire so that only relevant questions are asked. Irrelevant questions are restricted and errors of wrong questions being marked are reduced. Another advantage of using CAPI is that data validation can be enabled where the type of characters to be entered is specified.

The finalised dataset was analysed on appropriate statistical software, followed by data familiarisation, i.e. preliminary assessment of the datasets. Although the questionnaires were largely pre-coded, appropriate post-coding was carried out to reflect the aims of the study and framework of analysis. Statistical analysis was conducted using STATA statistical software.

2.4 Data Quality Upkeep

For ensuring that the data quality is of the highest standard, it is essential that the field investigators are given proper training. The training that was imparted to the field investigators focused on several aspects including

1. Handling of tablet computers
2. Familiarization with qualitative techniques like FGDs and in-depth interviews
3. Familiarity with the geographical area of the survey
4. Training in building rapport with local key individuals as well as villagers for ensuring smooth execution of the survey.

For the above, a week long training of the field investigators was done. During the training, pilot testing of the household survey questionnaire was also done. The training of field investigators aimed at ensuring that they avoid data errors to their best possible ability. The aim of the training was to equip the enumerators with enough knowledge on tools and the project to make data collection as seamless as possible.

Translation of the questionnaire: The tools were translated into the local language. The translation process was done carefully so that interpretation work is simpler and does not invite unintended responses. It is a strict necessity to thoroughly comprehend the original (source) message and field-test it before finalizing the translated versions of the questionnaire. The study instrument was handed over to a language expert for translation into local language, the local vernacular under the supervision of core team members. The draft tools were reviewed during the training program of the field investigators and supervisors and during the piloting of the tools.

3. Profile of Sample

The study focuses on the perception and preferences of rural households to choose cooking fuel options and the associated constraints. The proposed study also delves into the challenges and opportunities available with the local entrepreneurs working in the realm of providing clean cooking options to households in Samastipur district of Bihar.

So, the sample households that were covered for the household survey came from the rural areas of the Samastipur district. Moreover, the FGDs were also conducted with rural households. The selection of sample villages needed a sampling strategy that ensures not only equal probability of selection for all the rural households in Samastipur but also that the selected villages are also of sufficient enough size to ensure a representative sample is selected for the final analysis.

For this, mix of multi-stage stratified random sampling and probability-proportional to size sampling has been used. For the probability proportional to size (PPS) sampling using population in the villages as the size measure was used. Village wise population data from Census 2011 has been used for the PPS sampling. The district of Samastipur is divided into 4 administrative sub-divisions by the government i.e., Samastipur, Rosera, Dalsingsarai, and Patori. At the first stage, two sub-divisions were randomly selected. At the second stage, two blocks from each of the two sub-divisions were randomly selected.

At the third stage, five villages from each of the selected blocks were selected using probability proportional to size (PPS) sampling. At the fourth stage, 30 households were selected from each of the sampled villages using stratified random sampling. Stratification has been done on the basis of scheduled caste (SC) households and non-SC households. Stratification using scheduled tribe (ST) has not been done as ST population constitutes only 0.04% of the total population in the district. Census 2011 provides caste wise data for only SC and ST (Table 3).

Table 3: Demographic profile of sample villages as per the Census 2011, Govt. of India

Sub-Division	**Blocks**	**Sample Villages/Town**	**Total HH**	**Total Population**	**%Share of SC in Population**
Samastipur	Warishnagar	Sari	696	3,505	26.2%
		Chak Milki	112	576	7.3%
		Moglani Chak	566	2,654	16.6%
		Sadipur	783	3,696	21.3%
		Kishunpur	1,257	5,962	22.6%
		Total			
	Samastipur	Punas	1,106	5,291	33.1%
		Raghunadhpur Bela	621	2,784	23.6%
		Musapur	1,204	6,350	7.1%
		Bejha Dih	830	3,905	19.6%
		Hakimabad	885	5,110	11.3%
		Total			
Rosera	Rosera	Thahar Basarhia	2,024	9,217	19.4%
		Jahangirpur	4,109	19,898	18.8%
		Harpur	1,159	5,683	20.4%
		Mohiuddi Nagar	4,446	21,157	19.9%
		Chak That	1,812	9,259	26.4%
		Total			

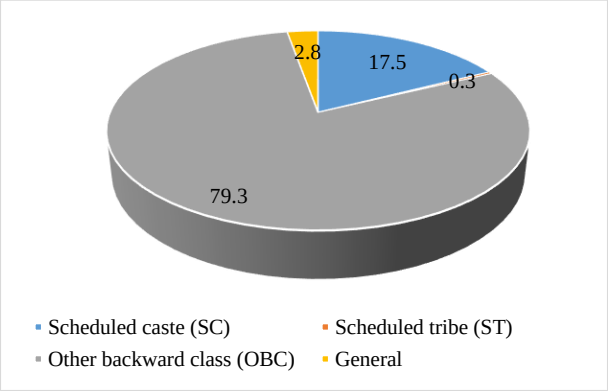
	Bithan	Parkauli	150	1,024	9.3%
		Lad Kapasia	581	2,895	16.2%
		Ujan	1,158	6,229	13.5%
		Bardauni	612	2,888	12.2%
		Jagmohra	1,137	6,031	6.2%
		Total			

4. Key Findings

4.1 Social Profile

The other backward class (OBC) constitutes more than three-fourth (79.3 percent) of the sample households followed by the scheduled caste (SC) households. The share of SC households in the sample is in line with the share of SC households in different sample villages as per the Census 2011. This was done to give proportional representation to the households belonging to the marginalized section.

Figure 1: Percentage distribution of households according to caste



As can be seen from Figure 1, general households constitute 2.8 percent while the share of scheduled tribe (ST) household is 0.3 percent which is in line with the Census 2011 trends where ST population constitutes only 0.04% of the total population in Samastipur.

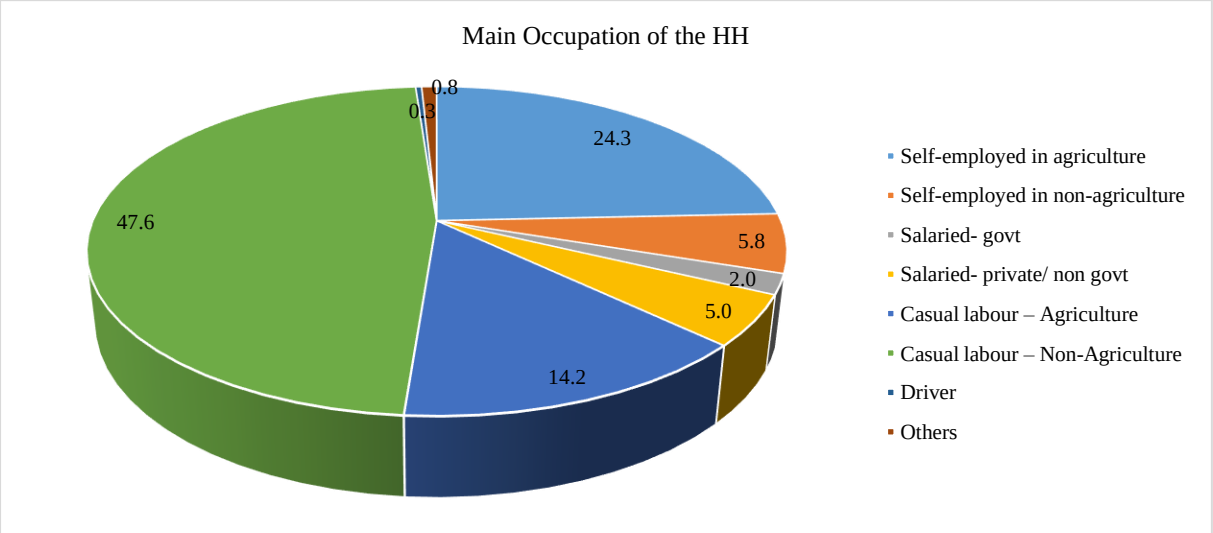
However, the caste wise distribution at the sample block level is a bit different. For instance, in Samastipur and Rosera, the share of general households is 5.3 per cent and 6.0 per cent respectively. Similarly, Rosera has the highest concentration of sample SC households at 21.2 per cent.

Religion wise, more than three-fourth (80.3 per cent) of the total sample households follow Hinduism while the rest of the households practice Islam.

4.2 Economic Profile

Main Occupation: For close to two-third of the households (61.8 per cent), casual labour is the main occupation. For about one-fourth (24.3 per cent) of the households, farming is the main occupation. However, for most of the households that own land, farming is basically subsistence farming as their landholding is very small.

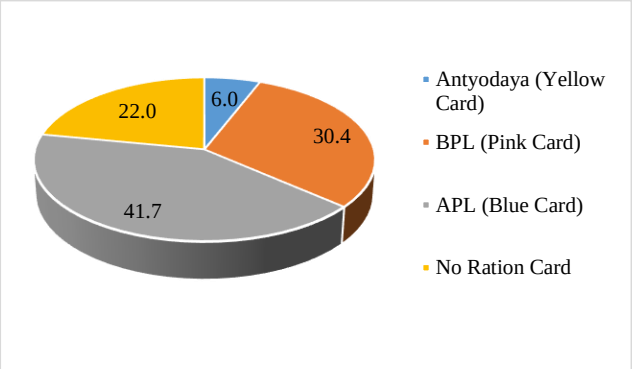
Figure 2: Distribution of the sample households according to the main occupation.



Ration Card: Ration card is one of the ways through which the government earmarks the entitlement of different type of households with respect to subsidized food grain, pulses and other food items. There

are basically three categories of ration card; above poverty line (APL) card, below poverty line (BPL) card and Antyodaya card for ultra poor households.

Figure 3: Distribution of households by ration card

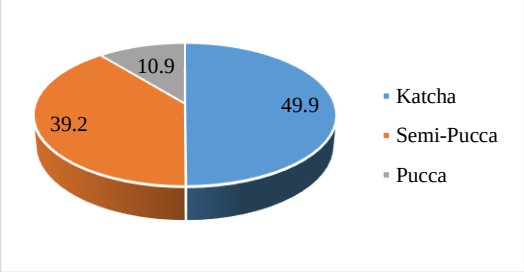


As can be seen from Figure 3, about one-third (30.4 per cent) are BPL card holders while six per cent have Antyodaya cards. Moreover, more than one-fifth (22.0 per cent) don't have any type of ration card. It is pertinent to mention here that households without a ration card are not economically affluent. They are basically those poor households who don't have the required documents, and are not aware about the procedure to obtain one.

Among the four blocks, Bithan has the highest proportion of households without any ration card, while Warisnagar has the highest proportion of households with APL card. In Rosera, about 10 per cent households have Antyodaya card which is the highest among the four blocks.

House Structure and Floor: Half of the sampled households live in *kutcha* houses. Moreover, in 93.2 per cent of the households, the floor of the house is made up of mud. So, majority of the respondents are living in houses that are *kutcha or semi-pucca*.

Figure 4: Distribution of households by house structure

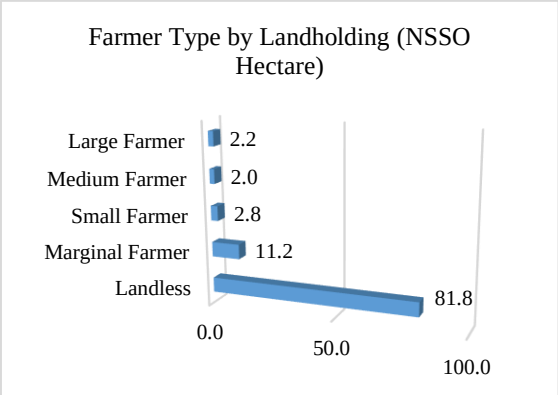


Only in 10 per cent cases is the house structure *pucca*. Moreover, there exists divergence between the different sample blocks. For instance, in Bithan only 2.6 per cent of the houses are *pucca*, whereas in Samastipur 15.3 per cent of the sample houses are *pucca.*

Out of the total 605 households only 38 have houses where the floor is made up of cement.

Land holding: Determination of whether a household belongs to one of the categories of farmer type is based on the total land owned by the household in hectare. Households having no land or having land holding less than or equal to 0.002 hectares is termed landless. Households having land between 0.002 hectare and less than or equal to 1 hectare are marginal farmers, households having land between 1 hectare and less than or equal to 2 hectares are small farmers, households having land between 2 hectares and less than or equal to 10 hectares are medium farmers, and households having more than 10 hectares land are large farmers. The definition is in conformity with that used by the National Sample Survey (NSSO), Govt, of India.

Figure 5: Distribution of the sample households according to landholding



As can be seen from Figure 5, more than three fourth of the total sample households are landless. Marginal farmers constitute 11.2 per cent of the households. This shows that on two parameters of economic well-being (occupation and land holding), majority of the sample households belong to either poor or marginalized category.

Even among the small and medium farmers, income from agriculture is not very high as most of them are net purchasers of food grains.

Income and Consumption Expenditure: In rural settings, many households are reluctant to report their annual income. At the same time, there are households who are unable to recall their annual income because there is no inhabitant whose main source of income is regular employment. As a result, the ability of a household to recall annual income is very low. In the present case, households were asked about the income they earned during the last year. Out of the total 605 households, respondents in only 270 households (44.6 per cent) were able to give a rough estimate about their income last year.

The average income reported by the 270 households during the last year was Rs. 67,709.26. Therefore, to better understand the economic condition of the households, consumption pattern of the households was also mapped. At this point, it is important to mention that there are certain expenditures which should be estimated on monthly basis while there are others that can only be estimated with accuracy on annual basis. For instance, expenditure on stationary, registers etc. are those that are incurred on monthly basis, while tuition fees and expenditure on books are usually incurred on annual basis as most of the books are purchased at the start of the academic year. Similarly, expenditure on medicines are usually incurred on monthly basis while getting admitted in a hospital for some major health issue is something that usually occurs once in a year for a prolonged period.

Table 4: Average monthly expenditure on different expenditure heads

Expenditure Head (Monthly)	**Avg. Expenditure (in Rs.)**	**Number of Respondents**
Food (cereals, vegetables, fruit etc.)	2,764.14	566
Fuel and light	773.51	557
Entertainment (cinema, picnic, sports etc.)	268.72	282
Household articles (electric bulb, glassware etc.)	421.57	508
Conveyance	123.97	287
Medical expenses	993.93	509
Education (including stationary etc.)	436.76	328

As can be seen from table number 4, expenditure on food accounts for the largest share of total monthly expenditure. This is expected as in poor rural households, expenditure on food is usually the highest. Another thing that emerges from the table is that medical expenses per month is the second largest expenditure head.

Table 5: Average annual expenditure on different expenditure heads

Expenditure Head (Annual)	Avg. Expenditure (in Rs.)	Number of Respondents
Medical expenses	16,334.11	525
Tuition and other fees	4,126.09	342
School books and other materials	2,269.14	337
Clothing and bedding	5,403.66	541
Furniture and fixtures	196.76	284
Cooking and household appliances	60.46	302
Goods for recreation	86.75	302
Transport equipment (bicycle, scooter etc.)	749.84	319
Other personal goods	98.71	310
Social events like marriage, death, birth etc.	14,980.77	312

The above tables show that medical and social events account for the first and second highest annual expenditure share respectively. Given the quantum of monthly and annual expenditure, the households are left with little or no scope for saving. Moreover, most of the households in the sample villages are members of some type of self-help groups (SHGs) from whom they have taken some kind of loan. The monthly loan instalment adds further to their expenditure list. In these circumstances, there is hardly any scope for further expenditure on clean fuel options or improved cookstoves let alone any kind of savings.

4.3 Cooking Fuel Usage

In all the sampled villages, it is observed that villagers usually depend on a mix of LPG and firewood for cooking. There is hardly any household entirely dependent on LPG for their cooking. However, there are many households that use only firewood as they do not have an LPG connection. Those who do own one, have either bought the connection on their own while others had received it free of cost through Ujjwala Yojana, a government scheme to provide LPG connections to BPL families in the country. Households that do not own an LPG connection have either applied for the same through the scheme, and have failed to get it due to incomplete documentation. There are also many cases where the poor households have not applied even once in fear of the administrative hassles of getting the connection.

Despite this, there is nothing denying the fact that connection of liquefied petroleum gas (LPG) has proliferated massively across the state especially after the launch of Ujjwala Yojana of the Government of India. However, the usage of solid fuel is still predominant in rural areas of Bihar. In Samastipur district, the existence of LPG along with solid fuel is prevalent. This is evident from the table below which shows the different type of fuels used for cooking in the sampled households. Households were not only asked about the cooking fuel used by them but also the fuel that are prevalent in their village.

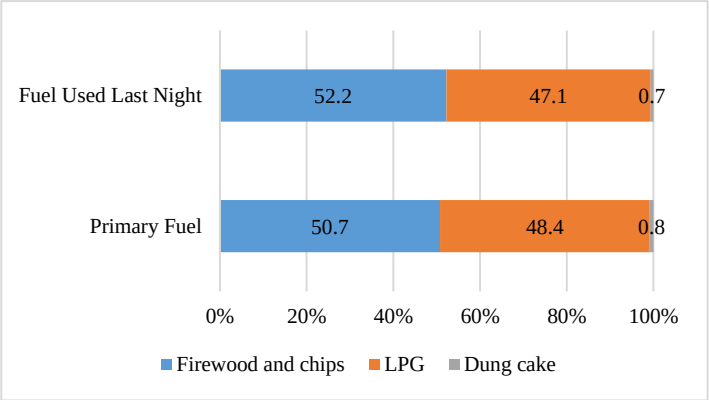
Table 6: Different cooking fuel used by households and in the villages (in %age)

Cooking Fuel	Used in the Household	Used in the Village
Coal	0.0	0.7
Wood	88.4	100.0
LPG	61.2	98.7
Gobar Gas	1.0	0.0
Dung Cake	9.1	46.4
Charcoal	0.0	0.2
Kerosene	0.0	0.2

Electricity	0.0	0.2
N	605	

As the above table shows, there is divergence between the respondents' perception about the village and what they practice in their home. While almost all of the respondents (98.7 per cent) said that LPG is used in the village for cooking, less than two-third (61.2 per cent) said that they use LPG in their home. This divergence is mainly due to the fact that while LPG connection has made strong inroads in rural areas, the cost of refill as well as delay in the delivery has ensured that villagers are still predominantly dependent on solid fuel like wood. While these questions allowed multiple responses as we wanted to map the different cooking fuels used by the households, attempt was also made to identify the main cooking fuel used by the households. So respondents were asked about the primary cooking fuel used as well as the cooking fuel that was used last night for cooking.

Figure 6: Distribution of Cooking Fuel Usage Pattern



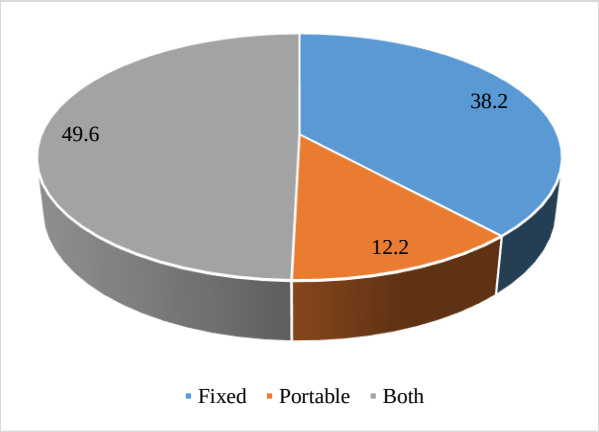
As can be seen from Figure 6, firewood and chips are the primary source of cooking fuel used by the half the households. While LPG has also emerged as the primary cooking fuel in the survey, in reality the usage of LPG is intermittent due to supply side constraints as well as financial constraints faced by the households. However, one thing that has emerged from the survey is that people are willing to make a move towards cleaner fuel and are aware about the health hazards related to the use of solid fuels for cooking.

Interestingly, if one looks at the block wise situation then divergence emerges. While in Samastipur block more than half the households use LPG as their primary cooking fuel, in Bithan two-third of the households are dependent on firewood and chips for cooking. This scenario is also related to the geographical distance between the district headquarter at Samastipur and other blocks of the district. Bithan block is farthest from the district headquarter which also explains why people are unable to access clean cooking fuel options like LPG.

The choice of fuel for the villagers has a lot to depend upon how it is procured and how much it costs. In terms of availability, firewood is available in plenty. It is used as the cooking fuel by combining wood, dried leaves and even cow dung. As the majority of households have cattle, cow dung is easily present and dried leaves are collected from nearby areas. Villages have plenty of green cover surrounding them, and hence obtaining firewood within the village premises is not a difficult task. Hence, this fuel is easy to access and literally always at their disposal. While LPG is also available as a decent option for them, its accessibility on the other hand fluctuates. A poor rural household can only obtain it through the Ujjwala scheme, unless they have the money to buy a connection on their own. However, the scheme does not benefit everyone as many villagers had applied for a connection long ago, but are still waiting for it. Even those who have a connection need to go through a lot of hassle to get the cylinders refilled.

Majority of the households use LPG and solid fuel alternatively for which they have both portable as well as fixed cookstoves. While portable cookstoves are mainly the LPG cookstoves, fixed cookstoves are made of mud and are used for firewood and chips.

Figure 7: Type of cookstoves in the households



As Figure 7 shows, only 12.2 per cent of the households have portable cookstove. This means that more than 90 per cent of the households are dependent on wood for cooking.

The portable cookstove does not always mean LPG cookstove that represents clean fuel, in many cases these cookstoves use firewood as fuel.

Not only wood is the primary fuel used for cooking by majority households, it is also used for heating purposes. Despite the availability of electricity connection in rural areas, electricity is not used for heating purpose because most of the households lack heating appliances. The free of cost availability of firewood and chips make them a cost effective choice for cooking as well as heating.

The pre-dominant use of wood as a fuel is prevalent across all three seasons in a year (summer, monsoon and winter). In fact, the use of wood increases during the winter season as is evident from the following table.

Table 7: Use of different fuels during different seasons by households in a year

Fuel	**Summer**	**Monsoon**	**Winter**
Coal	0.0	0.2	0.0
Firewood and chips	61.2	58.0	72.9
LPG	54.4	57.5	49.4
Gobar Gas	0.3	0.0	0.0
Dung Cake	3.5	2.5	3.6
Charcoal	0.0	0.2	0.3
Kerosene	0.7	0.0	0.2
Electricity	0.5	0.0	0.3

According to the respondents, convenience in collecting wood, better heating capacity of wood, and zero cost associated with it makes wood the most preferred fuel across the year.

We also need to delve into the cooking pattern of households in order to understand their fuel choices. Villagers that have an LPG connection use gas stoves to cook their meals in general and get the LPG refilled as and when they have the money for it. In between, they shift to firewood for cooking their meals. However, even when they have LPG in their house, firewood is still used to cooking meals for their cattle, to boil water used for bathing and/or other tasks such as cooking chapatis as they indicate that the chapatis taste better when cooked on firewood. Villagers prefer to use firewood as cooking for cattle takes longer and they prefer to not waste their LPG on these tasks alongside their taste preferences. Therefore, even if they use LPG on a daily basis, they are still exposed to the smoke of wood because of these chores wherein firewood cannot be substituted with LPG even if it is available. This is also because they consider LPG to be more precious than firewood as it is a better, cleaner and much more expensive fuel. Hence, they prefer to use it for limited tasks and try to conserve it as much as possible so that it lasts longer.

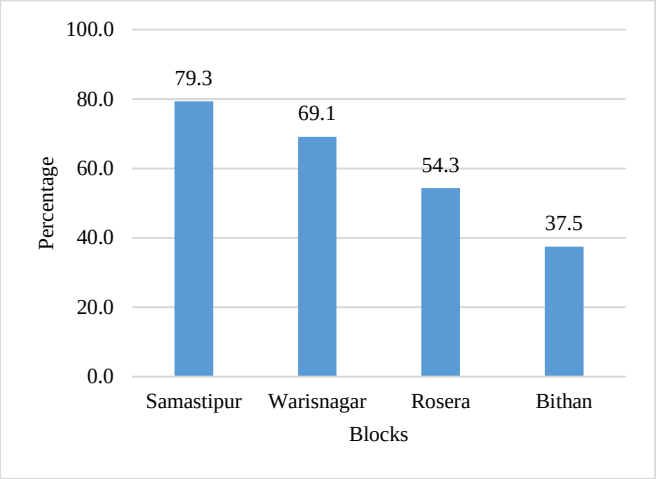
As this section shows, despite government's efforts in the form of Ujjwala Yojana as well as widespread awareness about the health hazards associated with the use of solid fuels for cooking and other purposes, solid fuel like wood is the pre-dominant fuel choice across the sampled households.

However, it is also true that given the opportunity and the means, the households do use clean fuel. This directs us to the question of constraints that the households are facing in making an absolute shift to clean fuel as well as the economic incentives associated with the solid fuel. The next section details the status of LPG connection in the sampled households as well as the maintenance and operating cost incurred by the households for continued use of the same.

4.4 LPG Connection and Usage

LPG connection exist in 60 per cent of the sampled households in the district (363 households). However, significant divergence exists across the four blocks.

Figure 8: Percentage of households having LPG connection in different blocks



As can be seen from Figure 8, while in Samastipur block more than three-fourth (79.3 per cent) households have LPG connection, in Bithan block a little more than one-third (37.5 per cent) have the connection.

The difference in the coverage of LPG connection is again related to the geographical distance between the district headquarter in Samastipur and other blocks of the district. Here again, Bithan being the farthest block from the district headquarter suffers with respect to LPG coverage.

Even among the 363 households that do have a LPG connection, close to three-fourth (70.8 per cent) of the households received the connection in 2016 or later. Among these, 257 households that received connection in 2016 or later, more than three-fourth (77.0 per cent) received the connection under the Ujjwala Yojana of the Government of India which started in the year 2016. Under the Ujjwala Yojana, households are eligible for connection subsidy. However, two-third (65.2 per cent) of the households that have received LPG connection under the yojana reported that they have not received any subsidy from the government yet. As per the provisions in the scheme, subsidy is given after one year from the date of receiving connection or in other words after 12 refills. However, most households who reported not having received any subsidy had an installed connection before 2019 thus making them eligible. In fact, among the 131 households that are yet to receive subsidy, more than three-fourth (76.3 per cent) have received connection before the year 2019. Low literacy levels further add to the plight of such households as they are not aware of the administrative mechanism to be followed to receive what is due to them. Issues with documents, discrepancy in name etc. are also factors that prevent people from receiving the subsidy. While difficulty in availing the subsidy is one problem, the cost of refill and getting the connection is another (Table 8).

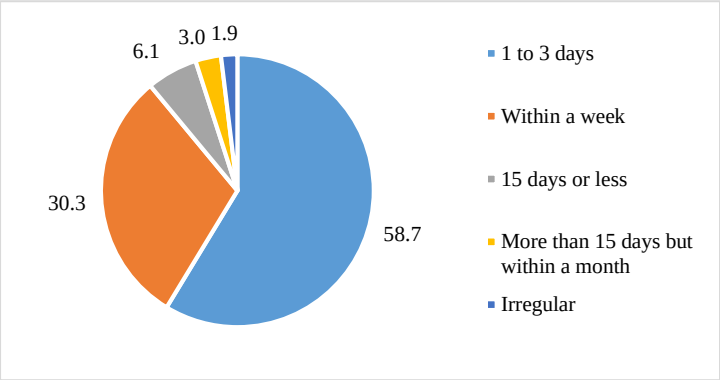
Table 8: Cost of LPG

Average Cost of Getting the LPG Connection	Rs. 1,575.00
Average Cost of Refill	Rs. 788.81

The type of cylinder that is purchased by the households weighs 14.2 Kg, which is also the standard household use cylinder weight in the country. Moreover, in more than two-third of the households (68.3 per cent), LPG refill is required after every 30 days. The cost of LPG is further compounded by the delivery charges that households are required to pay for receiving the refill. Out of the 363 households with LPG connection 288 (79.3 per cent) reported that they pay delivery charges to the LPG distributor. In fact, the average amount being paid by households as delivery charge is Rs. 50 per cylinder. On an average, it costs anything between Rs. 850-1000/- to get a refilled cylinder delivered to the village.

Households only have a single cylinder which means that once it is empty, the refill should arrive in a day or two otherwise the households will have no other option but to use wood.

Figure 9: Time for refill cylinder to arrive after placing order



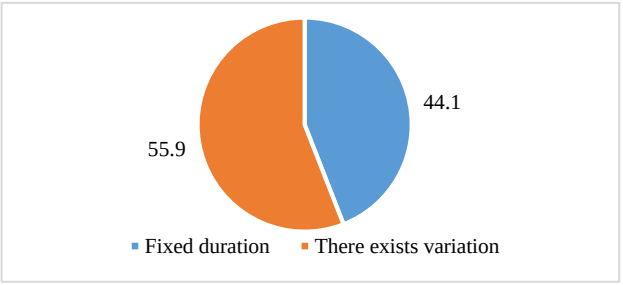
From Figure 9, it is evident that a little more than half of the total households with LPG receive refill within one to three days. Still, in more than 40 per cent of the cases, it takes at least one week for the refill to arrive.

Such delays erode the credibility of the system to provide regular support for LPG usage in rural areas. However, this also raises a pertinent question of why do households fail to estimate the requirement or the time by which they would be needing a refill. Most of the homemakers are usually well aware about the time by which different commodities in the kitchen need to be replenished. So, it is expected that the homemakers would have a fairly good idea of when their LPG cylinders will get empty every month.

To understand the situation better, the households were asked whether the households check the weight of the LPG refill at the time of delivery. Out of the 363 households with LPG connection, 278 (76.6 per cent) said that they don't check the weight of the cylinder at the time of delivery. Not only this, majority of the respondents with LPG said that there does not exist any fixed duration after which they order the refill.

Figure 10: Duration of LPG cylinder booking

As Figure 10 shows, for more than half respondents there exists variation in the duration of LPG cylinder booking. This means that households are unable to estimate the time by which they will require a refill. This is surprising as homemakers irrespective of their literacy level are usually very much aware about the time by which different commodities in their kitchen will need to be refilled.

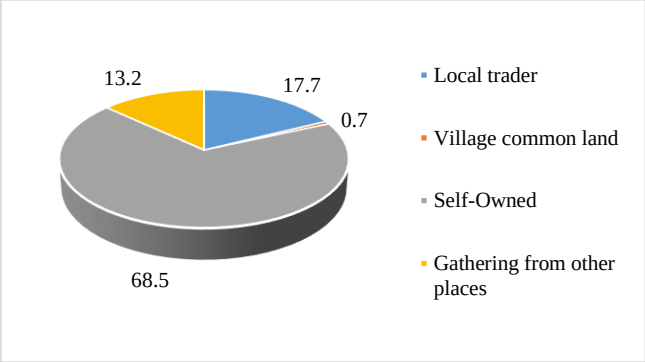


Another factor acting as a binding constraint on the households is the distance of LPG distributor from the village of the households. Out of the total 363 households with LPG, 358 (98.6 per cent) reported that the warehouse of their LPG distributor is located outside their villages. The average distance between the warehouse of LPG distributor and the household is 7.5 Kms and in some cases it is about 40 to 50 Kms. This disincentivizes the households to shift to LPG as in many places, the respondents report that they have travel to the warehouse to collect the cylinder. This happens because the distributors usually wait for a bulk order before sending their delivery vehicles for cylinder delivery. As different households require cylinders at different points in time, they have to wait for other people

in the village to place the bulk order. In case a household needs a cylinder urgently then one of the family members travels to the warehouse to collect the cylinder.

The above factors lead to a situation where people have no choice but to rely on solid fuels. Households use a mix of firewood, dried leaves and cow dung as these are available free of cost. Women and girls of the family go and collect wood from the nearby surroundings. Wood collected in one go lasts almost a week. A few rare cases where the villagers do buy wood, do so from their neighbours or someone selling it within the village and don't need to travel too far for it. They usually walk a distance of about two to five kilometres to procure firewood. The average monthly consumption of wood by households is 107.1 Kg. Almost all of it comes free of cost through collection from common grounds, forests, farms etc. For those who do buy wood, the price of buying wood comes around Rs. 600 to 800/- a quintal.

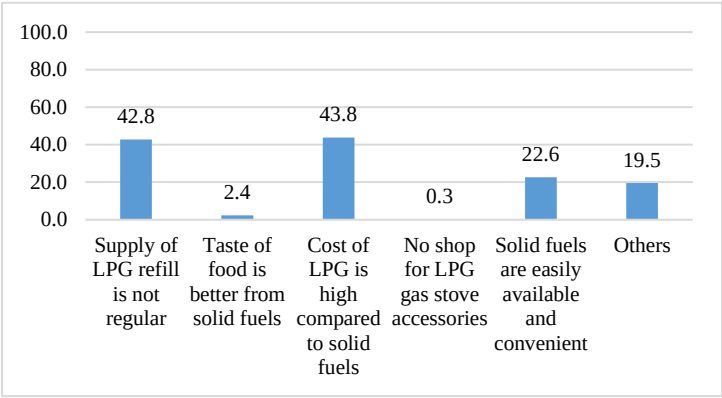
Figure 11: Source of Firewood



From Figure 11, we can see that less than one-fifth (17.7 per cent) of the households resort to buying firewood instead of selecting the option of LPG or just gathering wood on their own. The fact that wood is freely available while LPG comes not only with financial cost but with other administrative hassles ensures continuous reliance on wood for cooking and other household energy needs.

Similarly, other solid fuel options like dung cakes are also free of cost as the few households that do use them make them at their home themselves. On the whole, out of the 363 LPG users, 292 (80.4 per cent) reported that they also use solid fuel (mainly wood).

Figure 12: Reason for using solid fuel along with LPG



From Figure 12, we can see that irregular supply along with high cost of LPG are the main reasons why households use solid fuel even when they have a LPG connection.

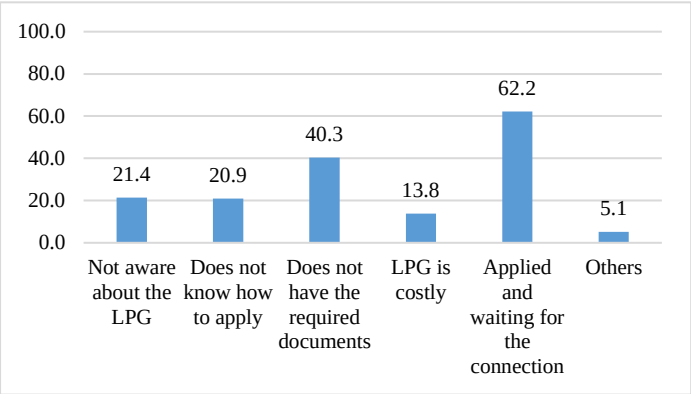
Easy availability of wood is the third most important reason with close to one-fourth (22.6 per cent) opting for it. The others option mainly relates to the situation where households are forced to use solid fuel when their LPG cylinders become empty and they have to wait for the refill. For some households, difficulty in using LPG cookstove is also one of the reasons why they consider LPG as an inconvenient source of cooking fuel.

While it is important to understand the reasons why people with LPG connection are still using solid fuels that create pollution, equally important is to understand why people are not at all using clean fuel options like LPG when even the government is providing incentive.

Out of the total 605 households, 242 (40.0 per cent) do not have LPG and are dependent on solid fuel like wood for cooking, heating and other energy needs. Out of these 242 households, 196 households (81.0 per cent) had never used LPG while 46 (19.0 per cent) earlier used LPG but have now completely

stopped using it. For those households who earlier had LPG, the reasons for its discontinuity are irregular supply of LPG refill and high cost.

Figure 13: Reasons for never having LPG



From Figure 13, it can be seen that out of the total 196 households that have never used LPG, 122 (62.2 per cent) have applied for a connection and are waiting for the installation. This is positive in the sense that households are making efforts to shift to clean fuel options. Lack of required documents is the second most prominent reason with more than one-third (40.3 per cent) mentioning it.

The impact of low literacy levels in rural Bihar can be seen on the access to clean fuel which is reflected from the fact that one-fourth (21.4 per cent) of the households without LPG are not even aware about it. Similarly, one-fourth (20.9 per cent) of them are not aware about the procedure to apply for LPG. This also raises serious questions on the government's effort to create awareness as well as its initiatives to ensure clean fuel is accessed by all households in the rural areas of the country.

Most villagers in the area are aware of health issues arising from the smoke of firewood and many women even complain of eye problems and breathing issues that they face often. They get it treated from a doctor if the situation gets unbearable or take some curative medicines, but it is hardly a deterrent for them to stop using wood as a cooking fuel.

Understandably, health does not hold much priority when it comes to choosing the type of cooking fuel for the villagers. They hardly practice any preventive measures and end up going to the doctor only if their medical condition worsens. One of the men commented that even though people are generally aware about the ill-effects of firewood on their health, but "we the poor do not think about it, we first think about saving the money, and how to use it in the best way possible, we think about lowering our expense, and we do not think about the future troubles it may cause us." This clearly reflects their way of thinking, as we realize that their short-term goals of getting food on the table with least expenses is something that holds priority rather than looking at their future healthy lifestyle which they might or might not be able to achieve by making significant and possibly expensive changes in their present condition.

An important finding that emerges is that while villagers admit that LPG is easier to use and even a cleaner fuel than firewood, the task of procuring it is seen as an inconvenience for many. Many households have received the free LPG connection and a stove through government schemes. However, poor after sales service in terms of refill cylinder is creating disincentive for the households and ensuring continuous use of solid fuel that not only adversely affects the environment but also the health of individuals especially women as cooking food continues to be the sole responsibility of women in the household in rural areas.

While trying to understand the cooking fuel being used by households in rural areas, it is important to understand the agency and power that women wield in the house. This is important because while cooking is done by females, they seldom have any say in the decision making in the house especially decisions related to finances. The next section therefore tries to understand the level of empowerment among female members of the sampled households.

4.5 Perception and Views of Women in the Household

Understanding the status of women in the household is important for the current study because under the Ujjwala Yojana of the Government of India, LPG connection is issued in the name of women members of the house. Moreover, the responsibility of collecting firewood and chips also rests on the shoulders of female members of the household. In many cases, school aged girls in the households are also made to collect firewood along with the adult female members. This adversely affects the education of girl child in the household. Therefore, it is important to understand the views and perception of females about clean fuel options like LPG.

In the 363 households where LPG connection exists, women members were asked about how LPG has benefited them. Almost all of the female respondents (98.1 per cent) said that LPG has reduced the level of household pollution which is beneficial for them. The following table shows the different benefits that female members of households using LPG have received.

Table 9: Benefits of LPG gas for cooking

Benefits	**Percentage**
Less Pollution	98.1
Does not have to go outside home for firewood	85.1
Less drudgery	43.3
Food is cooked fast so gets some free time	20.7
Is convenient to use	16.3
N	*363*

This brings us to those households that do not have a LPG connection. Out of the 242 households with no LPG, females in 233 households were aware about LPG and almost all of them (229) said that they would like to have a LPG connection in their house and have also discussed the same in their homes. Among those who said that they don't want LPG connection, high cost of LPG was the main reason for it.

It therefore becomes clear that even women in the households are very much aware about the benefits of LPG and are happy with the improvement in their daily working conditions. Moreover, women in households where there is no LPG also want LPG connection in their homes. However, agency of women within their households is limited and financial power resides mainly with men.

4.6 Preference, Perception and Innovation

Villagers do realize the benefits of LPG over other fuels. To them, using LPG as a cooking fuel is beneficial as meals cook faster, the utensils remain clean, it is easier to use than other fuels, is smoke free or emits less smoke than other fuels and can be used in all seasons (unlike firewood which is hard to obtain in monsoons). These are the major benefits listed by almost every villager. They are also aware about the health benefits of using LPG instead of firewood, but it doesn't hold a priority for many.

Since firewood is available easily and in plenty, it is a default option for many villagers. This becomes even more obvious when their financial constraints and administrative challenges further reduce their chances of using LPG. Getting an LPG cylinder is expensive in their opinion, especially when its alternative is readily available and costs nothing. They still use LPG but know that they run out of money to get their LPG cylinders refilled and will not be able to use it continuously, or even if they put in a refill request, the agencies are not close enough to get them delivered in less than 5 days. So, doing away with firewood completely is just not an option for them as they are well aware they will need it in days of no LPG.

4.7 Key Inferences

The previous sections detail out how the use of solid fuels like wood is rampant in rural areas despite governmental efforts to provide clean fuel like LPG at subsidised rates. At the same time, it is also true that the households are very much aware about the health hazards associated with burning solid fuels like wood. There are significant underlying factors due to which households are unable to completely shift to clean fuel. The present section tries to identify the factors that are ensuring continuous use of solid fuel like wood by rural households in Samastipur.

Multidimensional Poverty:

According to the Economic Survey of Bihar, 2020 of Government of Bihar, the poverty ratio in rural areas of Bihar is 34.1 per cent. The estimation is based on the Tendulkar Committee methodology which is based on the consumption of items like cereal, pulses, milk, edible oil, non-vegetarian items, vegetables, fresh fruits, dry fruits, sugar, salt & spices, other food, intoxicants, fuel, clothing, footwear, education, medical (non-institutional and institutional), entertainment, personal & toilet goods, other goods, other services and durables. The committee concluded that all India poverty line of Rs. 446.68 per capita per month in rural areas in 2004-05.

However, such estimation suffers from the drawback that people just above the poverty line need not be very much better off than those below the line. This calls for a different approach to understand the deprivations being faced by the households.

To understand the true extent of deprivation being faced by the households, a multi-dimensional poverty index (MPI) has been calculated. The MPI takes into account that there are negative interaction effects when people have multiple deprivations. This has been done to better understand the failure of government policies and subsidies in ensuring behavioural change among households to make a shift to cleaner fuel options or to improved cookstoves. MPI has also been created because poverty cannot be adequately measured with income alone. Moreover, households tend to either under-report or are reluctant to report or report rough estimations of their income in rural areas as majority of them don't have regular work with regular monthly or weekly payments. This makes, use of reported annual incomes of the households even more difficult for the purpose of determining the economic status of the households.

In the multidimensional poverty approach, a poor person is identified using the dual cut-off method, in which first, the cut-off levels within each of the dimensions and second, the cut-off of the number of dimensions in which a person must be deprived (below the line) to be deemed multi-dimensionally poor. For the present analysis, the MPI incorporates three dimensions at the household level which are health, education and standard of living.

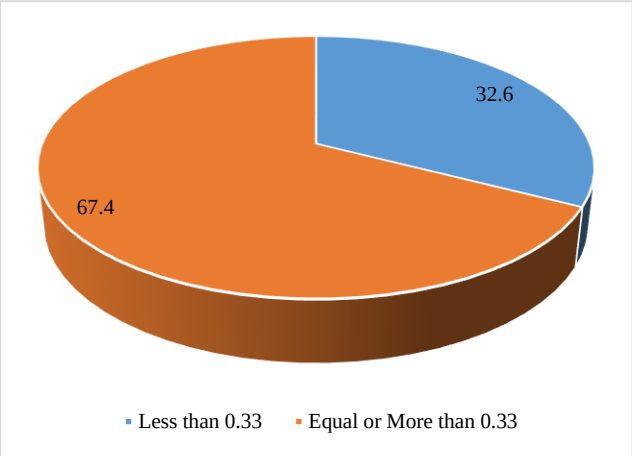
With respect to health, two indicators have been used – whether any member of the household is suffering from any disability and whether any person in the household is suffering from any disease. The two indicators have been weighted equally. Each of the indicator counts one-sixth toward the maximum possible deprivation in the MPI.

Regarding education, two indicators – Whether not even one adult member (18 years and above) has completed 5 years of education and whether any child in 6-17 age group is not studying. Again, each of the indicator counts one-sixth toward the maximum possible deprivation in the MPI.

In terms of standard of living, equal weight is placed on three deprivations (each accounting one-ninth towards the maximum possible): lack of electricity, inadequate flooring, and lack of more than one of five assets – mobile phone, television, radio, bicycle and motorcycle.

Individuals are then identified as multi-dimensionally poor if their household is deprived by a weighted sum of 0.3 or more.

Figure 14: Distribution of HH according to MPI



As can be seen from Figure 14, two-third (67.4 per cent) of the sample households are multi-dimensionally poor.

This is significantly higher than the poverty ratio estimated by government of Bihar. The high level of multidimensional poverty means just income subsidy provided by the government to make people shift to cleaner fuel will not be sufficient to facilitate such a shift.

Lack of Economic Incentives:

There exists a delay in the disbursement of subsidy under the Ujjwala Yojana. In a rural settings, such delays become known very easily and to every nook and corner thereby discouraging other villagers to make a shift to LPG. Given the poor economic condition among most of the households, it is very much rationalistic for them to not to put money in a scheme where they are not sure of getting the benefits in the form of subsidy.

Cost of getting the connection as well as the cost of refill is a binding constraint on the households which creates a deterrent for them to not shift to cleaner fuel. The bureaucratic hassles as well as location of the LPG distributors outside the village creates disincentives for the widespread use of LPG.

In addition to this, once a household gets a LPG connection, issues with the equipment, especially those given under the Ujjwala Yojana further creates financial problems for the households. Respondents reported that the LPG cookstove, regulator and other equipment given under the Ujjwala Yojana are not of good quality and require regular maintenance and repair. This further creates disincentive to switch to LPG.

Lack of Women Empowerment:

Women empowerment is essential for improving rural livelihoods. Increased say of women in household and society has been found to be beneficial for the family. Behavioural changes are rapid when women in the family have a greater say in decision making process. The study attempted to map decisions taken at two different levels and tried to disaggregate the instances where women are solely responsible or jointly responsible (with male members in the family) to take those decisions. This is important as we have seen in section related to perception and views of women that most of the women want to have clean fuel like LPG in their houses.

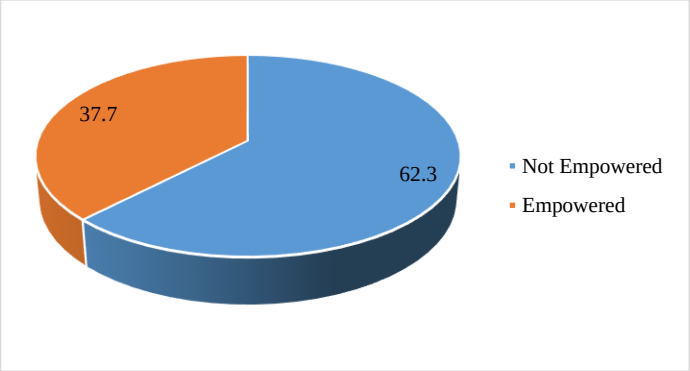
The decisions regarding which women in the households were probed included physical movement outside the house, and decisions economic in nature pertaining to savings and borrowings and purchase and sale of household assets. Based on this, an empowerment index has been created to understand the empowerment status of women within the household. The index is based on ten indicators which have been given equal weightage. The indicators that have been used are listed below.

Table 10: Description of indicators for women empowerment index

Indicator	Response	Weight
Whether visits market alone	Never or Rarely	1/10
Whether go outside village alone	Never or Rarely	1/10
Whether decides household maintenance expenditure	Never or Rarely	1/10
Whether women in the house work and earn money	No	1/10
Whether has a say in the purchase of asset in the household	Never or Rarely	1/10
Whether consulted for saving decisions	Never or Rarely	1/10
Whether consulted for investment decisions	Never or Rarely	1/10
Whether travel to bank to withdraw/deposit money	Never or Rarely	1/10
Whether travel outside home to health care centres alone	Never or Rarely	1/10
Whether own a mobile phone	No	1/10

Households with weighted sum of 0.3 or more is considered as the one where women are not empowered enough to affect the decision making process within the household.

Figure 15: Empowerment Index for women in the household



As can be seen from Figure 15, women in about two-third (62.3 per cent) of the households are not empowered enough to influence decision making in the house.

There exists a divergence among the sample blocks. For instance, in Bithan women in more than three-fourth (77.0 per cent) of the houses are not empowered, whereas in Warisnagar, in more than half of the sampled households, (55.9 per cent) women are empowered enough with respect to decision making within the household.

The above scenario shows that lack of women empowerment is also a major impediment for the shift of households to cleaner cooking fuel in rural areas.

5. Value Chain Mapping

6.1 Objectives and Methodology

Another objective of the current study is to undertake an in-depth assessment of LPG value chain as well as market assessment of clean fuel and improved cookstoves in Samastipur district in Bihar. The specific objectives of this dimension of the study are as follows:

- Mapping different stakeholders in the LPG cooking fuel value chain including distributors, refill traders etc. and understanding the cost dynamics of different stakeholders.
- Value addition at different levels and risk involved.
- Price spread analysis (how the price is distributed from source to the end user).
- Cost associated with improved cook stove manufacturing.
- Type of biomass cook stoves available (fixed and portable type; natural and forced draft type) and type of material being used for making improved cook stoves.
- Challenges being faced by entrepreneurs in terms of finance, marketing, and after sale services.
- Opportunities available for such entrepreneurs.

The study is based on both, a detailed review of secondary literature and analysis of primary data to yield extensive qualitative results pertaining to the various aspects and stakeholders of the value chain.

For the value chain analysis, primary data was collected at each level of the value chain as per the specific objectives outlined in the study. This information was critical in;

1. Mapping the value chain
2. In estimating the cash flows and profit margins for the buyers and sellers involved in the value chain
3. In identifying the strengths and weaknesses for the existing marketing systems

Four blocks, namely Samastipur, Warisnagar, Rosera and Bithan of Samastipur district in Bihar were covered. A total of 13 in-depth interviews were conducted covering cookstove sellers and repair shops, LPG distributors and informal intermediaries.

6.2 Marketing Channels and Actors

Cookstove sellers and repair shops

As more and more rural households started getting an LPG connection owing to the government scheme, the demand for shops selling and repairing cookstoves gradually increased. There are several small shops in and around villages that sell cookstoves while also providing repair services. The main source of income for most of these businesses is usually by selling ration or utensils and other items, and they provide stove repairing services as a side business. These small ration shops in the villages started repairing stoves once its demand increased in the area. There are also shops that primarily sell cookstoves which are located closer to the city.

Most of the shop owners that were interviewed commented on the poor quality of the stoves distributed under the government *Ujjwala* scheme. They claimed to be getting more customers in the past year, since many villagers had received LPG connections and stoves through the scheme and hence more stoves were now in need of repair. Villagers get their stoves to these shops to mainly get the burner or the plate in the stove repaired or replaced. As told by these shopkeepers, the burner in the government provided stove is made of iron and hence gets rusted quickly. Maintenance of the stoves is also of importance and the shopkeepers believe that villagers need to be given some basic information on how

to use and maintain stoves which is currently lacking resulting in a large percentage of stoves being repaired or replaced.

As there are intervals when LPG runs out and the households switch to firewood for cooking, the stoves lie unused while they wait to get the refilled cylinder or till they have the money to get it refilled. This sometimes causes the LPG to freeze inside the pipe which can be harmful and can cause accidents. The shopkeepers claim that villagers are usually unaware of such issues and don't take proper precautions.

While demand for cookstove repair shops has increased, the demand for new cookstoves has not been too high since the *Ujjwala* scheme came into action. As villagers get a cookstove with the LPG connection for free, not many people buy a new stove from these shops. The cost of getting cookstoves repaired or replaced varies with the location of the villages. For villages located far from the city, repairing the stoves costs anything between Rs. 50-100/- while getting the burner replaced costs between Rs. 50-100/-. For shops that are closer to the city, the shopkeepers claim to sell a pair of burners between the range of Rs. 120-300/-, after buying it for Rs. 80-200/-. The plate costs the shopkeeper Rs. 30-60/- for a pair and is sold to the villagers for Rs. 50-100/- for a pair. A new cookstove costs the shopkeepers something between Rs. 450-1300/- which they sell for Rs. 600-1500/- to the villagers.

These shopkeepers also claim to have seen a massive reduction in the use of kerosene stoves that used to be in demand before but are now not in use at all. Apart from these, no new technology of stoves that uses a fuel other than LPG was found to be promoted or in use in the area. The shopkeepers mention that several companies like Surya, Padmini etc. are selling LPG cookstoves in the market.

LPG distributors

Another stakeholder are the gas agencies that supply LPG cylinders to the villages. There are a few agencies that have warehouses and cover a large area of the district. These suppliers sell LPG gas cylinders to villages often taking orders in bulk from a village. One such distributor claimed to be having a customer base of 2000, having around 50 commercial cylinders and 500 small household cylinders in their warehouse. Another agency in the area reported to having witnessed an increase in their customer base to 4000 after the *Ujjwala* scheme. Such agencies deliver cylinders in their vans that can carry 40-45 cylinders in one stretch and charge anything between Rs. 40-100/- per delivery. Being in charge of a large area, they deliver them in 3-5 days of request. The total price of one cylinder hence becomes anything between Rs. 850-1000/- for a rural household.

Apart from these agencies, the local shops that sell and repair stoves also sometimes sell gas cylinders. Few such shop owners claimed to be selling 3-5 kg LPG cylinders that are in demand especially by college students and bachelors who live in or near the city. These small cylinders cost these shops almost Rs. 100/- per kg and are sold to customers at a profit of at least Rs. 40-45/- per kg.

Informal intermediaries

There are various middlemen present at different levels of the distribution as well. These jobs crop up due to gaps in the supply chain as the distribution network seeps deeper into villages. Some of the cookstove sellers and repair shop owners also work as informal LPG providers. For a charge of Rs. 90-100/- per Kg, gas refill is provided in cylinders weighing 3 Kg and 5 Kg. Moreover, at the price of Rs. 450-600/- gas cylinders weighing 3 Kg to 5 Kg are also sold by such cookstove sellers and repair shop owners. In addition to this, several examples cropped up during the study -

One was a tea seller who runs a small tea shop in his village. As there are not a lot of households with LPG connections in the village, the agency does not come and deliver the cylinders often. Hence, the

tea seller has taken the responsibility wherein all villagers who wish to get their cylinders refilled drop the empty ones along with their LPG cards at his tea shop. Once he has around 10-12 empty cylinders in place he calls the agency, who then deliver the refilled cylinders at his shop within 3-5 days of request. The tea seller charges Rs. 30/- per cylinder for this service and villagers seem to prefer this mechanism as they get the cylinders conveniently.

Another example is of an informal gas supplier whose job is to deliver LPG cylinders from the agency's office/warehouse to the villages. He receives Rs. 3500/- a month from the agency for his services. He claims to carry 12-15 cylinders in one stretch and does this at least two to three times a day. He also charges Rs. 30/- from the villagers upon delivering the cylinder.

The presence of such middlemen increases the final price of LPG for rural households, thus making it costlier and unaffordable for many.

6. Recommendations

Direct Financial Assistance: Multidimensional poverty among two-third of the sampled households means that the subsidy provided by the government is not sufficient to make the households shift to clean fuel. What is needed is full financial assistance in which the LPG connection and first refill is provided free of cost to the households. Increased coverage of LPG will make the financial debt incurred by the government self-liquidating in the long-run due to increased revenue from LPG usage.

Connecting Consumers with the Nearest LPG Distributor: During the study, it was discovered that in many villages while the nearest LPG distributorship is of one oil marketing company, the LPG connections with the villagers is of some other company which is several kilometres away from the village. Now, as we have seen in many cases if an individual urgently wants a cylinder then s/he has to travel to the warehouse of her/his LPG distributor, otherwise s/he will have to wait till sufficient amount of order is received by the distributor. To solve this problem, government should ensure fast and smooth transfer of LPG connections to the nearest LPG distributor.

Doing away with Delivery Charges: The government should ensure that the LPG distributors are barred from charging delivery fee from the consumers. In case distributors face additional financial constraints as a result of servicing far off places, the government should reimburse their delivery expenses instead of these distributors recovering the expenses from the consumers.

Opening up more LPG Distributors: During the study, it was discovered that the coverage of LPG was the worst in Bithan which also happens to be the farthest block from the district headquarter. What is needed is that more and more distributorships are opened in every block closer to the rural areas. For this, the government can either provide subsidy or subsidised loans to whomsoever wishes to open such a distributorship in rural areas.

Improving the Quality of Equipment: One of the reasons why people are reluctant to shift to LPG is the regular maintenance and repair cost that they have to incur on the equipment received under the Ujjwala Yojana. The government needs to ensure that good quality equipments are distributed under the scheme.

Adopting Best Practices from Other Sectors: In the banking sector, to ensure last mile banking service in rural areas, the concept of business correspondents is used. Business correspondents are representatives of banks that provide banking services in locations where bank branch cannot be opened. The same model can be imitated in the LPG distribution network. Such correspondents can replace the informal intermediaries and ensure that the consumers are charged uniformly instead as per the whims and fancies of informal intermediaries.

Reinvigorating Initiatives like National Biomass Cookstoves: Given the fact that firewood is easily available and that too free of cost, complete shift to LPG will not be easy in the near future. Therefore, in the meantime, improved cookstoves that use firewood but produces less pollution can be introduced in the market. Although National Biomass Cook Stoves Initiative (NBCI) was launched by the Ministry of New and Renewable Energy (MNRE) on December 2, 2009 it never achieved much success. This is because, while under the scheme testing facility was provided to organizations, NGOs, entrepreneurs and industries in the country for testing their improved cookstoves, what was needed was financial assistance and hand holding in the initial stages.

This is because initially when such cookstoves are introduced, after sale service infrastructure is instrumental for smooth adoption. Therefore, the government needs to provide financial assistance in the form of subsidy to improved cookstove innovators/manufacturers as well as hand holding support for after sales service infrastructure development.

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