Fuel expenditure on family size , income

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INTRODUCTION :

The government's focus to deepen the usage of LPG for cooking in rural areas has multi-pronged benefits. Apart from reducing tree cutting in forest areas, rural women will benefit as they would not be exposed to health hazards associated with smoke from chullas caused by cooking fuels such as biomass, firewood or other polluting fuels.LPG being a relatively environment-friendly and clean fuel has tremendous potential as a substitute of traditional fuels like coal and firewood. On account of limitations with traditional fuels and the associated health hazards, there is a strong reason to promote the use of LPG as a cooking fuel. Usage of LPG also leads to significant saving on time, which can be used to focus on more productive activities. In addition LPG used should be encouraged in order to help improve the air quality of the Environment .**This study** Analyzed the impact of household fuel expenditure as a means of identifying a sustainable energy. Secondary data were used obtained from general Households survey carried out in2022 . The study employed descriptive statistics, two regression models.

Despite the numerous advantages offered by LPG, over 39% households in the country still do not have access to LPG. The Minister of State (Independent Charge) for Petroleum and Natural Gas, Shri Dharmendra Pradhan, reiterated the goal of scaling up LPG penetration in India. In this context, the government intends to devise a strategy to increase LPG penetration in areas/states where the usage is low, and popularise LPG as a medium of cooking. Keeping in view the different needs of domestic households, national/state/district-level infrastructure, policy and marketing strategy need to be developed for greater adoption of LPG. In pursuit of scaling up LPG penetration, a primary survey among unconnected LPG households was conducted with low penetration. This is the smallest survey of its kind that has ever been conducted in the Indian energy sector. The survey results are being used as a reference to prepare a comprehensive master plan for increasing LPG penetration in india in the next three years.

However, the rural population in India still continues to rely heavily on traditional fuels such as cow dung, biomass, kerosene etc., for cooking purpose. The preference for liquefied petroleum gas (LPG) as a preferred fuel for cooking has been restricted to urban areas, with rural areas still dependent on traditional fuels due to affordability, accessibility and awareness issues. Addressing these deterrents is

imperative to enable the rural populace to switch to cleaner and efficient cooking, thereby achieving the government's stated objective of**progressive growth.**

The year 2016 has been declared by the Government of India as "The year of LPG consumers" with focus onsupplying clean fuel to majority of the households in the coming three years. As part of this thrust, the government has launched the Pradhan Mantri Ujjwala Yojana, which aims to provide LPG connections to five crore below poverty line (BPL) households by 2018-19. The scheme is expected to be a fillip for the rural populace to use the clean fuel in an affordable manner.

The goal of the survey, conducted by a team of 122 enumerators, was to assess the potential of LPG adoption and cooking fuel usage among the unconnected households by:

a. **Mapping current cooking fuel usage and expenditure incurred on cooking fuel of unconnected households,**
b. **Identifying key drivers and barriers for LPG use among urban and rural households that currently do not use LPG as a cooking fuel,**
c. **Assessing market readiness and price sensitivity for new LPG connections and refilling, and identifyingmarkets that could easily adopt LPG,**
d. **Enumerating conversion drivers that can facilitate LPG adoption in these markets, and**
e. **Providing directions to formulate interventions through schemes/policy frameworks to scale up demand.**

Motivation :

Participants' perceptions of their own main cooking fuel (firewood, dung, and LPG ,kerosene) . Households cooking primarily with LPG are much more satisfied with their main cooking arrangement than those cooking primarily with solid fuels. Inclusive, even households using firewood or dung as their primary fuel widely perceive LPG to be better for their health and more convenient for cooking. Furthermore, LPG-using households have higher reported satisfaction with their fuel availability as compared to firewood- and dung-using households. Overall dissatisfaction is very low among primary LPG households. Although these are the most relied on cooking fuels, solid fuel users noted severalsignificant drawbacks: excessive smoke (about 0.95), too time consuming (about 0.85), too difficult (about 0.55), and that their cookstove was impacting their health (about 0.80). Primary LPG users did regularly note its high cost (0.58), a perception of danger (0.62), and that it was harming their health (0.35).LPG owners received a second set of more specific questions related to their perceptions of the fuel. the distribution of these LPG-specific perceptions among households using it as a primary fuel as compared to those households for whom it is a secondary option. Satisfaction is high across both user groups, though, as expected, slightly higher in primary LPG households. Dissatisfaction is significantly higher among households using LPG as a secondary fuel, though LPG is still heavily preferred over firewood for convenience and health. Cost and availability are the primary reasons cited by households dissatisfied with their LPG situation. Notably, three-quarters of secondary LPG households cite cost as a reason for dissatisfaction while cost is cited by only slightly more than half of primary LPG users. Secondary LPG households report a monthly expenditure of 5019 INR, which means that a 15 kg cylinder (at 460 INR) is nearly 10% of the household's total monthly expenditures. As a result, many secondary LPG households limit their use to make one 15 kg cylinder last two months or purchase one 5 kg each month (230 INR). Still, for primary LPG households with an average monthly expenditure of 7237 INR, a 15 kg cylinder is 6% of their monthly spending.Access to fuel, an issue for all LPG owners, is divided in two questions: (i) poor LPG availability is a large factor for both primary (0.82) and secondary LPG households (0.77) and, even more pervasive, (ii) travel distance required to acquire LPG is very problematic for primary (0.91) and secondary LPG (0.87) households. Travel distance required of households to acquire LPG does not vary between primary and secondary LPG households; both on average must travel 8.5 km and more than half of households must travel more than 5 km.

Literature review :

There exists large number of research studies and articles on Fuel expenditure on family ,income . Enormous number of economists and researchers has shown interest in working on this expenditure movement. THE previous studies on households gas consumption can be categorized into two types . The first type of studies solely focused on households gas consumption . Namazkhan et al. (2019) found that gas use for space heating in winters was significantly affected by individual characteristics and building quality. Li et al. (2021) showed that an increase in temperature and tariffs was associated with lower levels of household gas con-sumption and identified four temporal patterns of consumption: single point spike, double-point flat-peak, micro-peak and linear. Harold et al. (2018) studied the impacts of demand-side management on gas con-sumption. They concluded that demand stimuli had a more significant impact on high-income households rather than low-income households. Zhu, Zhang, Tao, and Yu (2015) found that gas prices had a larger impact on urban than rural households. Namazkhan et al. (2020) concluded that psychological factors significantly impacted the level of gas consumption, among them biospheric, egoistic, hedonic and altruistic values. van denBrom, Meijer, and Visscher (2017) found a significant gap in the actual and expected gas consumption of buildings with different energy labels. The authors disclosed that low-income households consume more gas than expected. Li et al. (2016) simulated the impact of time-of-use (TOU) gas pricing and concluded that TOU measures could control the peak demand load. Krauss (2016) showed that an increase in natural gas tariffs could push more households under the poverty line. Liu et al. (2018) concluded that price and income affected household gas consumption and forecasted a sharp increase in consumption by 2025 in China. Franco (2016) modelled the demand for natural gas based on socioeconomic indicators, urbanity, economic development, and weather. Panapakidis and Dagoumas (2017) developed a hybrid model using genetic algorithms and neural networks to forecast gas use at the metropolitan scale in Greece. Jiang et al. (2021) concluded that deregulation of gas prices would decrease chainas carbon marginal abatement costs (MACs) .

The second type of studies offered parallel analyses of different fuels, among them gas. However, these studies did not offer an insight into the gas share of households' energy consumption. Najmi, G, and Keramati (2014) analysed the impact of various factors on household gas and electric consumption, including socioeconomic characteristics, the energy efficiency of buildings and appliances, and the size of dwellings. A study on the Randstad region in the Netherlands compared the determinants of gas and electricity consumption, among them socioeconomic and urban form factors (Mashhoodi & van Timmeren, 2018). Morris, Allinson, Harrison, and Lomas (2015) developed two separated models for households' gas and electricity consumption, analysing the impacts of income, climate, and dwelling size. Zhang et al. (2021) studied the impact of economic growth on gas and electricity consumption. Wu et al. (2019) illustrated the energy profile of Chinese rural households by separated analyses of different energy sources, among them coal, electricity, LPG, wood. Ravindra et al. (2019) studied the trends in household energy consumption in India, considering different energy sources: firewood, biogas, LPG, and electricity. Adua (2020) analysed the annual gas and electricity consumption of households in the United States. Acharya and Adhikari (2021) studied Nepal's electricity, coal/briquette, LPG, and Kerosene consumption. . Shupler et al. (2021) assessed the nature of energy consumption among the households in Kenya during the COVID-19 pandemic and reported that a quarter of households have switched from LPG to kerosene and wood due to a decline in livelihood and income opportunities. Similarly, Ravindra, et al . (2021) reviewed the impact of COVID-19 pandemic on the clean fuel program in India and highlighted the concerns for the rural population on affordability and accessibility of clean cooking fuel due to loss of income and livelihood during the lockdown.

Based on the literature review, we have developed a research framework to analyze the factors affecting the access to clean cooking fuel among rural households during the COVID-19 pandemic in India. It is evident from the reviewed literature that the socio-demographic characteristics of the households are determining factors in making the cooking fuel choices. Similarly, the asset holding capabilities of rural households have also been assumed to be influencing the clean cooking fuel adoption ..Access to clean cooking fuel is an area of concern for rural house-

holds across developing nations (Muller & Yan, 2018; Puzzolo et al., 2019; Guta, 2020; Liu, Wang, Xiong, & Liu, 2020; Ochieng, Zhang, Nyabwa, Otieno, & Spillane, 2020). Empirical evidence indicates that rural households by and large use mixed fuel for their cooking needs and adoption of clean fuel is influenced by household characteristics, asset holdings, price of fuel, and supply factors (Kuo & Azam, 2019; Schunder & Bagchi-Sen, 2019; Pye et al., 2020). As biomass cooking fuels is cheaper in price, most rural homes in low-income countries widely use locally available cooking fuel sources (Pant, 2012). Several studies have discussed the problems of indoor air pollution due to the use of bad cooking fuels. While, Gautam et.all (2013) argued that cow dung is the most polluting fuel for cooking followed by wood and kerosene, Sehgal,et.all(2014) stressed the severity of health burden due to biomass cooking fuels among women in India as they assume the primary responsibility of household cooking. A study by Tian, Tian, Shen, and Shao (2021) evaluated the rural-urban gap in health issues related to cooking fuel choices in China and concluded that rural households are prone to higher health risks due to their high dependence on solid fuels for cooking..Choudhuri and et.all(2020) evaluated gender inequality in Indian households in terms of fuel choices and concluded that households with empowered females have more chances of using and investing in cleaner fuels for cooking. This assessment is in tandem with the key objective of Pradhan Mantri Ujjwala Yojana (PMUY) of the union government, which aims at empowering women by ensuring access to safe and healthy cooking fuel to female-headed households.

Objectives:

This study is based on the secondary data from census. The main purpose of this study is Household income and expenditure statistics serve a variety of purpose with respect to economic ,social and other forms of description and analysis in west Bengal. This paper focuses on the discussion about the factors which causes a massive increase LPG prices and its impact on the rural people of west Bengal.

The detail objectives of this study are--

a. Map current cooking fuel consumption and amount spent on cooking fuel of unconnected households,

b. identify barriers affecting use of LPG in rural and urban areas , especially in low-usage areas with specific emphasis on price and access barriers,

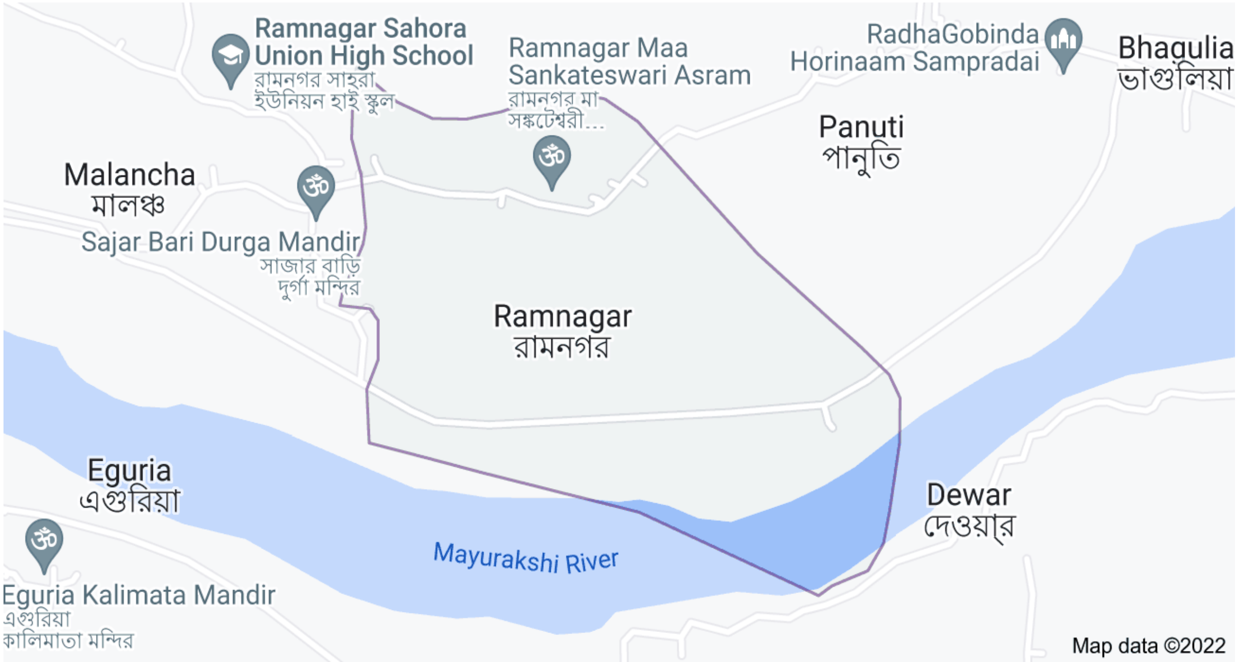
c. enumerate conversion drivers for LPG usage according to end –users and key influencers such as GPs,
d. Estimate price-sensitivity for purchasing new LPG connection and refill
e. identify priority markets for increasing LPG penetration in the short term ,
f. provide direction for formulating intervention that can be addressed through schemes/policy frameworks to scale up the demand and
g. outline socio –economic profile of unconnected households.
In this paper we will show the interrelation between percentage of LPG usage, family size and households income by using two variable linear regression model.

METHODOLOGY

The data used in the analysis was collected through a structured interview schedule from theDistrict Birbhum of West Bengal. The survey involved first-hand information obtained through According to 2011 Census Birbhum District consists of a population of 3,502,387 roughly equal to the nation of Lithuania or the US State Connecticut. This gives it a ranking of 84th in India. The District has a population density of 771 inhabitants per square km. The data was collected through Sampling Method. Administratively, Birbhum District is divided into eight community development blocks. Out of these eight blocks, one block viz. Illambazar was selected randomly and Ramnagar village was selected for sampling.

Ramnagar village is located in Illambazar subdivision of Birbhum District in West Bengal, India. It is situated 9.4 km away from Sub-District Headquater Illambazar (Tehsildar Office) and 38.8 km away from the District Headquarters Suri. As per2009 stats, Illambazar is the gram Panchayat of Ramnagar village.

Google Map of Ramnagar



The Map data on this website is provided by Google Maps, a free online app service, one can access and view in a web browser.

Three - variable regression model has been used in the study. Total fuel expenditure (rs/ months)has been considered as the dependent variable. number of family member and income of households **are considered as the independent / explanatory variables. Descriptive Statistics has been used to know the Mean, Median, Mode, Standard Error, Standard Deviation, Skewness, Kurtosis, Sample Variance, etc of dependent and independent variables taken in our regression model. The collected data of the variables have been represented in Histograms and Pi-Charts. To study the difference between hours spend by male and hours spend by female in farms, a Three – Variable Regression Model has been used. T-Test has been performed to check whether the overall regression is statistically significant or not.**

RESULTS

DESCRIPTIVE STATISTICS :

For this study we have randomly drawn a sample of 32 villagers from Ramnagar village. Then we have calculated the Descriptive Statistics (Mean, Median, Mode, Standard Error, Standard Deviation, Skewness, Kurtosis, Sample Variance, Range, Minimum, Maximum, Count, Sum) individually for both the Dependent variable and the Independent Variables.

Descriptive statistics of the variables taken during the survey.
Our regression model is specified as:
Y=α+ X1.β1 + X2.β2+ ε

Where y is our dependent variable which represents total FUEL expenditure (rs/months) .X1 and X2 are our explanatory / dependent variables which represents number of family member and income of households . and β1and β2are our regression coefficients.

M.2 Details of Fuel Expenditure (Rs/Month)		*C.2.Number of family members:*		*C.11. Family Income of household-*	
Mean	500.9333	Mean	5	Mean	9233.333
Standard Error	52.46621	Standard Error	0.283654	Standard Error	5909924.
Median	440	Median	4.5	Median	9000
Mode	500	Mode	4	Mode	6000
Standard Deviation	287.3693	Standard Deviation	1.553639	Standard Deviation	3236.999
Sample Variance	82581.1	Sample Variance	2.413793	Sample Variance	10478161
Kurtosis	-0.73714	Kurtosis	0.404891	Kurtosis	-0.8307
Skewness	0.332126	Skewness	1.004883	Skewness	0.406204
Range	976	Range	6	Range	10000
Minimum	0	Minimum	3	Minimum	5000
Maximum	976	Maximum	9	Maximum	15000
Sum	15028	Sum	150	Sum	277000
Count	30	Count	30	Count	30

The above table represent the mean ,median , mode, standard error, standard deviation , kurtosis, skewness, Range ,Minimum, Sum, And Count of the variables taken .

From the Descriptive Statistics data table, the Mean of Total FUEL expenditure(Y) is 500.9333. We see that the Mean of number of family members (X1) is 5 and the family income of households (X2) is 9233.333. Therefore, we find that the number of family member is greater than the Mean of family income of households. Hence we conclude that on the Average Revenue of500.9333 ,

The mean of the Variables are given as follows:

	Number of family members.	Family income
Mean	5	9233.3

standard deviation. 1.5533236.9

Number of respondents. 30. 30

Here our level of significance is 10% i.e., 0.1/2 = 0.05

We set the Null and Alternative Hypothesis:

HN : µA = µB

HA : µA ≠ µB

Now, t = $\bar{X}$A - $\bar{X}$B /

= [5 –9233.3] / [(1.55/30) + (3236.9/30)] = (-9228.3) / (0. 051+ 107.89) = -9228.3 / 107.941= 85.49

The Mean of Total fuel expenditure(Rs/Months) which is representd by variable Y is 500.9333 .The mean of number of family member which is represented by variable X1 is 5 .The mean of income of households which represented by variable X2 is 9233.333

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The median of the variables is given as follows:

Y	440
X1	4.5
X2	9000

the median of the Y is 440 .the median of X1 is 4.5 and that of X2 is 9000 .

The Mode of the variables is given as follows:

Y	500
X1	4
X2	6000

The mode of Y is 500. The mode of X1 is 4 and that of X2 is 6000.

The standard error of the variables is given as follows:

Y	52.46621
X1	0.283654
X2	5909924.

The standard error of Y is 52.46621 .the standard error of X1 is 0.283654 and that of X2 is 5909924.

The standard deviation of the variables is given as follows:

Y	287.3693

X1	1.553639
X2	3236.999

The standard deviation of Y is 287.3693 .the standard Deviation of X1 is 1.553639 and that of X2 is 3236.999 .

The Sample variation of the variables is given as follows:

Y	82581.1
X1	2.413793
X2	2.413793

The Sample variation of Y is 82581.1 .the standard Deviation of X1 is 2.413793 and that of X2 is 2.413793 .

The Kurtosis of the variables is given as follows:

Y	-0.73714
X1	0.404891
X2	-0.8307

The kurtosis of Y is -0.73714 .the standard Deviation of X1 is 0.404891 and that of X2 is -0.8307 .

The Skewness of the variables are given as follows:

Y	**0.332126**
X1	**1.004883**
X2	**0.406204**

The Skewness of Y is 0.332126. The Skewness of X1 is 1.004883 and that of X2 is 0.406204 .

The Range of the variables is given as follows:

Y	**976**
X1	**6**

X2	**10000**

The Range of Y is976 . The Range of X1 is 6 and that of X2 is10000 .

The Minimum of the given variables are as follows:

Y	**0**
X1	**3**
X2	**5000**

The Minimum of Y is 0 . The Minimum of X1 is 3 and that of X2 is 5000.

The Maximum of the variables are as follows:

Y	**976**
X1	**9**
X2	**15000**

The Maximum of Y is 976 . The Maximum of X1 is 9 and that of X2 is 15000 .
The sum of the variables are given as follows:

Y	**15028**
X1	**150**
X2	**277000**

The Sum of Y is15028 . The Sum of X1 is 150 and that of X2 is 277000 .

The Count of the variables are given as follows:

Y	**30**
X1	**30**
X survey 2	**30**

The Count of Y is 30. The Count of X1 is 30 and that of X2 is 30.

OBSERVATION

The has been conducted in a village Ramnagar in Birbhum district. We have interacted with the people of Ramnagar. The maximum number of family size is 8 and minimum is 3 among the respondents. The occupation of the respondents is mainly agriculture and every family possess their own agricultural land. Both men and women work in farms.

Figure-1: Number of family members

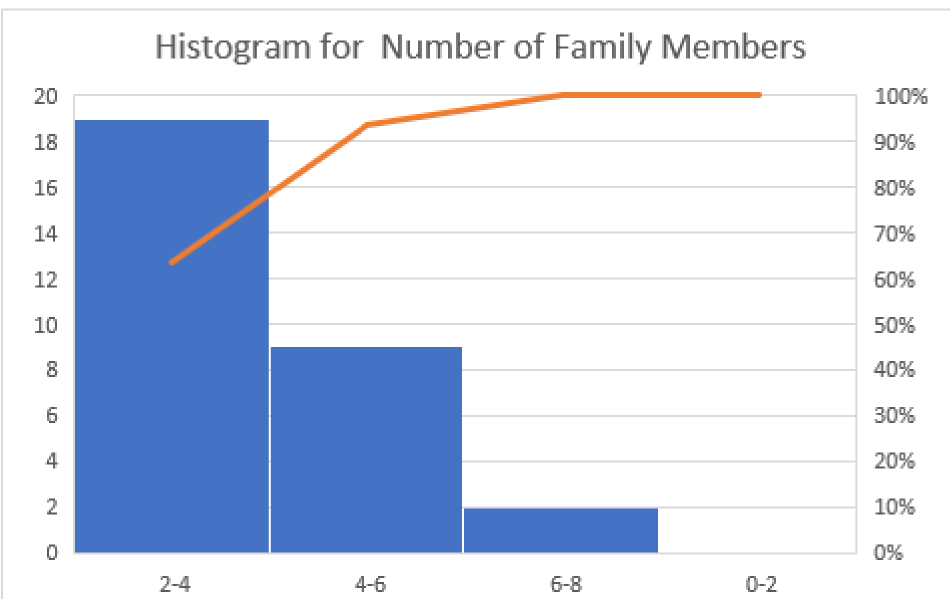

Figure-1 represents total number of members in the family. The highest number of family members is 8 and lowest number of family members is 3. Most of the families consists of 2 to 4 members. More than 90% families consistof 2 to 4 members. 10% families consist of 6 to 8 members.the average family size among the surveyed households is more than 8 members: 1-2 male adults, 1-2 female adults, 1-2 male children and 1-2 female children. Tripura and Odisha have smaller families with 4-5 members.

Figure-2: Total fuel expenditure (rs/ months)

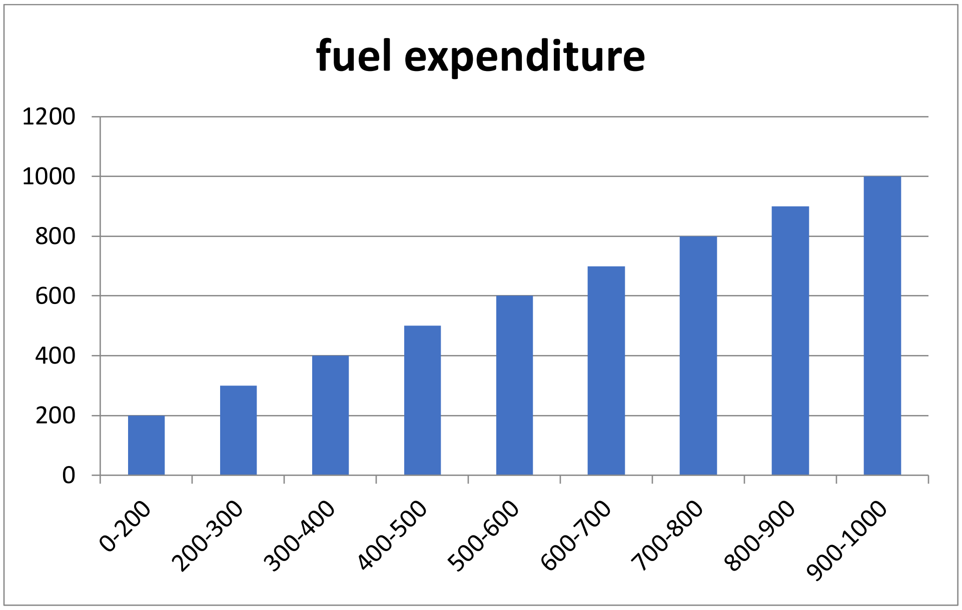

Figure-2 represents total fuel expenditure for cooking. We see that most of families' fuel expenditure range is Rs. 0 to rs. 200 . Very few number of families' expenditure range is Rs.500- Rs.1000. 90% of the families only fuel expenditure Rs. 500 to Rs. 900 for cooking . Less than 10% families fuel expenditure is Rs. 500 to Rs. 1000 for cooking.

Fuels used for cooking

Use of firewood as cooking fuel is found to be significantly high among all the surveyed village -94%

households. Other fuels used include kerosene (69% households), cow dung cakes (60% households) and biomass (33% households). Most households use more than one fuel.

: Major fuels used for cooking

Firewood 

The usage of firewood is lower in Bihar (77%) as compared to other states where it is over 90%. Some of the salient features of firewood usage are:

1. There is no significant difference in the usage of firewood as fuel between unconnected LPG households in urban and rural areas.

2. Shortage of wood was highlighted by households in certain districts of Uttar Pradesh (Banda and Chitrakoot) and Bihar (Aurangabad, Banka, Gaya, Jamui and Nalanda). This was further confirmed during the GP survey.

3.Kannauj, which uses biomass as fuel for cooking, falls in a plain non-forest area in Uttar Pradesh characterized by 90% farming population. The principal crops are potatoes, wheat and maize which provide easy access to biomass for fuel. Cow dung cakes are found in abundance due to a sizable population of livestock in the area. Chitrakoot is a hilly dense forest area resulting in difficulty in accessibility and households prefer to use biomass from mustard farming or cow dung cakes. Households in Banda district located adjacent to Chitrakoot also exhibit similar behaviour.

4. Aurangabad, Banka, Gaya and Jamui are covered by dense forests that are unsafe for firewood collection on account of wild animals and insurgent activities. In Nalanda, cow dung cakes are preferred due to their easy availability.Firewood is used as cooking fuel in all the surveyed states, except Nagaland, where it is also used for lighting.

5Easy availability of forest wood and cow dung has been cited as a barrier to adopt LPG as cooking fuelin Madhya Pradesh. In Rajasthan, good quality wood (mainly babul wood) is easily available for cooking purpose, which might be a barrier to shift to LPG. In Chhattisgarh, Assam, and Tripura the availability of plenty of wood has been cited as an important barrier for not switching over to LPG. In Odisha too, wood being available free of cost in large quantity results in low inclination towards using LPG. Firewood is easily available in the North eastern states of Meghalaya, Tripura, and Nagaland and its usage to not only for cooking but also for heating purposes, resulting in firewood being theirprimary source for energy.

Kerosene

Kerosene usage for cooking in the states of Meghalaya (5%), Nagaland (23%), Chhattisgarh (48%), West Bengal (52%) and Rajasthan (59%) is lower when compared to the other states covered in the survey. The salientfeatures of kerosene usage are:

1 . No significant difference is observed in the usage of kerosene as fuel between unconnected LPG households in urban and rural households.

2. Usage of kerosene in households is high across all states except Nagaland and Meghalaya due to limited availability of ration cards. The gram panchayat members mentioned easy availability of kerosene in Uttar Pradesh, Assam, Odisha and Gujarat as reason for its high usage while gram panchayat members from Rajasthan, Meghalaya and Nagaland cited limited availability as the cause for low usage.

3. Kerosene is the principal fuel used for lighting, i.e., to ignite firewood or cow dung . It is also used for other purposes such as running water pumps.

Biomass:

Figure-3: Family income of households(rs/ months)

Figure-3 represents monthly income of households . From the figure we can conclude that the highest and lowest number of households income in one family is15000 and lowest income 6000. Maximum income of households 6000 to 15000 Very few of them spend6000 to 9000 in one family.

RESEARCH METHODOLOGY;

The data for this study were collected in 12 April 2012. A total of 32 questionnaires were randomly administered in the area through face-to-face interviews. The questionnaire included information on income , fuel expenditure patterns and their general view about their socio-economic status .and expenditure patterns, respondents' And their general view about their socio economic status. In total, data from 32households were deemed legible for the purpose of this study. The data were analyzed using Statistical Package for the Social Sciences (SPSS). A two linear regression model was used to determine the socio- economic and demographic factors affecting Fuel expenditure. The regression model was estimated as follows:

M.2 Details of Fuel Expenditure (Rs/Month)	C.2.Number of family members:	C.11. Family Income of household-
420	6	15000
960	4	10000
360	4	6000
360	4	8500
250	4	9000
960	4	6000
500	5	5000
600	4	10000
0	4	11000
600	5	5500
325	4	12000
500	3	15000
976	8	10000
220	3	9000
300	4	8000
600	5	9000
400	3	10000
250	6	15000
325	4	5000
976	7	10000
976	7	5000
500	6	12000
800	4	6000
0	5	6000
260	4	6000
750	5	6000
460	6	8000
400	9	12000
200	5	15000
800	8	12000

In determining the interrelation among Total FUEL expenditure (Rs/months) , number of family member and family income of Households facilities this study fits the Two variable linear regression. In our linear regression analysis Total fuel expenditure (number of LPG cylendar)is the dependent variable and number o family member and income of households facility are explanatory variable. The model is specified as follows:

$Y_i=\alpha+\beta_1X_{1i}+\beta_2X_{2i}+\varepsilon_i$ ....(i)

Where, i=1,2,…,32

Y_i = fuel expenditure (Rs/months)
X_{1i}= number of family member

X_{2i}= income of housrholds

α= intercept term

ε, β_1 and β_2 are unknown parameters .

Estimating the equation (i) by OLS estimator we get -
$\hat{Y}$ i = $\hat{\alpha}$+X 1i. $\hat{\beta}$ 1 +X 2i .$\hat{\beta}$ 2 . + e i …………………….(2)

$\hat{\alpha}$, $\hat{\beta}$ 1 and $\hat{\beta}$ 2 are the numerical estimates of α, β 1 and β 2 respectively

$\hat{\alpha}$, $\hat{\beta}$ 1 and $\hat{\beta}$ 2 are the numerical estimates of α, β 1 and β 2 respectively.

$\hat{Y}$ i , gives the estimated values of Y i for different values of X 1 and X 2

and obtained the estimated residual

e i = ε i .

e i = Y i -$\hat{Y}$ i = Y i - $\hat{\alpha}$- $\hat{\beta}$ 1i .X 1i - $\hat{\beta}$ 2i .X 2i ------------------ (3)

Estimated values are:

$\bar{Y}$ = 15028/32 =469.62.5

$\bar{X}$ 1 =150/32 = 4.6875

$\bar{X}$ 2 = 277000/32 = 8656.25

CALCULATIONS

Result of regression :

Regression Statistics	
Multiple R	0.447398
R Square	0.200165
Adjusted R Square	0.140918
Standard Error	266.353
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*

Regression	2	479365.7	239682.9	3.378483	0.049035
Residual	27	1915486	70943.93		
Total	29	2394852			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lo 95.*
Intercept	332.4932	200.6919	1.656734	0.10915	-79.2926	744.2789	-79
C.2.Number of family members:	77.00811	32.46109	2.37232	0.025061	10.40345	143.6128	10.4
C.11. Family Income of household-	-0.02346	0.01558	-1.50567	0.143762	-0.05543	0.008509	-0.0

Estimated values of slope parameters:

α^ = 332.4932 $\hat{\beta}_1$ =77.00811, $\hat{\beta}_2$ = -0.02346

Hypothesis Testing:

For testing the significance of $\hat{\beta}_1$ and $\hat{\beta}_2$ we have to test the validity

of the null hypothesis (H_N) that the value of $\hat{\beta}_1$ and $\hat{\beta}_2$ is equals to

zero against the alternative hypothesis (H_A) is not equal to 0. We set

our hypothesis as:

$H_N : \hat{\beta}_1 = 0$

$H_A : \hat{\beta}_1 \neq 0$

Now we have to compute the t-value which is denoted by t*. The

formula for computing t* is

$|t^*| = \lambda/2 / SE(\hat{\beta}_1) = (77.00811) / (0.01558) = 4942.754$

where SE($\hat{\beta}_1$) is the Standard Error of $\hat{\beta}_1$

Estimated value of $|t^*|$ is 4942.754 . Now we have to compare the value

of $|t^*|$ with the critical value of t from the t-table for the significance

of $\lambda/2$ and degrees if freedom n-k-1. Here n is the number of

observation i.e., 30.

At 5% level of significance $\lambda/2$, (n-3) is 2.052

We see that $|t^*|$ < $t_{\lambda/2, (n-3)}$, i.e., absolute value of computed t is

greater than the value of critical-t at 5% level of significance $\lambda/2$

and degrees of freedom i.e., 27. So H_N is accepted and we can

conclude that $\hat{\beta}_1$ is statistically significant at 5% level of

significance.

$H_N : \hat{\beta}_2 = 0$

$H_A : \hat{\beta}_2 \neq 0$

Now we have to compute t value which is denoted by t^*. The formula

for computing t^* is

$|t^*| = \hat{\beta}_2 / SE(\hat{\beta}_2) = (418.56) / (234.649) = 1.7837$

Where SE($\hat{\beta}_2$) is Standard Error of $\hat{\beta}_2$.

Estimated value of $|t^*|$ is 1.7837. Now we have to compare the value

of $|t^*|$ with the critical value of t from the t-table for the significance

of $\lambda/2$ and degrees if freedom

POLICY SUGGESTIONS :

The evidence suggests that low income urban households rely on traditional fuels to a greater extent than higher income households, and are paying higher prices for useable energy due to the inefficiency of traditional fuel-using cooking stoves and kerosene lamps. Poorer people also spend a larger share of their money income on energy than higher income urban consumers. As the principal consumers of traditional fuel, the poor also bear a disproportionate share of the health and inconvenience costs associated with residential energy consumption. Taken together, these findings suggest that the poor are relatively burdened by the pattern of residential energy utilization in developing countries.

One important policy variable is fuel access. Expanding fuel access will increase the flexibility to substitute one fuel for another, and the responsiveness of low income consumers to the price of different fuels. This flexibility could reduce inconvenience and monetary costs, allowing poorer households to lessen the burden of regressive energy taxes on traditional or transitional fuels, and face lower monopoly markups in monopolistically competitive markets. The flexibility to fuel switch also allows consumers to minimize the burden of sudden price increases caused by local shortages. Such cyclical price rises are common in developing countries, which often see increases in wood and charcoal prices during the rainy season. If the poor lack access to fuel alternatives — through limited supplies, economic barriers to fuel access, or institutional restraints -- they have no choice but to pay relatively high prices in a restricted traditional fuels market. Policies to promote market access include investments in modern fuel infrastructure and distribution, and reducing the financial barriers to entry for the poor through loans for stoves or rolling up-front costs into market prices. The substantial initial costs of LPG equipment deter many poor consumers.

The price of lighting is generally the consequence of electrification policy. Both the poor and the rich are able to take advantage of electrical lighting in countries that promote universal service. Where barriers to electricity adoption exist, the poor are usually differentially restricted and pay more for lighting services. One potentially sensible energy assistance program for the poor that is carried out by many developing-country power companies is the practice of using increasing block rate tariff structures along with connection charges that are rolled into the overall price that the public pays for electricity. This reduces the barrier to entryfor the poor to adopt electricity for the low levels of electricity that they use -- about 50 kilowatt hours per month. In countries with such policies, most of the poor take advantage of electricity service for lighting. The level of service should be geared to this use level, and should be accompanied by wide access to connections, which will forestall the common practice among the poor of buying electricity for lighting from a neighbor, often at higher prices than they would be charged by the power distribution companies. This practice is more prevalent in urban areas of developing countries than many power distribution companies realize. Thus, the adoption of the block-rate tariffs potentially could benefit poor customers as well as the cash flow of utility companies.

Broadly-applied subsidies on transitional or modern fuels would also help lower income households. The effects of such subsidies are both direct and indirect. The direct effect is that many poor people use the transition fuel, thereby reducing their energy expenditures. The indirect effect is that biomass fuels must compete with transition fuels that are subsidized and widely available to the poor. Therefore, subsidizing substitute fuels provides a price cap on traditional fuels. Many countries with high biomass fuel prices have large markups between roadside supply of the fuel and final market price in urban areas. This margin often contracts with changing supply costs and greater competition from fuel alternatives.

Broad-based subsidies on modern fuels benefit all income classes. In fact, the better-off classes will garner the greatest share of modern fuels subsidies since they consume more modern energy than lower income households. Subsidies also impose budgetary and economic costs, and foreign exchange costs if subsidies encourage additional fuel importation. Despite these negatives, it should be reemphasized that fuel subsidies do help the poor. In addition, the foreign exchange costs would not be notable for the countries in this study because the main subsidies are for indigenously-produced fuels—coal in China and kerosene in Indonesia. Indeed, subsidizing import-competing domestic fuel sources could actually reduce foreign exchange costs, thereby providing an additional benefit.

To overcome the drawbacks of general subsidies, some countries have tried limiting fuel subsidies to rationed quantities. This policy avoids some of the problems of more broadly-applied subsidies, but is difficult to apply and administer effectively (See Chapter 6). Moreover, the price differential between subsidized and unsubsidized fuel provides a motive for those who control fuel distribution to divert shipments onto the open market. The market bifurcation between subsidized and unsubsidized fuel also has the drawback in not capping the price of traditional fuel at the lower subsidized level. In short, the direct benefit of this kind of subsidy policy can be attenuated, and the indirect benefit of the general subsidy – lowering the backstop price of traditional fuels – is absent.

Either subsidizing modern fuels or taxing traditional fuels could be used as a policy instrument to accelerate the energy transition for environmental, health, or other reasons. However, subsidizing modern fuels would have a positive effect on the poor, while taxing traditional fuels would have a negative effect in a market where poor consumers are already burdened. For this reason, using policy to accelerate or subsidize the modern fuel sector would seem presumptively better of the two options. Again, however, the practical problems of subsidies, as well as their budgetary impact and net economic cost, would have to be weighed in the decision-making.

Sometimes Kerosene, LPG, and electricity are taxed in developing countries. The intention is often laudable --taxing “rich peoples” fuel is a progressive way to generate revenue and encourage energy conservation. In the end, however, such taxation hurts the poor by raising the effective cap that modern fuel prices put on biomass fuels. Not only does this policy hurt the poor in the short-term, it delays the energy transition in the long-term by raising the backstop price of traditional fuels.

Another point is that structural economic reform proposals that would remove subsidies in the energy sector, or deregulate prices (e.g., for electricity) must be assessed very carefully (Estache et. al., 2001). If subsidies are removed without a compensatory program, the poor will be hurt the most. Unfortunately, many countries cannot continue to provide subsidies for financial reasons because residential energy demand are growing more rapidly than energy demand in other sectors, making household subsidies an increasingly untenable financial burden. As mentioned above, fuel subsidies in conjunction with quantity rationing – one solution to this problem – has some practical problems.

We have been focusing on energy utilization patterns in urban energy markets, and the way they evolve; consumer attributes affecting consumption demand, and the responses of consumers to incentives and constraints; and the particular issues that confront low income consumers in urban energy markets. Throughout we have considered the role of policy. we shift the focus to consider the environmental and health implications of urbanization and traditional fuel consumption patterns. We will specifically examine the relationships between ruralization, residential energy consumption, and periurban deforestation, and the implications of biomass consumption trends for the exposure risk consumers face to the indoor pollutants generated from using biomass fuels for cooking.

DISCUSSION AND CONCLUSION

This study analyzed the expenditure patterns of households in a westbengal village of Ramnagar. A Two variable linear regression model was used to determine the factors influencing household expenditure. Data from a random sample of 32 households in ramnagar was analyzed, with the monthly household expenditure as the dependent variable and a Number of family member and income of households as explanatory variables. The total average household expenditure was recorded at 277000 per month. The next biggest single item is energy expenses at 9.8%. The respondents were also found to be repaying household debt (7.8% of household expenditure). An analysis of the sources of household income shows that salaries and wages make the most contribution (50.5%) to household income. The various government grants given to those in need and qualifying contributes about 36.3% to household income.

The results of the regression analysis on the factors influencing household expenditure suggest thathousehold income, household size, the number of people employed, employment status, marital status, and the educational attainment of the household head significantly affect total monthly expenditure. Specifically, as household income increases, total monthly expenditure is expected to increase. A percentage increase in household income was associated with a 32% increase in total household expenditure. Household income is important as it determines how much can be spent on various needs of the household. The quantity and quality of a household's expenditure patterns are highly correlated with the purchasing power of the household. Larger households are also associated with increased expenditure. In elasticity terms, a one percentage increase in household size will lead to a 17% increase in household expenditure. It was expected that household size would significantly impact household expenditure. These results are consistent with those of Davis et al. (1983) who concluded that household income and household size exert a significant .

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