

WHY NOT LPG? 4A MATRIX OF ENERGY CHOICE

Satyasiba Das¹, Prof. Suchitra Pal², Sampriti Mahanty³

¹Indian Institute of Management, Raipur; India.

²Xavier School of Human Resource Management, XUB Bhubaneswar,

³Xavier Institute of Management, Bhubaneswar, India

Corresponding Author: Prof. Satyasiba Das, e-mail: satyasiba.das@iimraipur.ac.in

REFERENCE NO	ABSTRACT
POLC-04	LPG is one of the cleanest source of fuel for urban Below Poverty Line (BPL) households. It is one of the biggest challenges for developing countries to provide cleaner sources of cooking fuel to its urban below poverty line households. The household of urban BPL group are shifting from traditional cooking fuels to cleaner energy use. This paper reported on a recent survey on household energy consumption pattern of urban (BPL) families living in the slums of Bhubaneswar, Odisha, India. The study developed a 4A's matrix (Affordability, Availability, Awareness and Attitude) to evaluate the different reasons behind acceptance and non-acceptance of LPG among the respondents. The results indicate that 4 A's do not function in silos; rather they create a cumulative effect by working alongside of each other.

Keywords:
Energy, LPG, Below Poverty Line

1. INTRODUCTION

Household energy use is a major component of GHG emission in many developing countries. There is a preference of using solid fuel for cooking in the households of developing countries (Bonjour et al., 2013). Almost 80% of the total energy consumed in India is to meet their energy requirements for cooking NSSO (2001). Nearly half of the country still cooks with firewood and largely depend on traditional biomass fuels, charcoal, fuel wood, agricultural residues and animal dung (NSSO, 2001, Population Information Bureau, 2012, Johansson and Goldemberg, 2002), out of that three-fourths of India's populations uses fire wood as their main fuel for cooking (NSS, 2010). However, till date household energy use got little attention, even though households are the main contributors to pollution, which is energy based and affects both the climate and human health. The demand for modern fuels like electricity and LPG is likely to grow at a faster rate in the domestic energy sector by 2030 (Bhattacharyya, 2015).

Jain (2010) reported that due to high price and limited availability of clean fuels, most of the rural and urban population in India still depend

on traditional fuel. Pachauri (2004a) observed that both in an urban and in a rural set up the role of household income and location contributes to the major energy consumption pattern. Energy plays an important role in both the development of society and poverty alleviation (Pachauri and Spreng, 2004). Bhatia (1998) reported that the poor households pay more than the higher income households, and most of the time the energy poor are also income poor (Khandker, Barnes and Samad, 2012). According to the Ministry of Petroleum and Natural Gas India, there are a total of 17.78 crore domestic LPG connections in the country making it 715 connections in every 1000 household. Data on energy availability or energy consumption per capita in India does not amplify the household fuel choices because of changing demographic conditions and specific policies targeting the household energy sector till Census 2011. India is currently planning to have different subsidy systems, introducing different financial schemes for below poverty level citizens, to boost the adoption and use of LPG in the rural population (Lucon et al., 2004; Smith & Sagar, 2014; Tripathi et al., 2015). But it is not clear from the above report about the number of

households in urban, rural and (the BPL group) in urban areas using LPG.

Many researches focus on energy consumption patterns of rural Indian households. Of India's total population, 27.1% to 28.3% of rural population and 23.6 to 25.7% of urban population has been reported as living below the poverty line (Indian Statistic). Our paper reports on the urban below poverty line household's energy consumption pattern in Bhubaneswar city of Odisha, India. Therefore, the purpose of this paper is to systematically find out the reason behind the acceptance and non-acceptance of LPG user among the BPL group in Bhubaneswar city. We have arrived at four pillars from an economic, social and psychological perspective which will ultimately help in determining the energy choice of a certain household. The four salient factors which determine a household's ultimate energy choice decision are Affordability, Availability, Attitude and Awareness. We call it the "4A Matrix of Energy choice" and we will find out how far these matrices contribute to the uses of LPG among Urban BPL households.

Fig 1 Matrix of Energy Choice

AFFORDABILITY	AVAILABILITY
ATTITUDE	AWARENESS

1.1. Back Ground of Bhubaneswar City in The State of Odisha

Bhubaneswar, one of the first planned cities in India and the state capital of Odisha, has become prominent due to economic and religious importance. Bhubaneswar Municipal Corporation (BMC) covers an area of 135 square kilometres and provides service to 8.41 lakh people. BMC area has 377 slums where 3.09 lakh people live in 60126 households. 37% of the BMC population live in slums. Migration is becoming a serious issue for cities like Bhubaneswar which can be seen from the decade; city growth and a large slum

population. Growing urbanization and employment opportunities has attracted a vast majority of people from their home to earn basic livelihood. Bhubaneswar Municipal Cooperation (BMC) covers an area of 135 sqkm and provides service to 8.41 lakh people.

In Bihar and Odisha, the spread of LPG lags far behind the rest of the country, with less than 12% of households in both states using LPG. The difference among the states in energy use may be due to the market variation and significant policy autonomy of Indian states (Jenkins, 2004; Sinha, 2005). The key question is thus what kind of intervention is required to facilitate the use of LPG among the lower end of the consumer pyramid. At the same time, government initiatives, have favoured the economically sound, because of the inequalities in fuel and equipment available in the different income groups (Alma, Sathaye and Barnes, 1998).

2. METHODOLOGY

A month-long LPG outreach survey was undertaken for hundred percentage usage in households, through document analysis and a self- reported questionnaire was filled out by the interviewers.

2.1. Research Sample

Sample consists of 3065 respondents from three identified slums of Bhubaneswar, i.e. SaliaSahi, Ghatika, and Bharatpur.

2.2. Research Questions

The present study is divided into five parts. A pilot study was conducted to improve the reliability and validity of the questionnaire used for this present study. *Part 1* consists of general information regarding the respondents which includes demographics (for e.g., age, gender, monthly income of the households). Then personal information is about the main source of income, monthly house hold income, economic status, whether they have any photo identity card, bank account in their name,

mobile number, type of house they live etc. *Part 2* of the survey is about the acceptance/awareness of LPG among the respondents. For e.g., the approximate time spent in cooking, primary source of fuel used for cooking, from how long they have been using the LPG, size of the cylinder (5Kg or 14.2kg), cylinder type, the source from where they buy the cylinder etc. *Part 3 (A)* of the survey is all about the non-acceptance of the LPG connection. Which cover if not using the LPG at present then what are the reasons? For e.g., is there any personal problem in getting the LPG connection or the problem is from the distributor/supplier of LPG. Under personal problems we have asked whether financial constraints are the reason. / Whether they have ever tried to get a LPG connection? Firewood is easily available! Whether the valid document required in getting a LPG connection? On the distributor/supplier side we have asked about the cooperative attitude of the nearest Distributors, the availability of the nearest Distributors etc. *Part 3 (B)* also cover non-acceptance due to availability/non-availability of Identity proof or not belonging to the present address, problems faced by the participants while transferring the LPG connection from permanent to present address etc. *Part 4 covers measuring the attitude of the participants* only asked the participants who do not have LPG connections and those buying from the grey market. *Part 5* is all about those not having the LPG connection but having the potential/attitude to afford LPG in future.

3. RESULTS AND DISCUSSION

The Part 1 of the survey which cover the general information about the participants, we found out of 3036 number of participants, number of male is 1804 (which is 59.4% of the respondents) and 1174 females (which is 38.7% of the total samples). There are 11 missing cases. The average age of the participants is 38. Among the respondents 563(18.5%) are Schedule Cast (SC), 342 (11.26%) are Scheduled Tribe (ST), 860 (28.32%) are Other Backward Classes (OBC), 1015 (33.43%) are general category and 206

(6.78%) are minority groups. Most of the respondents are from general categories and out of that 15.6% live in Pucca houses, 72.4 % live in semi Pucca and the other 3% live in kutchha houses.

More than 50% of the respondents did not have any type of card identity proof card which would enable them to get social benefits as Indian citizens. The ration card holders are more than the BPL card holders. To understand the economic status in a better way we have asked the respondents about the monthly house hold income. 10.7% of the participants earn more than 2000 rupees per month, 54.3% of the respondents earn more than 5000 rupees per month and less than 10,000 rupees. 29% of the respondents earn more than 10,000 rupees per month. When it comes to having a bank account in their name or one of the family members name 2458 (81%) of the respondents replied that they had and 439 (14.5%) of the respondents did not have any bank account. The remaining 90 (3%) of the respondents were not ready to disclose it. (Note: The above-mentioned numbers of participants were those who were able to produce on Identity proof at the time of interview).

Part 2 of the survey is about the acceptance level of participants about LPG uses. Respondents were asked about the approximate time they spend in cooking per day. 106 respondents (3.5%) of them spend an hour in cooking per day, followed by 1229 (40.5%) who spend two hours per day and a majority of the respondents 1349 (44.4%) spend three hours in cooking.

Table 1. Primary Source of Fuel Used for Cooking

Source of Fuel	Participants (%)
Firewood	34%
Electric heater	02%
Kerosene	18%
LPG	38%
Coal Briquette	0.3%
Induction cooker	0.1%

From the table 1 it is clear that 38% of the participants are using LPG as one source of

cooking fuel. We have also asked the respondents when they have started using LPG as one of the source of fuel for cooking, 41% of respondents replied they are using it from last five years. 38% of the total participants in number (1169 participants) have asked whether they have LPG connection from Government or private sources and we found 626 respondents have connections from government sources and 183 respondents have LPG connections from the private sources (grey Market).

Table 2. Approximate Time Spent in Cooking Per Day with LPG (N=1169).

Hours of Cooking	No of Participants
0.5 hour	47
1 hour	28
1.5 hours	405
2 hours	13
3 hours	307
Not sure about it	361

From table 2 it is clear that out of 1169 LPG users 405 (35%) of them use it for 1.5 hours per day. 307 out of 1169 (26.26%) use it for 3hours per day. Another 25% of them are not sure about the amount of time spent, followed by 4% use it for less than one hour and less than 3% use it for an hour per day. When it comes to know the size of the cylinder, out of 1150 LPG users 650 of them having 14.2 kg cylinder and 192 respondents were using 5kg cylinder. 582 respondents have single cylinder and 258 respondents have double connections. 859 respondents have given information about the source they buy the cylinder and refill. 228 respondents out of 859 which were 27% of the LPG users in the present survey were buying from the grey market. The 26.54% of the respondents those who buy from grey market paying an average of Rs. 580 per cylinder/refill on an average.

Part 3 (A) cover the non -acceptance of LPG households.

From table 3 some of the identified reason for not having an LPG connection becomes clear. Out of above ten mentioned reasons lack of Income (1311 agree and 526 disagree), never

made an attempt to get an official connection (1016 agree and 556 disagree), followed by LPG connections not available freely (548 agree and 991 disagree) were the major reasons of not having the LPG connections. In the same time documents I have not accepted by the distributors (300 agree and 1394 disagree), valid documents (147 agree and 1375 disagree), distributors are far away (354 agree and 1183 disagree), lack of space (224 agree and 1279 disagree), and followed by (99 agree and 1383 disagree) in case of fear of safety, leakages and explosions were the major reason behind the non- acceptance of LPG connections.

Table 3: Reasons Behind the Non-Acceptance of LPG Households (N=1839)

Reasons behind Non- acceptance of LPG	Respondents	Yes (%)	No (%)
Never tried to get an official connection	1572	1016 (65%)	556 (35%)
LPG connections not available freely	1539	548 (35%)	991 (65%)
Distributers are far away	1537	354 (23%)	1183 (77%)
Distributor is Non-cooperative	1525	205 (13%)	1319 (87%)
Address/ID proof problem	1547	205 (13%)	1342 (87%)
I have not been accepted by distributor	1522	147 (9%)	1375 (91%)
I do not have valid documents	1694	300 (13%)	1394 (83%)
Lack of Income	1839	1311(72%)	526 (28%)
Lack of space in the home	1505	224 (15%)	1279 (85%)
Fear of safety like leakages and exploration	1483	99 (7%)	1383 (94%)

Out of 1839 non- acceptance 16% (236) of the participants have valid BPL cards. 137 households have BPL cards in present address (where they currently live) and 99 of then having it in their permanent address (in their village where the respondents originally belong).

Part 4 of the survey measured the awareness about LPG connections and distribution scheme.

Table 4: Awareness of LPG connections schemes (N= 3001)

Awareness	Yes	No
Aware about the present cost of taking LPG connections	1267	1501
Have anybody told you about the LPG connection	1347	1179
Total cost	1043	1425
Refill cost of the Cylinder	1239	1359
Awareness about the subsidy	1184	1238
Subsidy given to each cylinder	1250	1179

From the above table it is clear that close to 45% of the household were aware about the LPG connection schemes, 35% of the households is aware about the total cost of the new connections, 42% of the households is aware about the refill cost and subsidy given in each cylinder.

Table 5 Attitude of the Households (N= 2187)

Attitude	Yes	No
Do you have any interest to use LPG cylinder?	2147	37
IF an official gas connection is provided, are you ready to accept and use LPG for cooking	2136	40

The part 5 of the survey studied about the potentiality of the households not having the LPG connections. Table 5 reports about the Attitude of the house hold to get the LPG connections in future (The data include the non-users of LPG and the buyers from Grey market). Close to 98% (2147/2187) of the non-users have positive attitude towards taking the LPG connections in future.

Table 6 Affordability of studied Households (N=2011)

Money can spend for security deposit		Money can spend for refilling the cylinders Per Month	
INR 500-1000	36%	INR 300	20%
INR 1000-	25%	INR 500	40%

2000			
INR 1500-3000	27%	INR 1000	22%
More than INR 3000	2%	INR 1500	18%

However, when respondents were asked about the affordability of the LPG, 97% of the household not having official LPG connections (N= 2011) can afford the connection in next three months. Because 60% of the (N=2011) were spending 500-1000 rupees per months for buying other source of fuel. The survey showed that 51% of the respondents can afford additional expanses to avail the LPG connections.

3.1. The major findings of the Survey (Linking the 4A's Matrix)

The first factor that is of great importance in the energy choice matrix is that of "availability". To begin with we must understand the dimension of availability of LPG from a rural and urban perspective. The principal reason of under developed and developing countries using firewood rampantly as a means of cooking fuel is the extensive availability of biomass and firewood. The rationale is simple in such situations; there is no motivation to spend on cooking fuel when it is available for free. The study conducted by Bisu, Kuhe, & Lortyer (2016) on a Nigerian sample reported that a policy encouraging availability of LPG will force citizens to use cleaner cooking fuel. However, in the cities (urban areas) biomass isn't available freely hence there is a higher possibility of a household using LPG or other clean cooking sources rather than biomass. Availability dimension is also linked to the opportunity cost perspective. In households where there are a higher proportion of females, who do not undertake jobs outside the household, there is ample amount of time available to search for and prepare biomass as for cooking fuel. Even though these means of cooking might take up higher amount of cooking time there is ample time available which counterfeits any reason to take up LPG or any other clean cooking fuel for that matter.

In the present study we have measured availability dimension by asking the respondents whether LPG connections were not freely available! 35% of the respondents responded with a “yes”. For the lower income bracket the meaning of freely available is that they can procure it from the grey market by bypassing the official channel. The reason they use the grey market for procurement is because they do not have the official requirements such as identity card, which makes it difficult for them to utilise the official channel for procurement. For procurement of LPG participants are preferring grey market over the official route were the dealer had either informed them that official connections are stopped for the time-being or that they did not have valid documents for the official connection. Additionally, the initial cost of the deposit for an LPG connection, was too high for the participants to afford and, the requirement of having to purchase a stove from the distributor, they have to purchase a stove from the distributor, which is available in the market at a cheaper price in the market was an issue. Similarly, respondents favoured the convenience of being able to purchase a refill whenever they required it at a time of their choosing. The grey market also allowed them to purchase and refill gas according to the quantity they could afford or desired, (In a 5 KG cylinder I can refill 2 KG Gas). For making this significant shift from the grey market to official channels, policy interventions will have to be directed to these pain points, the major ones being issues with the identity card, bank account, and address proof. There will have to be initial groundwork which needs to check these boxes and once these issues are addressed and a redressal mechanism attached as a tertiary to LPG procurement, there will be significant improvement in LPG usage amongst the lower income bracket.

The second factor in the energy choice matrix is “affordability”. From extensive literature review and quantitative analysis, we can safely conclude that affordability is another principle

component in determining a household’s energy choice. From the survey we can decipher that middle and low-income class have an inclination towards using LPG and the convenience of using LPG is a striking factor for them notwithstanding the fact that they have the capability to afford LPG as a fuel source for cooking. The higher income bracket will continue to use LPG no matter the subsidy or policy changes since it is more likely a way of life for them. The lower income groups are eligible for kerosene subsidies but the rapid shift towards using LPG has reduced the burden on the Government owing to the kerosene subsidies. The shift is mainly due to the increasing disposable income in the middle and high-income brackets. The initial outgo on the purchase of a cylinder and stove is evidently the foremost barrier to the penetration/use of modern cooking fuels. The same result was also found by the study conducted by (Nayak, Werthmann & Aggarwal, 2015). Across this range of perspectives, however, the dominant underlying position has been that price differentials serve not to influence consumer preferences or active decision making but to reduce the range of affordable choices, preventing the poor from using “more ‘decent’ sources of fuel supply like LPG, biogas, kerosene, etc.” (Akabab, 1990, p. 231).

For the Government’s policy initiatives to be successful, it will have to ensure a way to provide for this high initial cost incurred to secure a connection. Microfinance agencies could be a big help in this direction. Other developing countries such as Bangladesh have started to rely heavily on the microfinance structure for social upliftment. India could also use microfinance as a means to reach a middle ground in this scenario. Also, instead of charging a upfront set up cost which is difficult to pay at one go, the price could be evenly distributed across various months so that the burden is not borne all at once. Policy interventions need to be in the direction wherein they make LPG more affordable to use, but this does not mean that subsidies are the only way out. Previous studies reported that

giving a subsidy is also not helpful to attract using LPG because there could be financial arrangements which are made so that a middle ground is reached, and solutions of these kinds would be more sustainable than mere subsidies, discounts or price reductions. This will help in looking at the whole scenario from a long-term perspective. On inquiry why, LPG users prefer the grey market, the responses are as under: “I have the facility, in the grey market to pay for a quantity convenient for me”, (In a 5 KG cylinder I can refill 2 KG gas). For the non-acceptance category 10% of the household’s average income is Rs. 3000 per month. 47% of the households earn in an average of 5000 rupees and beyond Rs. 5000 there were 43% of the households. From the average income it is clear that they can afford LPG as a cooking fuel up to some extent.

The next factor in the energy choice matrix is “awareness” about the cooking fuel. The key understanding here is that the target population are Below Poverty Level people, who have attained a bare minimum education. In order to enhance the demand for cleaner fuels there needs to be an increased awareness about health, economic, social, and environmental benefits of clean fuels. The study by Ramirez, Dwivedi, Ghilardi and Balis (2013) clearly stated that proper information about cleaner sources of cooking fuel available to households will help people to switch to LPG. Once, this awareness has been taken care of the government can continue to drive scale by focusing on fuels with impact and extending fuel supply chains and last mile distribution. Policy makers need to push for advocacy platforms and awareness creation. Consumers are expected to make informed decisions after they are made aware of the benefits of clean cooking fuel. Most of the respondents reside in semi pucca or kuccha houses which do not have separate kitchen facilities and they feel that it is unsafe to use LPG inside the house with children around. Awareness and understanding around issues of this kind will help in boosting the use of cleaner fuel.

The last quadrant of the energy choice matrix is the “attitude” of the end consumer, once the

consumer surpasses quadrants such as affordability, availability, awareness, the last mile is primarily to have an attitude towards using LPG as a clean fuel and give up on other cheaper sources. Attitudes are defined as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour” (Eagly & Chaiken, 1993, p. 1). Behavioral attitude and preferences have a huge role to play in determining cooking practices and that in turn also has a role in governing the attitude the final consumer has towards using LPG. There are cases in our survey responses wherein the households have the capability to afford LPG, they know the procedures and practices but from an attitudinal perspective they do not want to embrace a new practice. Once the consumers have surpassed the other three quadrants this quadrant will be the most difficult to achieve because this needs to be intrinsically driven by the consumer rather than extrinsically driven by the government or any other external agent. First, as early as the 1980s, Black, Stern, and Elworth (1985) recognized that various socioeconomic, attitudinal, and physical factors are associated with different energy-saving behaviors but till date, to our knowledge, not a single paper focused on the attitude of LPG as household energy use behaviour. From the analysis of how much you spend per month in buying fuel? 57% of the households have fuel expanses of 15% of the monthly income and 20% of fuel expanses for rest of the households. 83% (N=868) of the households declare that they can spend up to Rs. 600 per month for refills. As LPG will be a recurring expenditure 48% of the respondents are willing to have additional expenses and 57% said that they require monthly refilling. At the same time 98% of non-users and grey market LPG users have a positive attitude to spending money to get an official LPG connection within the next six months.

4. CONCLUSION

According to the result of the present study we can conclude that there are inherent

correlations amongst these 4A Matrix factors. There was a similar study focused on sustainable uptake of LPG in rural India taking 3A matrix (Kumar, Rao and Reddy, 2016). The 4th component of our matrix, attitude, plays a major role in energy choice and is a special contribution of our present study which gives direction to further energy research. We found that energy consumption need is also a factor of many non-economical and non-technical factors, which is supported by previous studies on energy use (Lutzenhiser, 1993; Abrahamse et al., 2005; Stern, 2007; Wilson & Dowlatabadi, 2007).

REFERENCES

- [1] Abrahamse, W. Steg L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy consumption. *Journal of Environmental Psychology*, 25, 273-291.
- [2] Akabah, E. M. (1990). Real incomes and the consumption of wood fuels in Ghana: an analysis of recent trends. *Energy Economics*, 12, 227-231.
- [3] Alam, M., Sathaye, J & Barnes, D. (1998). Urban household energy use in India: efficiency and policy implications. *Energy Policy*, 11, 885-891.
- [4] Bhatia, R. (1998). Energy Pricing and household energy consumption in India. *The Energy Journal*, 9, 71-105.
- [5] Bhattacharyya, C. S. (2015). Influence of India's transformation on residential energy use. *Applied Energy*, 143, 228-237.
- [6] Bisu, Y., Kuhe, A. & Lortyer, H. (2016). Urban household cooking energy choice: an example of Bauchi metropolis, Nigeria'. *Energy, Sustainability and Society*, 6, 15-18.
- [7] Black, J. S., Stem, D.C., & Elworth, J. T. (1984). Personal and contextual influences on household Energy adaptations. *Journal of Applied Psychology*, 70, 3-21.
- [8] Bonjour, S., Adair-Rohani, H., Worf, J., Bruce, N. G., Mehta, S., & Pruss-ustun, A. (2013). Solid fuel use for household cooking: country and regional estimates for 1980-2010. *Environment Health Perspective*, 121, (7), 784-790.
- [9] Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. Orland, FL: Harcourt Brace Jovanovich college publishers.
- [10] Jain, G. (2010). Energy Security issues at household level in India. *Energy Policy*, 38, 2835-2845.
- [11] Jenkins, R. (2004). *Regional reflections: Comparing politics among India's states*. USA: Oxford University Press.
- [12] Johansson, T. B., & Goldemberg, J., (Eds.) 2002. *Energy for sustainable development: a policy Agenda*, United Nations Developmental programme (UNDP), New York.
- [13] Khandker, S. R., Barnes, D. F. & Samed, H. A. (2012). Are the energy poor also income poor? Evidence from India. *Energy Policy*, 47, 1-12.
- [14] Kumar, P., Rao, R. K. & Reddy, N. H. (2016). Sustained uptake of LPG as cleanerfuel in rural India. Role of affordability, accessibility and awareness. *World Developmental Perspective*, 4, 33-37.
- [15] Lucon, O., Coelho, S. T., & Goldemberg, J. (2004). *Energy for Sustainable Development*, 3, 82-90.
- [16] Lutzenhiser, L. (1993). Social and Behavioural aspect of energy use. *Annual Review of Energy environment*, 18, 247-289.
- [17] Measure of poverty in rural and urban India (Source: <http://www.indiastat.com>).
- [18] Nayak, B. P., Werthmann, C., & Aggarwal, V. (2015). Trust and cooperation among urban poor for transitions to cleaner and modern cooking fuel. *Environment Innovation and Social Transitions*, 14, 116-127.
- [19] NSSO (2001). Level and pattern of consumer Expenditure in India, NSS 55th Round, July 1999-June 2000, Report no 45. National sample survey organization, Ministry of Statistics and programme implementation, Government of India. New Delhi.
- [20] NSSO (2012). Household consumption of various goods and services in India NSS 66th Round National Statistical Organisation, New Delhi.
- [21] NSS Energy Sources of Indian Households for Cooking and Lighting National Sample Survey Office, Government of India (2010).

- [22] Pachauri, S. (2004a). An analysis of cross-sectional variations in total household energy requirements in India using micro survey data. *Energy Policy*, 32, 1723-1735.
- [23] Pachauri, S., & Spreng, D. (2004). Energy use and energy access in relation to poverty, *Economic and Political Weekly*, 271-278.
- [24] Ramirez, S., Dwivedi, P., Ghilardi, A., & Bailis, R. (2013). Diffusion of non-traditional
[25] cook stoves across western Honduras: A social network analysis. *Energy Policy*, 66, 379-389.
- [26] Sinha, A. (2005). The regional roots of developmental politics in India: a divided leviathan. Indiana University Press.
- [27] Smith, K. R., & Sagar, A. (2014). Making the clean available: Escaping India's Chulha trap. *Energy Policy*, 75, 410-414.
- [28] Stern, N. (2008). The economics of Climate change. *American Economic Review*, 98, 1-37.
- [29] Tripathi, M., Tripathi, S., & Dedhia, R. (2016). Challenges face by Micro, Small & Medium Enterprise (MSME) sector in India, 849-857.
- [30] Wilson, C., & Dowlatabadi, H. (2007). Models of Decision making and residential Energy use. *Annual Review of Environment and Resources*, 32, 169-203.