Indian Journal of Science and Technology, *Vol 9(32), DOI: 10.17485/ijst/2016/v9i32/100216, August 2016*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Energy Consumption Pattern at Household Level: A Micro Level Study of Himachal Pradesh

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Abstract

Objectives: Household energy composition is generally looked upon as a concept associated with the income level of the household. Current study is an attempt to understand various factors that influence the phenomenon of fuel switching in rural India in general and Himalayan state of Himachal Pradesh in particular. **Methods/Statistical Analysis:** For the purpose of the study primary data was collected to look upon the energy use pattern at household level with respect to the household size, income level of household, availability of various energy sources, prices of the alternate fuels sources, time taken to utilise different fuel sources, and household's accessibility to fuels. **Findings:** Study finds that despite major differentials in income at household level, the energy mix across income strata doesn't show any significant difference. Clean energy sources availability, affordability and cultural preferences are three major factors that still influence the household energy mix in Himalayan transact. **Application/Improvements:** Fuel switching approach needs a major rethinking and income based top down approach is highly desired.

Keywords: Energy Consumption, Fuel Switching, Household Energy, Income, Socio-Economic

1. Introduction

As per World Resources Institute (1999) estimate almost half of the world's population for their everyday household energy needs rely on the biomass fuel (comprised mainly of wood, animal dung or crop wastes) and coal. The household energy composition is an important indicator of the level of economic development. Energy source composition at household level through its impact on quality of life plays very vital role in the socio-economic development of any country[1]. According to Figure 1 in less developed countries where the per capita income is generally very low, the dependence on traditional energy sources (fire wood, dung cake, charcoal, agricultural residues etc) are more prevalent. As societies develop, major shift in both energy source and energy requirement is observed. In general, a shift towards modern energy sources (electricity, Coal, Kerosene and LPG) is observed globally[2] (World Energy outlook).

For developing countries like India the energy use composition at household got multidimensional implications. As per an estimate (Table 1) in developing countries, especially in rural areas, 2147 million people still rely on traditional energy sources to meet their energy needs for cooking. With the population increase coupled with increase in nuclear family practices this number is going to increase. Unsustainable harvesting and inefficient energy conservation technologies led to adverse implications on health, time utilisation pattern, environment and economic development[3-5].

In India, according to an estimate, household sector accounts for nearly 45%of total (traditional and commercial) energy consumption. As per International Energy Agency (2006) study nearly 740 million Indians are still

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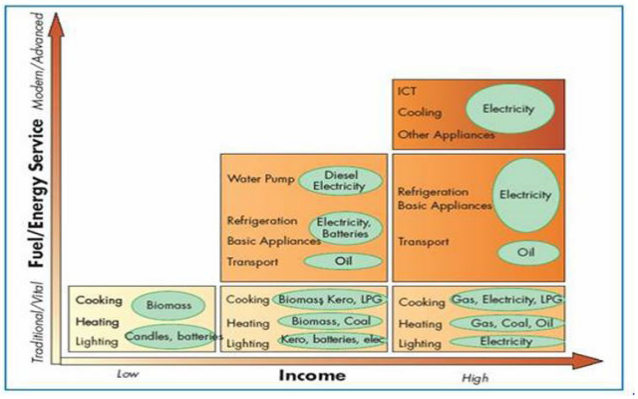

Figure 1. Income and Household Fuel/Energy Transition

Table 1. People relying on Biomass Resources as their Primary Fuel for Cooking, 2004

	Total Population		Rural		Urban	
	%	million	%	million	%	million
Sub-Saharan Africa	76	575	93	413	58	162
North Africa	3	4	6	4	0.2	0.2
India	69	740	87	663	25	77
China	37	480	55	428	10	52
Indonesia	72	156	95	110	45	46
Rest of Asia	65	489	93	455	35	92
Brazil	13	23	53	16	5	8
Rest of Latin America	23	60	62	59	9	25
Total	52	2528	83	2147	23	461

Sources: Adopted from World Energy Outlook, 2006- Focus on Key Topics, OECD/IEA (pg. 422).

relying on biomass resources for their primary fuel for cooking. Two chief household activities (cooking and heating), accounts for nearly 90% and 50% of rural and urban household energy composition[6-8]. Of total commercial (LPG, kerosene, electricity) energy consumption household sector accounts for 15% share[3]. Firewood and dung cake are the primary energy sources for cooking used by rural households (70%). Commercial fuels, like LPG, have achieved little penetration into the domestic sector, with only 1.3% of households using the fuel for cooking in rural India.

To improve upon the condition at rural and urban areas two approaches generally looked upon: 1. the use of more efficient and sustainable use of traditional biomass; and 2. encouraging people to switch to modern cooking fuel and technologies. But these approaches are easy said than done. Success of these two approaches in turn is dependent upon various factors that influence the attainment of the desirable outcomes[4].

Current study is an attempt to understand various factors that influence the phenomenon of fuel switching in rural India in general and Himalayan state of Himachal Pradesh in particular[9]. Study at Nagwain Village of Mandi District were conducted to look upon the energy use pattern at household level with respect to the household size, income level of household, availability of various energy sources, prices of the alternate fuels sources, time taken to utilise different fuel sources, and households accessibility to fuels.

2. Profile of Study Area

To capture the fuel switching pattern and factor that contributes most to determine the fuel wood sources the study was conducted at Nagwain Village of the Mandi District of Himachal Pradesh. As per census 2001, the village consists of 384 households with a population of 1903. Out of total population 851 (nearly 44.7%) and 62 (nearly 3.3%) belongs to scheduled caste and scheduled tribe. On education front the 574 persons of the village are illiterate and sex ratio in the village stands at 845. In case of scheduled caste and scheduled tribe population the sex ratio as per census 2001 stands at 1012 and 722 respectively. Average family size of the village stands at 5.

In current study context a total of 77 households (nearly 20.05% of whole village) were randomly selected. Of these 77 households 45, 30 and 2 households belong to general, scheduled caste and Mohammedan category respectively. Sample households consist of 390 of total population of the village. The sex ratio of sampled households stands at 893. Among the sex ratio the scheduled caste households with sex ratio of 795 females per 1000 males had the worst amongst the three categories. Besides these 29 families surveyed were below poverty line. Table 2 shows the socio-economic profile of the sample households.

Based upon the household income, the sample households were further sub-classified into five income strata/groups. Households and population falling under each income group is shown in the Table 2. The study area depends to a great extent upon forest (private as well as government) resources for its energy needs. Fuel wood, Fodder and Tiber for construction are three major

Table 2. General information and income groups of sample population

Parameter		General	SC	Mohammedan	Total
Households		45	30	2	77
Population		233	149	8	390
Gender	Male	119	83	4	206
	Female	114	66	4	184
Sex Ratio		958	795	1000	893
BPL Families		13	16	0	29
Households (Population) under different income groups					
0 to 20, 000 (Group I)		07 (36)	07 (36)	00 (0)	14 (72)
20, 001 to 50, 000 (Group II)		08 (39)	06 (30)	00 (0)	14 (69)
50, 001 to 75, 000 (Group III)		12 (64)	10 (53)	00 (0)	22(117)
75, 001 to 1, 00, 000 (Group IV)		11 (56)	03 (14)	01 (5)	15 (75)
Above 1, 00, 000 (Group V)		07 (38)	04 (16)	01 (3)	12 (57)

Source: Field Survey

requirements for which the households of the study area depends upon the surrounding forest region.

To understand about the current household energy source mix, and importance of these sources in household livelihood, primary data was collected with the help of well structured questionnaire. In the following section analysis tries to capture current fuel-wood use practice prevalent in the sample households.

3. Alternate Fuel Sources for the Households

Analysis of sample household data shown in Table 3, attempts to capture the caste differentials in the use of fuel resources. From the table it becomes evident that use of fuel sources is independent of the social status of the family. As in almost all these cases the households belonging to different social constructs have approximately same energy combinations. Electricity in study area is mainly used for lighting purpose. In some instances, at households, use of electricity for space and water heating is also observed. LPG though is adopted by majority (nearly 71.43%) of the households, its use as primary source for cooking is not reported by any of the study households. Fuel wood still is the primary source for cooking needs at the household level. Nearly 89.61% of the sample household firewood was still used as primary source of energy at household level. Biogas as an energy source for cooking was once adopted by few households but now baring a few rests all are either not working or damaged. Use of kerosene like biogas has also seen a decrease in recent past as only few households (18 in total) still reports of using it for their energy use.

Household energy situation was further studied from income perspective and the findings of the same are shown in Table 4. Despite wide variation in income of sample households there is not much variation in the energy use at the household level. Therefore, energy consumption as a factor influenced by income of the household was very scantly observed. From table, in economically poor household traditional fuel sources are more prevalent in use. Electricity and firewood are two most important energy sources at poorest households. More than the energy source it is the nature energy use which make the difference. In poor household's electric-

Table 3. Household Energy Situation for Consumption

Energy Type	General (45)	Scheduled Caste (30)	Mohammedan (2)	Total (77)
Electricity	44 (97.78)	30 (100.00)	2 (100.00)	76 (98.78)
LPG	34 (75.56)	19 (63.33)	2 (100.00)	55 (71.43)
Kerosene	9 (20.00)	9 (30.00)	0 (0.00)	18 (23.38)
Firewood	41 (91.11)	27 (90.00)	1 (50.00)	69 (89.61)
Any Other	7 (15.56)	11 (36.67)	0 (0.00)	18 (23.38)

Source: Field Survey

Table 4. Income-wise household energy situation for consumption

Energy Type	Group I (14)	Group II (14)	Group III (22)	Group IV (15)	Group V (12)
Electricity	13 (92.86)	14 (100.00)	22 (100.00)	15 (100.00)	12 (100.00)
LPG	06 (42.86)	05 (35.71)	17 (77.27)	15 (100.00)	12 (100.00)
Kerosene	06 (42.86)	04 (28.57)	05 (22.73)	02 (13.33)	01 (8.33)
Firewood	14 (100.00)	14 (100.00)	22 (100.00)	12 (80.00)	07 (58.33)
Any Other	06 (42.86)	04 (28.57)	07 (31.82)	01 (6.67)	00 (0.00)

Source: Field Survey

ity apart from lighting barely plays any role in household energy needs. Whereas wood is used by the households in approximately every energy need of the household ranging from cooking, water heating, space heating, marriage, funeral to construction of household. Therefore, whatever switching is observed is basically a replacement of minor energy requirements whereas the major household energy requirements are still fulfilled by the traditional energy sources.

With the increase in the household income a shift in energy source from more electricity to more LPG and less kerosene has been observed. But income strata differences hardly make any change in terms of fuel wood use by the households. Wood still continues to be a major constituent of household energy.

To assess the cost as a criterion to influence the fuel switching, study tries to capture the proportion of household income spent on different cost sensitive energy sources. Table 5 shows the share of household income spent on three widely used cost sensitive energy sources.

From analysis of the Table 5, depending upon the income strata of the household clean energy takes nearly 3.31 to 12.58% of the household income share. In case of poorest households, the share of LPG and Electricity stands at 4.58 and 5.99 respectively. This group is the most vulnerable group for the success of fuel switching by the households. Any government policy resulting in increase in the price of these energy sources would affect this group of households the most. Any such measure can result in tremendous increase in energy head of the already ailing poorest household. In case of kerosene the share of income spent upon kerosene is very small and it continues to decrease.

Table 5. Proportion of income spent upon three major cost sensitive energy sources

Proportion of Income on	Group I	Group II	Group III	Group IV	Group V
LPG	4.58	1.39	2.13	2.20	2.08
Kerosene	2.00	0.48	0.21	0.09	0.04
Electricity	5.99	2.74	1.61	1.27	1.20
Total	**12.58**	**4.61**	**3.95**	**3.56**	**3.31**

Source: Field Survey

Table 6. Reason for not opting clean energy source

Reason	Group I	Group II	Group III	Group IV	Group V
Too expensive	2.07	1.86	2.32	1.93	2.33
Family Income	2.14	3.14	4.36	3.33	3.50
Not readily available	3.50	2.57	2.59	3.00	3.00
Don't want to	3.29	3.57	3.41	4.33	2.67
Any other	4.00	3.86	2.32	2.40	3.59

Source: Field Survey

Table 7. Implications of Fuel Switching from Respondents point of view

Reason	Group I	Group II	Group III	Group IV	Group V
Natural resources conservation	2.71	2.29	1.55	1.73	1.33
Health Benefits	3.86	3.43	3.77	2.13	2.25
Less burden on women	4.86	3.86	3.59	4.87	4.17
Better Time utilization	3.57	3,57	3.09	3.87	3.08
Productivity benefits	3.00	4.00	5.00	3.93	5.00
No effect	3.00	3.86	4.00	4.47	5.17

Source: Field Survey

4. Fuel Switching: Perception Gap

Study also analysed few factors that influence the energy choice at household level. On the question of reasons for not switching completely to clean energy source like LPG and Electricity respondents were asked to rank the possible reasons and the average rank scoring of the households based upon their income based economic status has been shown in the Table 6 ahead.

From the Table 6, across all income groups the cost of clean energy devices was posed as the major reason for not opting for it to be household's primary energy source. Among other factors timely availability of clean energy sources is also a factor that causes households to continue with traditional energy sources. Therefore, the energy source switching whatsoever achieved at the rural part of the state couldn't generate the much desired substitution effect. Therefore, even the household, who have already

shifted to clean energy sources, are also using traditional energy sources.

In order to shift people from traditional fuel use to new clean alternates, a clear understanding about the positive implications of fuel switching is required. The study further tries to capture the implications of fuel switching from respondent's point of view. Table 7 below shows the findings of the analysis.

Awareness of the rural people towards environmental concerns is imperative from the findings shown by Table 7. Irrespective of the income strata of the households all households perceive natural resource conservation as the biggest benefit that can be achieved by way of fuel switching. Besides this the health benefits were perceived as second major befit by the households. On the matter of productivity benefits and better time utilisation in more productive activities no clear unanimity were observed.

5. Conclusion

Based upon the survey findings and field experience the study finds that in rural areas the issue of fuel switching got complex structure which requires various contradictory policy measures. Fuel switching in Himalayan region besides income of the household, and cost associated with any fuel switching, is also dependent upon the social construct. This is imperative from the fact that even in high income strata households also fuel wood not only is the primary source of energy but by playing a vital role in nearly all energy related household decisions it still continues to hold major position. Therefore, fuel switching approach needs a major rethinking and income based top down approach is highly desired. Lack of awareness on the part of people about the environmental and health concerns associated with traditional fuel sources in rural Himalaya is never been a problem, rather it is some other factors that needs to be identified and addressed by the policy instruments.

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