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Household energy consumption in India: A review

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Abstract
Energy studies have highly relied on secondary sources. There are a few studies on behaviour of households in energy choice, particularly with reference to India. While household income was found to play an important role in the selection of energy carrier and its usage, monthly household income and household size had nonlinear relationship on the probability of choosing a fuel. Household expenditure or income level is found to be the most important explanatory variable causing variation in energy requirements across households. Demographic and geographical variables along with the size of the household dwelling and the age of the head of the household are related to higher household energy requirements. Choice of energy and its usage are influenced by household income level, poverty, health, education, age of the head of the household, living conditions, size of the households, location of the house, socio-cultural factors and easy availability and comfortability to use the device. Lack of knowledge, training, lack of service backup, cost of the device, irregular supply of electricity and black-outs are some of the factors highlighted for low adoption of clean energy sources. Government policies also influence energy choice. Understanding the fuel selection pattern and inter-fuel substitution possibilities play an important role for policy planning. For effective policy interventions and developing sustainable pathways it is necessary to enhance the understanding of factors affecting energy demand which impacts resource base.

Keywords: Energy Consumption, Household Sector, Government Policies, Fuel Usage, Household Behaviour

1. Introduction

Household sector is one of the major consumers of energy accounting for about 26.88% (19.32 MTOE) of the total energy consumed in India (TERI, 2012) [1]. The two major energy end uses in the residential sector are cooking and lighting. According to NSSO [2], LPG constitutes about 68.4% of fuel used for cooking and 96.1% of households rely on electricity for lighting in urban areas. Further, 85% of rural households depend on solid fuel for their cooking needs. 55% depend on electricity and rest of them depend on kerosene (NSSO 2012[2], MNRE 2015) [3]. The usage of these fuels lead to health hazards such as eye and skin problems, pneumonia deaths, respiratory disorders (WHO, 2011) [4]. Not only that, the collection and transportation of firewood to long distances involve drudgery and economic loss in terms of opportunity cost (Shailaja, 2000, Laxmi *et al*, 2003 and Parikh 2011) [5-7]. A high reliance on LPG and kerosene needs to be reduced, as it leads to increased subsidies and import dependence asserting pressure on foreign exchange reserves (MNRE 2015)[3].

As far as energy for the household sector is concerned, the focus should be on renewables that are reliable, locally available, affordable, clean and efficient (Reddy 1999 and Reddy 2003; Kaundinya *et al*, 2009) [8-10]. Renewables, especially solar and biogas, not only lead to increased energy security, but can also help in climate change mitigation, creation of jobs, industrial development and increased energy access, especially through decentralized generation. Government of India had several programmes to encourage using renewable sources of energy at the household level, in terms of providing subsidies, invention of technology and so on. But their impact seems to be not so impressive. In this context, it is essential to probe the reasons for not taking up renewable source of energy as an alternative to non-renewables.

Several research works on energy use pattern have been carried out in different parts of the world focusing on various issues. An attempt is made here to review such research works with a focus on studies conducted in India. The research studies on energy broadly may be classified as – studies related to supply side i.e., sources, production, technology and studies related to demand side- cost/ price, choice-making, distribution and so on. There appears to be a strong variation in the use of energy carriers in India. Households in rural regions use traditional biomass fuels, such as fuelwood, and the urban households rely on LPG or electricity, the modem energy carriers. Households consume a combination of fuels for cooking and heating. Various household characteristics influence the demand for fuel. Understanding the fuel selection and inter-fuel substitution play an important role for policy planning in order to identify, quantify, and address key issues related to household energy usage. For effective policy interventions and developing sustainable pathways it is necessary to enhance the understanding of factors affecting energy demand which impacts resource base. There is very less research available on the influence of behavioural factors on fuel choice, particularly for Karnataka. A research in this regard could help develop strategies to improve access to energy sources. In this background, the present paper aims to analyse energy consumption in India in terms of access,

availability, factors affecting fuel choice and the scope of energy policy affecting it.

The paper is presented in five sections including introduction in the first section. Energy studies have been discussed under three main issues viz., household energy consumption including usage, access and availability, government policies affecting usage and household behavioural factors. The fifth section presents conclusion.

2. Energy consumption in household sector

Reddy *et al* (2009) [11] studied the difference in the rural and urban energy usage and the relation between income and energy consumption in the domestic sector in India. By keeping the year 2010-11 as base, predictions are given for 2030-31 for the adoption of LPG, biogas and electricity to its fullest extent for cooking and lighting in Indian households. The NSSO data of 61st round and information obtained from the equipment manufacturers were used to study the annual energy required for cooking and lighting, costs of procurement of different sources of energy services and carbon emission. The standard discounted cash flow method is used to estimate the capital and the operating costs of supplying modern energy services and life cycle costing method was used for economic analysis. The study points out the connection between poverty, living conditions, health, education and gender. The difference in urban and rural fuel usage can be seen, where in urban households prefer modern fuels while rural households continue with biomass usage. Income and demand for commercial fuels are positively related. While the poor spend a higher share of their income on energy, the percentage share towards energy expenditure gets reduced with an increasing income. Biomass is widely used for cooking among all households of various incomes. It is predicted that by 2030-31, LPG and biogas will be universalized for cooking in urban and rural households respectively, thus leading to economic development by being energy (secure) self-sufficient with the internally produced renewable/biogas fuel. The study states that the use of biogas as fuel causes indoor pollution which is almost negligible and hence reduces the carbon dioxide emissions in the households. An entrepreneurship-based model for provision of wholesome energy related basic services has been suggested. This model links the best of capacities and capabilities of each stakeholder. It has also been suggested by the study to provide basic energy services with the entrepreneurship based model combining the potentiality of all the stakeholders.

A similar study conducted by Pachauri and Spreng (2004) [12] examined how access and use of energy are related to poverty in India using two approaches. The first approach estimates the basic energy needs of a household using income to calculate energy poverty. The second approach uses the engineering type estimates to understand direct energy required to satisfy basic needs. While the third approach is estimating poverty in terms of access to energy services to find out how they are linked to the households' well being. The NSSO 50th round data is used for the study. Household's affordability of any energy fuel depends on the price of the energy sources in market and efficiency of the devices. Fuelwood is preferred over the other fuel sources due to its free availability and easy accessibility and also due to manageable capital cost required for the installation of the stove. The household energy access has a powerful link to infrastructure, literacy and other socio-cultural factors. It has been found that literacy and access to tap water correspond closely to electricity access. It has also been observed that households with efficient energy access require very less primary energy in comparison to energy used by households using biomass for a same level of energy services. The accessibility and affordability to sufficient amount of modern fuels improves the condition of the poor. The study suggests that in order to reduce poverty the energy provided to the poor areas should be subsidised and also suggests for the taxation of the energy use.

Reddy and Nathan (2012) [13] studied the usage of energy with specific reference to women and poverty and examined the influence of the poor usage of energy on rural and financially deprived women in India. The role of various modern energy providers was also analysed. It is learnt that women had to face a series of hardships right from collecting fuel wood to exposure to hazardous gases thus exposed to various health related issues. Children who played around their mothers were also harmed by the pollution from the smoke. Young girls were deprived of education to lend a helping hand to their mothers in fuel wood collection. It is found that the problem lies not in the inadequacy of fuel but in the lack of ability to choose the perfect fuel to meet the energy needs and that a little advancement in the adoption of energy sources brought about a tremendous change in the livelihoods of women. Entrepreneurship-based Model for Provision of Wholesome Energy Related basic Services (EMPOWERS) model was adopted to initiate modern energy technology (biomass, wind, solar and small-hydro) dispersal through Self Help Groups (SHGs) formed by women. The study suggests the integration of Self help Groups of women to achieve better energy solution.

Using secondary data from NSSO, Reddy and Srinivasa (2009) [14] studied the causes and effects of various players on the use of energy at the household level in India. Different players determining the fuel choice in the household sectors were classified into three viz., 'micro, meso and macro'. Wherein, macro are defined as public utilities i.e., the state owned agencies or corporations, micro constitutes of households or the final users and meso consists of various intercessors that supply fuel from public utilities to the households (macro to micro). And how these various three players together influence the energy usage is analysed using a 'state diagram', which shows the degree of mutual relation between these players. The results showed the households' fuel choice and upward movement towards modern fuel usage with the addition of new players.

Reddy (2004) [15] examined the efficiency of energy used in the Indian domestic sector and the factors that causes change in the fuel choice and usage. The NSSO data from 1983 to 2000 were used for the study which classified the rural- urban households into various heads of socio-economic classes and their final end use is taken for the study. It was found that biomass was widely used by the rural households for energy consumption and that their quality was very less compared to urban households. It was found that households gradually move on to efficient fuel with an increase in their income level and variation in their lifestyle. The study also observed a direct relationship between per capita income growth and household energy demand and a considerable difference in the energy usage between rural and urban households as well as

lower and higher income categories.

A study by Ramachandra *et al* (2000) [16] analysed the household energy usage structure and made a comparative analysis of village level domestic energy consumption patterns across various geographical zones considering regional and seasonal variations. The study was conducted in five talukas in Uttara Kannada district of Karnataka covering Ankola, Kumta, Mundagod, Siddapur and Sirsi - which fall under different geographical regions viz., coastal, hilly and plain. Samples were collected to represent different communities and land possession. Data on energy procurement and usage was collected from the sample. The households were classified into 5 groups based on their land possession. It was studied that the average energy used for cooking and water heating diverged to a great extent in various seasons across the zones. Since biomass was highly available in hilly zones it was found that the kerosene usage for cooking was very less. Less income coupled with free availability of bio fuels were the factors behind choosing biomass in rural areas. The dependence on kerosene also by the grid connected households was due to the power failures (electricity) that existed throughout the year. The other reasons for not adopting modern fuels were insufficient knowledge, training and lack of service backup facilities. A few households adopted modern cooking systems due to education and financial soundness of the households. The shortage of firewood was often replaced by agricultural wastes and dung cake. Also the hapless fuel distribution (kerosene and LPG) restricted people from adopting them. It was observed that consumption of electricity increased positively in accordance with land possession. Biogas using households also used kerosene as a supplementary fuel for cooking. And that kerosene usage increased with income. It was found that education and energy usage are linearly correlated. The increased literacy level is found to bring down the energy usage level. It was also found that the appropriate designed vessels used for cooking and water heating were significant factors in decreasing fuelwood usage even though there was an increase in household members. Fuel wood usage differs among all the three regions/zones. Seasonal changes in the fuel wood usage were found in all the regions irrespective of different communities. Household income did not change the per capita fuel wood usage to a great extent both in rural and urban areas. Less income coupled with free biomass availability prompted people to use biomass as fuel.

Murugan (2011) [17] studied the fuel usage in the domestic sector and chances of replacing the existing fuel with bio renewable fuels in Kanyakumari district in Tamil Nadu using 200 randomly selected household samples. It was found that firewood constituted a major percent of the total fuel usage since it was abundantly available. Likewise the waste from agriculture, which was also freely available, was largely used. LPG consumption was seen only among those who were rich, middle class, and had free connection and was found that its limited use was to save money. It was also observed that since the initial cost of setting up of gobargas /biogas unit required high expenditure it was not taken up, though cow dung was highly abundant for biogas production. The lack of awareness about renewables among rural households and prices of renewables were observed to be reasons for non-acceptance of renewable devices. The study suggests for the subsidization of loans on installation of biogas plants and minimising their costs to encourage households to accept it.

Rao and Reddy (2007) [18] examined the components that decide household's choice for energy service for rural and urban households in India. The NSSO data of 1999-2000 was used for the study. The Multinomial legit selection model was applied to find out this. Four groups were made out of the 21 variables to measure economic status, characteristics of households and individual characteristics, etc. Five state dummies have been used by dividing the country into 5 regions to find out the state wise differences. Integrated rural development assistance along with religion and social group dummies was also considered for rural areas. Various economic and social variables like household size, monthly expenditure of the household, per capita expenditure, household category, religion, age etc were considered for the study. Four major fuel choices were analysed with firewood as the base fuel (kerosene, LPG and other fuels). It was found that the results vary between the rural and urban regions and within rural and urban regions. Per head income, size of the households, education of the household head, occupation and household location decided the households' fuel choice. The monthly income and size of the households had a nonlinear relationship with fuel choice.

Lam *et al* (2016) [19] studied the usage of kerosene for lighting in the Indian households, with a view to minimise its use in the future. Emission of pollutants and its affect on health are also estimated for 2020 and 2030. Deriving data from the Indian Human Development Survey (IHDS) 2005, the kerosene using households were divided into two; first group being the households whose lighting purpose was solely met by kerosene since they had no access to electricity and second group with households, which kept kerosene as a standby fuel for lighting Service demand model for kerosene was linked to the MESSAGE (Model for Energy Supply System Alternatives and their General Environmental Impacts) model to study the household demand being influenced by the larger energy system. It was studied that kerosene usage can be considerably substituted by efficient services though cannot be made completely invalid. These changes were further estimated for 2020 and 2030 keeping 2005 as a base year. Pico solar lighting is considered as a substitution to kerosene by 2030. It was found that by reducing kerosene usage for lighting, it is possible to reduce pollution and diseases related to it, at least to a little extent.

Purohit and Purohit's (2007) [20] study evaluated the prospective theoretical applicability of box type solar cookers in households in India along with its practical achievement by 2020, with a view to lessen the severity of the carbon dioxide emission from household level cooking. The study uses the census of India data to get the population numbers to estimate its Clean Development Mechanism (CDM) coverage. It has taken into account only those regions in each state (of the country, which get more than 4 kWh/m^2 sunlight (solar radiation). The yearly performance of box type solar cooker was estimated counting the total energy spent to cook the amount of food in a year. The study found that by 2012, 0.7 - 2.1 million tonnes and by 2020, 1.7- 5 million tonnes of Certified Emissions Reductions (CER) could be achieved practically by disseminating box type solar cookers to the households. However, the study states that a wider diffusion of this device is not possible for another 50 years, with all forms of encouragements. The study asserts that solar cooking can only be taken as an alternative over the existing conventional

fuels; though it cannot totally substitute the same. The study further suggests that the major hindrance to accept box type solar cooker can be dealt successfully with proper training, education and field visits.

Nathan (2014) [21] examined the significance of solar lighting for rural households, the government policies with regard to electricity provision and the unsuccessful solar PV (photo voltaic) schemes. It was found that there are variations in the per head electricity usage in rural and urban households even when the electricity needs are similar for both. A converging trend was seen in the urban and rural electrification rates while the monthly per capita consumption of electricity showed divergence. It was observed that the inability of the rural households to afford solar lighting coupled with inadequacy of equipments and skilled manpower has made these schemes unsuccessful. It was also found that the village households already connected to the grids lack electricity supply for lighting. The study suggests urban areas to take up generation of solar off-grid systems, since they can afford the same and availability of skilled manpower is not a hurdle here. Through this they can reduce their dependency on grid connected electricity and the same saved electricity can be supplied to the rural areas.

Farsi *et al* (2007) [22] studied India's urban households' forms of usage of cooking fuels (viz., LPG, kerosene and firewood). The discrete choice model was employed to analyse the data regarding urban cooking fuel usage derived from the Indian Household Consumer Expenditure Survey 55th Round (of NSSO 2002). The fuel choice and the quantity used depended upon income and size of the household positively. An income increase led to shift to modern efficient versions of fuel. The cost of LPG highly influenced the lower income category users where as the effect was almost negligible in case of cost of other two fuels. It was also observed that season - wise shift to various cooking fuels was not quite existent among the urban households. Household head's gender and education also influenced the fuel choice to a great extent. So also the efficient distribution of LPG led to its choice for cooking in urban areas. The study suggested that by subsidizing the modern fuels, increasing the educational level, improving the status of women and overall development of the economy households can be motivated to use more modern fuels.

Mishra (2008) [23] explained how households behave in relation to accumulation and usage of firewood. The study sample constituted 600 households, 300 each from 2 districts viz., Ganjam and Gajapati of Orissa (20 selected villages), which were surveyed in 2003. Education, sex ratio, lifestyles, size of the households, properties owned, etc., analysed by the one –way ANOVA test showed that there exists huge difference between these two districts which lie in two different geographical zones, coastal and hilly regions. The study examines the theory linking households' labour allocation decisions to choice of fuel and models household decision using a three-stage least squares probit specification. It was found that as many as 98% of households depended on firewood for cooking. The use of other fuels for cooking like LPG, kerosene and electricity was considerably very less. Again the usage of kerosene as lighting fuel was very high (90%) while very few used electricity (12%). The rural households using firewood were divided into 4 categories viz., 'seller' –who collected and sold firewood for their living; 'collector' who collected firewood for their home consumption; the third category which collected firewood and also bought from market for own use; and 'buyer' who bought firewood for usage. It was found that the latter two categories were rich enough with higher income, larger household size and education and high per capita firewood consumption. The existence of a positive relation between economic ability and availability of fuel alternatives and firewood purchase by households was observed. The non- availability of fuels to substitute from leads the households with more income to shift back to firewood usage using their own labour.

Filippini and Pachauri (2004) [24] studied whether Indian urban households' electricity demand changes as a response to change in price and also examined the factors that regulate the electricity demand in the domestic sector. Household expenditure survey for 50th Round (NSSO 1998) covering 30,000 households of urban India has been taken. A single equation model was employed to find out the household electricity demand for all the three seasons. Variables like income, household expenditure, electricity expenditure, total amount of electricity consumed, approximate electricity cost, and size of the house and size of the households, age of the household head are used to examine the demand for electricity. It has been found that price and income are inelastic to electricity demand. It was also studied that the consumption of electricity of urban Indian households were determined by the dwelling size, number of people in the household, household in a more urbanised location and so on.

Ingole (2013) [25] studied the pattern of energy usage in Daryapur Block's rural households. Using stratified sampling, 10 households, each from 10 villages of Daryapur Block of Maharashtra were chosen for the study based on the size of their landholdings and the community they belonged. It was studied that due to the adequate availability of biomass and kerosene, LPG usage for cooking is in small range. The usage of energy for cooling equipments like air coolers and refrigerators again was positively depended on the size of landholdings of the households and their socio-economic conditions. The usage of biomass for cooking and water heating and kerosene for lighting was also high because of longer duration of power- cuts.

Verma *et al* (2011) [26] explored the household energy usage of Gwalior city using 500 households chosen by simple random sampling. To get a clear picture of the season-wise pattern of energy consumption, data were collected in two stages i.e., summer and winter seasons. Various end uses like cooking, lighting, space heating, cooling, running appliances- washing and entertainment etc., were considered and results were derived applying the mean, standard deviation and Pearson correlation coefficient. Electricity, followed by LPG was observed to be largely used in the aggregate energy usage. Seasons highly impacted the usage of these energy services i.e., electricity usage went up in summer season while LPG use was lower. During winter, both LPG and electricity was used on an equal scale. It was observed that the possession of appliances, number of rooms, doors and windows were related to family size. It was seen that space cooling equipments required much energy consumption. Water heating was met by electricity and LPG. It was also noticed in the study that cooking with high flames also led to high energy consumption.

Pachauri and Muller (2008) [27] examined the region-wise electricity usage in Indian households and its growth over a

period of twenty five years i.e., from 1980-2005). The data was taken from various rounds of nationally representative household consumer expenditure surveys and from data on number of connections and domestic electricity sales from various state utilities as reported by the Central Electricity Authority of India. Using the Divisia index decomposition method, the study tried to learn various factors by disintegrating the domestic electricity usage into 4 groups namely total population, household size, electricity use by household was taken to capture the per capita consumption and to represent the changes in electrification the share of connected households among all households was taken. A state level and aggregated groups of state level analysis were done. The study showed that an increase in population and households procuring electricity connection led to an increase in the overall usage of electricity by the residential sector. Urbanization also was the main impelling factor for higher consumption of electricity by the residential sector.

3. Government Policies and Fuel Usage

Alam *et al* (1998) [28] studied the supply- demand related changeover in household energy services to help the government in efficient delivering of fuels to the households. Using a stratified random sampling, a total of 2800 households in Hyderabad, 2000 from the municipal area and 800 from the suburbs, were taken for the study. The study focused on the components that lead to the reduction of accessibility to efficient energy services by the poor consumers. It was found that households chose fuels which are easily available and comfortable to use coupled with government's motivation with subsidies and distribution of the same. A significant change in the fuel usage pattern was seen where in a majority of user's opted efficient fuels to firewood. It was also observed that the government's subsidies on fuels were highly used by the rich and middle income groups though it was actually meant for the economically backward households. The study suggested for the stoppage of kerosene distribution through fair price shops. The poor should be given coupons to access kerosene from retail markets, which facilitates them to avail it on discounted rates.

Ekholm *et al*., (2010) [29] studied cooking energy options in India and suggested schemes for the removal of fuel scarcity. NSSO 2000 data was used for the study, which was further classified into 10 groups based on expenditure for urban and rural households. A household energy choice model was developed. It was observed that the high cost of LPG was an obstacle in its usage and their decisions to use them depended on discounts declared for their usage. They suggested that subsidies on modern energy services coupled with the financial assistance on modern energy devices will boost the consumers to adopt the modern energy services, especially LPG.

In India Reddy (2003)[9] identified barriers that prevent the government from achieving its energy efficiency goals such as the high investment cost of devices viz., LPG and electric stoves which has to be borne by the consumer, particularly relative to the low incomes in many rural areas. Shortages of particular fuels, lack of a distribution network, and failures of the distribution system are the other factors identified.

4. Household Behaviour and Energy Consumption

There are a very few Indian studies that have examined the influence of behavioural factors on energy consumption. A better understanding of the behavioural factors that impact fuel substitution and fuel complementation is necessary for encouraging clean fuel usage and develop policies to improve access to these sources.

Claudy and O'Driscoll (2008) [30] discussed the adoption of Sustainable Energy Systems in the household sector and the role of economic and behavioural science based on various literature. From the review, it was found that in return to the adoption of renewable services as fuels, the household anticipates the reduction of pollution (i.e., reduction in the emission of carbon dioxide) and thus reducing the environmental damage, savings on energy prices, improvement in their lifestyles and status. Along with that, the influence of friends, family and neighbours also help in deciding adoption of renewable energy. Along with conscious usage of fuel, social and demographic factors such as age, income, education; legal and government rules, restraints from the institutions, etc., play a role in the adoption of renewable. The study suggests that behaviour factors are less influential in choosing renewable when the government rules and monetary incentives are powerful.

Pollitt and Shaoshadze (2011) [31] reviewed the application of behavioural economics to energy usage. They explain that energy usage behaviour includes three main aspects viz., energy usage, reduction and habits; investments in energy efficient systems and contributing to public goods and pro environmental behaviour. The environmental friendly behaviour prompts the consumer to invest in effective energy services which ultimately lead to lesser energy consumption over a period of time. It was found that consumers find themselves incapable to change their routines and daily habits and if there is a need to do otherwise, they instead ask for a heavy compensation. Also they want to continue using the devices even though they are not efficient enough to reduce the electricity consumption because they are attached to their appliances. Consumers' adherence to social norms has a great deal in bringing down the energy usage. It was also observed that keeping the energy consumers informed about their energy saving and giving feedback about their performance also brought about a change in lessening the energy use.

Frederiks *et al*'s (2015) [32] review explained the understand household behaviour of energy use by focusing on fundamental cognitive biases and motivational factors. Maintaining status quo, fear of losing rather than gain, risk aversion (tend to take more chance for small losses), tendency to use more or unable to pull out because of the investment already made on the device, discounts, social norms, intrinsic rewards or the feeling of contributing to the wellbeing and incentives are said to influence the adoption of energy services by consumers. The study suggests simple messages highlighting the loss of non adoption, laying emphasis on the safe, dependable, low-risk of energy-saving practices and investments by offering money-back guarantees can motivate consumers. Rebates, discounts, cash-back bonuses for replacing old devices with new ones or to subscribe renewable energy proved to be more effective. The study suggests that while the investment costs in energy efficient measures are immediate and big, the benefits are often delayed. Hence consumers should be rewarded for taking up such actions by offering intrinsic rewards like praise, recognition or extrinsic rewards like gifts are to be given.

5. Conclusion

The studies discussed above have tried to link energy usage in terms of household income level, poverty, health, education and government policies, etc., which can play as a deciding factor in fuel choice at household level. It can be concluded that income is positively related to demand for commercial fuels. Poverty is another important decisive factor in household energy consumption. There exists a positive relation between economic ability and availability of fuel alternatives and firewood purchase. Education of the household is linearly correlated to energy use. Living conditions, size of the households, location of the house, socio-cultural factors and easy availability and comfortability to use are the other influencing factors, which act upon the choice of modern fuels adoption. Motivation by the government with subsidies and distribution also decides the households' fuel choice. One of the impelling factors for higher consumption of electricity was urbanisation. Seasons also highly impacted the usage of fuels.

The factors that are identified for the non-adoption of efficient fuels include insufficient knowledge, training, lack of service backup facilities and expensive investment cost. Irregular supply of electricity and black-outs also are impeding factors for people switching to inefficient fuels for lighting. The main reason for the failure of solar schemes is found to be the inability to afford and the high investment cost coupled with inadequacy of equipments for replacement and skilled personnel for maintenance.

A close examination of the literature on household energy use reveals that most of the analysis is on the share of the households using various carriers and factors that influence the carrier choice but very less has been researched on the behavioural aspect of energy users that influence the household energy use. Most of these studies are based on NSSO data and information derived from secondary sources / reports of governments. Very few studies have relied on primary data.

Understanding the fuel selection pattern and inter-fuel substitution possibilities play an important role for policy planning. For effective policy interventions and developing sustainable pathways it is necessary to enhance the understanding of factors affecting energy demand which impacts resource base. There is very little research available on the influence of household behavioural factors on fuel choice, particularly for Karnataka in India. A research in this regard could help develop strategies to improve access to energy sources on a sustainable basis in future.

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