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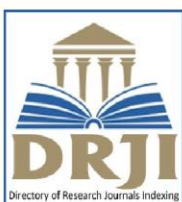
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POLICY IMPLICATIONS AND RECOMMENDATIONS

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INTRODUCTION

The most significant input for any economic activity - may it be production or consumption is energy. Its sources varied in importance from time to time and from place to place. Still without access to one or other forms of energy economic life comes to a standstill. Today we cannot imagine a world without coal, electricity or petroleum products. They have become so inevitable to mankind that modern technology of production leans heavily on these energy sources. This situation has also led to an ever increasing competition and search for cost effective and eco friendly energy resources. At the same time there is also the need for conservation of the available supply as most energy resources are nonrenewable in nature. Energy conservation can be real if only we make efforts to assess energy demand, reduce transmission and distribution losses and cut down energy consumption. This study is an attempt to report the observations of a study on domestic consumption pattern of energy conducted in three districts of Kerala -Ernakulam, Palakkad and Wayanad.

The basic objective of the present study was to analyse the nature and extent of energy use by activity and resource among the sample households in the study areas with regard to their preference for fuel as a source of lighting, working appliances and for cooking. Having got conclusive evidences of marked preferences to LPG and electricity by the families our next attempt was to estimate the quantity and expenditure on energy used by the sample households. An effort was also made to recognize the differences in the usage of energy and extent of differences in expenditure on each energy source between the rural and urban regions. The data shows the strong positive relationship between energy consumption and income of the households.

Simultaneously energy resources deplete very fast on a large scale and most of them are non-renewable. In this context it is fundamental that we take steps to conserve our energy resources and try to promote the use of renewable energy sources. It was noticed from our study that even though people have knowledge about renewable sources and energy saving methods, they are not applying it in their practical life. There is no large difference between rural and urban households for using their electric gadgets and this has led to high

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consumption of electricity in the state. To reduce this consumption level awareness is to be created among the households and amidst each individual within the household. In contrast to electricity where there is not much difference in rural urban consumption in the case of LPG, firewood and petrol/diesel there do exist considerable difference between rural and urban households. Mainly in rural households are poor and their income is hardly 300 per day and their monthly income is below 10000. They are mainly daily wage earner. Some people are even not able to satisfy their family income due to low income. Many rural people not only working as daily wage earner but when they are not getting any kind of work they used to work in agriculture field.

MAJOR FINDINGS

In each of these households' selected detailed enquiries about the nature and pattern of energy consumption was made. The data analysis first concentrated on observing the nature of preference of the households with regard to their consumption. The major findings of the study are reported use wise and source wise. The uses of energy in the sample households were for lighting, working of appliances, cooking, heating, and for transport. Of these lighting and working of appliances were taken together whereas heating was clubbed with cooking.

Lighting and Working of Appliances

Ninety six percentages of the households in the sample districts was found electrified. Kerosene lamps were used in one third of the rural households for lighting during power failure. Ten percent households made provisions for inverter. No households in the sample from Ernakulam bought kerosene from the open market. In Palakkad and Wayanad people admitted buying kerosene even from black market but not to a considerable amount. Even in rural areas the use of kerosene was limited to the amount they got from PDS. In the urban area more than one fourth had invertors, and 6percent rural households had installed solar water heaters. Three fourth of these households were aware of voltage fluctuations and has installed stabilizers for their valuable electrical appliances like TV and refrigerator. In the kitchen five percent of the rural and 19 percent of the urban households used induction cookers. Among the rural households one percent had microwave ovens, in the urban area this proportion comes to 11 percent. In rural households mostly they have joint family including 8 to 10 member in a single household so it is not possible to uphold the standard of living because their income is low, when they are not able to provided food there is no chance pay electrical bill and they use electricity illegal way by hooking or they use to take electricity from those household those who have taken electricity.

Varied are the sources of energy used for cooking in the sample households. They include firewood, electricity, kerosene, LPG and bio-gas. Ninety six percent of the rural households had LPG connections and only 4 percent used kerosene stoves. Around 24 percent had induction cookers or electric heaters, and 13percent had bio gas as an alternative for LPG. In the urban areas traditional *chulahs* were not at all preferred by the high income group who constituted 4percent of the sample size. More than two third of the households in the first three strata of income also used firewood for cooking. Eighteen percent of these households had bought and used electrical appliances for cooking including microwave ovens, induction cookers and electric water heaters.

Firewood and Other Bio Mass Fuels

The households in the sample area are found to be shifting away from bio fuels including firewood. The rural rich and the urban households have moved away from this source of fuel. Sixty two percent of the total sample households bought this fuel as a supplementary source of cooking. Sixty nine percent of the rural households and fifty seven percent of the urban households bought firewood for cooking. The total purchase of firewood in the rural and urban households for consumption in the past month prior to the survey was 17919 kilograms and 16623 kilograms respectively. The average monthly consumption in a rural household amounted to 60 Kg. In the urban areas a household used 55 Kg of firewood a month. As the income increased, proportion of users of firewood declined. Only 7 percent of the highest income group and only one fourth of the strata just below this group used firewood. The independent sample 't' test rejected the null hypothesis and accepted the alternate stating that there does have significant difference in the consumption pattern of firewood between the rural and urban area. Firewood is not an efficient source of fuel. It produced large amounts of Carbon Monoxide which is harmful to people in the vicinity. It is advisable for people to use more modern methods such as LPG because of the following reasons we could note down from our survey. First of course there is a health issue involved in collection of firewood in the rural areas. The women surveyed in our study expressed back pain, itching, rashes and allergies while engaged in the process of collecting firewood. Then there is acute shortage of firewood especially in urban areas and this poses a major challenge to those who are completely dependent of collection of firewood for cooking purpose. The collection of firewood is also a very tiring and time consuming exercise and after that women and other household family members hardly get any time for other works to be done. In rural household women spent up to three to four hours of their productive time of a day in fetching fuel wood

and cooking. Children too are involved in collection of fuel wood. About 55 percent of the rural energy used is derived from biomass. Dearth of space in the house to store the firewood collected for a prolonged period of time is another major concern especially in the rainy session. Due to fear of animals from the forest area from where it is collected and snakes from where it is stored there is increased risk in the usage of firewood. Still the sample households in Wayanad and Palakkad used firewood because of their strong habits and preferences. They argued that there is a special taste for food being cooked on a chulha which is a part of their tradition to them. Almost all elder respondents surveyed have shown a clear preference to this fuel for cooking in these two districts. In rural areas where it is a free gift of nature use of firewood saved other expensive fuels i.e. LPG and electricity. Since they don't have to buy it and as most of them collect it from their premises. They are used for cooking even in rainy season by drying and keeping them in storages or sheds adjacent to their homes. The most rural house in Wayanad district have inadequate ventilation for kitchens and living rooms are not separated from kitchen areas, the emissions from use of solid fuels are inhaled routinely by the members of the household. Particularly the women, children and elderly in the house get maximum exposure from these emissions. ANERT the governmental agency for Non-conventional Energy and Rural Technology is providing of subsidized rates for domestic biogas projects. Solar energy will become a viable energy source. So in Palakkad district 3 percent of the households in rural areas have biogas plants. Plants of portable or fixed models are made available by ANERT.

Electricity

The quantum of usage of electricity is more or less the same in both the rural and urban households. Fridges, mixers or grinders were the main appliances that consumed power in the sample households though they saved much time and labour of the women members. Ninety two percent urban households had mixy/grinder. But in the rural area only forty percent had mixer grinders. Ninety percent urban households had fridge but only seventy four percent had a fridge in the rural area. Ninety four percent urban households had TV but only 87percent of the rural households possessed a TV. While 45percent urban households used a washing machine only 32percentages of the rural households used it. There were only 9 ACs recorded from all rural households where as the number come to 15 in all the urban households together. The number of computers, iron boxes and fans in the urban households were extensively larger than their numbers in rural households. The total units of electricity consumed in the sample households come to 75093 KWh. In rural areas this appears to be around 36845 KWh and in urban region this comes to 38248 KWh. The consumption per

household of electricity was found to be 113 KWh. In the urban households it was revealed as 130 KWh. The total and average consumption of electricity in the urban households is thus around 17percent higher than that of the rural households. In both regions as the income strata went high up in the ladder the units of electricity consumed also went up. The percentage differences among the income groups ranged between 8 to 12. The t test of the averages between two areas reveal that though there exists significant difference between the rural and urban electricity consumption at aggregate level, there is no such significant difference when we consider the different income groups of the two regions except for the fourth strata- upper middle income group. Filament bulbs are no longer preferred by the households in general. On an average the rural households use only three such bulbs whereas the urban households rarely used it. There is increased preference for CFL lamps in both the rural and urban households followed by LED lights. LED lights are shown to have more usage in rural areas than in urban areas. On an average a rural household uses 9 lights whereas an urban household utilizes 12 lights for lighting.

Liquefied Petroleum Gas (LPG)

Liquefied petroleum Gas has now become the most popular fuel in the modern kitchen. Even in the rural households LPG dominates as the main source of fuel used. Eighty eight percent households reported having access to LPG. Only in 12percent poor rural households we noted the absence of LPG. The total consumption of LPG is lower in rural region than the urban region. The average volume of use of LPG increased as income increased except when the progression is from the rural low income group to the immediate next strata. When tested statistically in all income strata except that of the second, that is the low income group, the consumption of LPG was not found significantly different among the households of the two regions. In the aggregate level there exist significant differences in the consumption of LPG between the quantity consumed in rural and urban area. Around 17 percent rural high income households are aware of and had shown the responsibility in installing bio gas facility and conserved the non renewable sources of energy. These households could produce bio energy equivalent to fuel their stoves for one hour a day as a measure of energy conservation. Enquires on the advantages of using LPG revealed that it is used mainly to save time. Because of the easiness and convenience in lifting the fire especially in the morning working women prefer it to prepare breakfast and lunch. Smokeless cooking without any irritation to eyes and lungs is another attraction. The food also does not taste smoke and the young respondents showed a clear preference to LPG for cooking. Easy maintenance of utensils as they are not spoiled while in use and the convenience in cleaning and washing them also make LPG

popular even among the rural households. The users of LPG takes pride on it and considered it as a status symbol.

Petrol/Diesel

Around 50 percent of the rural households and 82 percent of the urban households in the sample used vehicles either a two wheeler or a four wheeler for travelling in and around their locality. The total consumption of petrol/diesel in the urban area is definitely larger than that of the rural area - the percentage of increase being 25 percent. It comes to 7146 litres in the former and 4982 litres in the latter. Household transport demand for petrol/diesel is around two times the energy value of the electricity used for lighting and working appliances in the urban Ernakulam. The average consumption of the fuel in the rural households is found to be more or less the same quantity as that of an urban household. It comes to 22 litres in both the area. At the disaggregated level of each income category it was found that except that of the first strata in all other income category rural consumption is higher than the urban consumption. The results of the statistical test comparing the per household consumption of this fuel show that besides the aggregate consumption in all the strata also there is significant difference between the rural and urban consumption.

Expenditure on Energy

Firewood is revealed as the most expensive fuel used up in the sample households if we consider its purchase from the market. In the rural area 69 households used firewood and they had spent on an average Rs. 1035/- per load consumed. In the urban area only 52 households used firewood and their per household expenses amounted to Rs.780/- per load. For electricity the rural households paid on an average Rs. 321/- a month. The urban households at the same paid Rs. 430/- per month. The per household expenditure on this fuel increased as income strata went to higher levels in both the rural and urban regions. The total and average expenditure are found around 44 percentages higher in the urban households than the rural households. The rural households utilized more Kerosene than their urban counter parts. But even they had spent only a meagre amount of a total of Rs. 918/-. The average urban household consumption of kerosene was found to be a trivial as only a few urban households used it as a cooking fuel. The rural households restricted their purchase of kerosene to the quantity available from the ration shops i.e. half a litre per month - at Rs 7/- per litre. But in households where kerosene was bought from the open market the price amounted to Rs 30/- per litre. The cost of roof top PV systems of solar plants is very high. The rural households had spent Rs. 322/- and the urban households had spent Rs. 418/- for LPG a month. The

percentage hike in an urban household in comparison with the rural household is found to be 49 for all households in the sample together. Except for the poorest and the highest income strata, the rural households had spent less on LPG than the urban households. In the rural areas, the alternative source of LPG was firewood for the poor household. The high income urban household's electric appliances served as an important LPG saving measure. The urban households are found to have had 20 to 25 percent of their average monthly consumption expenditure on fuels. In the rural area these percentages range between 15 to 21. In all income strata the urban households incurred more percentage of their consumption expenditure on fuels

Energy Conservation Measures

Questions were also asked on the efforts of the households to conserve energy. But the answers were often vague and inconsequential. The few measures the respondents suggested were switch off fan and lights off when leaving the room, and not to use light at daytime and not to use fan at rainy season. The households surveyed used CFL and LED for household use. Ironing all clothes together, reducing the usage of energy to 3hrs in the morning and morning, use of energy efficient electric appliances like star products etc were the other measures suggested by the respondents to reduce energy consumption. Still the overall impression the survey gave us is that the people are not much bothered about the volume of their energy consumption and does not deliberately make much efforts to reduce their consumption and save money. This negligence is to be removed with massive awareness campaigns to the new generation which should begin from childhood itself from both at home and the school level. Energy efficiency & energy conservation are the most cost effective solution for sustainable development. During the survey it was realized that large savings and conservation opportunities exist in all sectors of the economy. But to tap this opportunities and conserve energy massive efforts are to be taken for better utilization of energy and effective utilization of existing sources in all sectors of life. If such measures are taken it would be A WIN –WIN FOR ALL. Some of the energy conservation measures that was revealed from our focus group discussions are Minimize wastage of energy by using energy efficient appliances/ equipment and by popularise energy conservation measures. Awareness should be created among people to use CFL bulbs instead of 100 watt bulbs because it saves energy and power. Conduct energy Audit along with load flow studies at regular intervals for reducing the system losses. Reduce the AT & C Losses from the present levels to at least 15 percent. As the main reasons for losses in the system are: weak and inadequate T & D system, long distribution lines, too many transformation stages, overloading, increase in low power

factor loads, poor quality of construction, unmetered supply to certain section of society, defective meters and theft of energy etc, such defects are to be identified and immediate remedial actions are to be taken for saving the precious energy. In this context we suggest a cell solely devoted for energy conservation & audit to be established in the utilities under a senior engineer, for effectively implementing energy conservation and load management. Possibilities for increasing generation at peak load hours, by adding more machines to the existing generating stations shall be explored and implemented for meeting the excessive demand for electricity. Incentives are to be given to all consumers to reduce the usage of electricity during the peak load hours. Jevons paradox may work out in future when energy efficiency increases. That is as technology progresses, the increase in efficiency tends to increase rather than decrease the rate of consumption of that resource, Jevons (1865) 'Rebound effects' from improved energy efficiency is also to be considered. In addition to reducing the amount needed for a given use, improved efficiency also lowers the relative cost of using a resource, which increases the quantity demanded. This counteracts the reduction in use from improved efficiency.

Policy Implications and Recommendations

Energy policy embraces economic policy and environment policy, planning, pricing, consumption, expenditure all these relate to economic principles whereas conservation and management of the resources are to be guided by the principles of environment. An admirable energy policy begins with the efficient use of energy. Energy intensity of the economy remaining constant, the energy demand will increase and the relationship between energy consumption and GDP becomes directional. The implementation of renewable energy sources should ensure uninterrupted supply. The empirical results reveal that in the long-run energy demand will be price inelastic and in our results, we have found co integration between the series in the presence of structural breaks arising in the variables. We found that energy consumption increases as income increases and raises energy demand. Economic growth and energy consumption are interrelated. Energy consumption boosts economic growth and income increases also contribute to economic growth. Furthermore, energy consumption and economic growth increase the rate of energy expenditure. Energy consumption and energy expenditure are also interrelated. Household's income increases the consumption of energy also increases. Using energy efficiently can reduce the cost of heating, cooking, lighting and working appliances. But many a consumers are unfamiliar with energy efficiency policies. The role of energy in the economy and in our lifestyle is profound and unquestionable. From the policy point of view it is very essential to know the type of fuel being used in a particular

area. For, example, a district like Wayannad, which has abundant forest resources would need a separate type of policy compared to a district like Ernakulam where the area under forest is very less. The policy regarding conservation of fuel wood and forest resources will not have much relevance for a district like Ernakulam, which has almost negligible forests, whereas it is crucial for a district like Wayannad. Thus estimation of household fuels consumption in different areas should be the primary policy requirement. A number of recommendations are proposed for an successful, competent and dynamic energy use pattern in the present study. As even commercial types of fuels are available in the rural areas, it is evident that the people are ready to shift away from the traditional forms of fuels like fuel wood. Thus this can be used to wean the households away from fuel wood use. An endeavor should be made from the government to provide electricity to rural people at a subsidised price so that they can afford to pay the electricity bill as well as get the registration and connection. This way the practice of illegal connection by hooking electricity from electrical pool can be avoided. In rural area many BPL holders are getting free electricity but the electricity is provided to them is insufficient, therefore a high level of voltage should be provided. The priority within wood energy conservation programme should be the supply of convenient, healthy and attractive household stoves at affordable prices, so as to reach the maximum number of wood energy users. Infrastructure should be developed further in areas where wood is already a traded item and where potential exists for supply enhancement to meet the existing and growing demand. A special programme for improving the construction of kitchen has to be included in the existing household energy programmes. There is also necessitating providing investment support or subsidies to investment in renewable energy sources. There is a need to develop strategies of alternate energy supply for rural people to avoid total dependence on forest for firewood. Such alternative measures would help to protect and sustain forest ecosystem. Attempt to produce improved stoves that reduce pollutant emissions needs to be encouraged, considering the large number of women and children that would benefit from this. Literacy programme, especially for women, should be organized to create awareness about energy efficiency in energy end-use. If literacy rate is improved among the family members; they can easily understand the modern energy programmes. Women should be involved in planning of household energy issues as a means of getting a more realistic scenario of the end-users of household energy. Encouragement to non-commercial, potential types of renewable fuels like solar, biogas and wind energy should be given, as they are not only non-polluting in nature, even remote areas can become self-sufficient as far as fuel needs are concerned. Though subsidies are given for usage of solar cookers, the maintenance of the same is very important, which is over looked. In this respect the crucial nature of improved stove programme should

be emphasized. This programme in a way can be viewed as an alternative source of fuel, in the sense that, by the employment of improved stoves, almost 60-70 of fuel can be saved compared to traditional stove use. The effective dissemination of the improved stoves may go a long way in improving the fuel availability situation, especially in the rural areas. Regarding the usage of potential, renewable sources of energy, biogas assumes much importance. The unique nature of this source of energy is that the feed-stock for getting the biogas is available in abundance within the village itself, and more so because in the rural areas, most of the household maintain some farm animals, which can provide adequate amount of animal wastes to feed the biogas plant. The policies for energy consumption, conservation and usage should not be clubbed with other major programmes, where it is only a small part of the other project. The important role of energy in the household use makes it imperative for a separate programme which will look into the consumption, conservation and possible shifts to other fuels. If energy is made a part of any other programme, say on rural development, the other socioeconomic factors assume importance over energy, where its importance is overlooked. From the present study on energy ladder, it can be observed that with the increasing household incomes, people are inclined to shift away from the traditional sources of energy to more efficient, commercial fuels. In this move away from traditional fuels, it becomes crucial that alternatives, at least cost to the consumers is made available within comfortable distance. The implications from the above mentioned recommendations are many. First of all, a shift away from traditional, biomass fuels like fuel wood is that, it will leave the degraded forests free to regenerate and replenish, which is crucial for the environmental well being of the country. The shift to better, efficient fuels has a positive impact on the household, in the sense that, not only is it more convenient to use, it will be cleaner to use. The time saved can be effectively used for other productive purposes. This also means that the health of the users would not suffer, as earlier, because of the usage of fuels which emit large quantities of smoke. The implementation of the above mentioned recommendations thus, may radically change the rural and urban household energy use and will have an equally radical impact on the lives of the users.

The study, therefore, recommends and the researcher is quite optimistic that the study will be of tremendous use to the progeny in general. The most prominent of such uses are, It would pave the way of numerous innovative and scientific researches in the years ahead, on the domestic consumption, expenditure pattern and the factors influencing them. It will create awareness among people about the need to make a rational and optimum uses of all available non-commercial energy sources, The study will educate people, of the necessity of depending

on the natural environmental around for their domestic energy requirements as a major pre-requisite for bringing down their day to day family expenditure in the years ahead. In evolving energy efficient technological upgrades in appliances, the main efforts should be focused on targeting consumer's behaviour and increasing their energy-use awareness and knowledge. Formation of energy clubs among housewives for energy competence and energy conservation may be studied and it will be a persuasive area for future research. Greater reductions of electricity consumption can be achieved by changing people's habits and usage patterns. An assessment of the process of fuel markets and the relationship between the prices of marketed bio-gas and fossil fuels will be a persuasive area for future research. This will be helpful for framing future fuel subsidies and action policies. Households from the high income group did not complain about their electricity bills and consumed much more electricity than the rest of groups. The group with high energy usage had displayed had higher incomes and needed a different motivation to save energy. The parameters of age, family size, income, caste, occupation, geographical area etc are to be chosen after analyzing and comparing a large set of feedback preference data and are highly recommended in future development of policies.

CONCLUSION

The study has probed in detail all the objectives set prior to the detailed enquiry. There were many macro level studies in energy economics using census and NSSO data while there was a total lack of micro level studies. This prompted us to initiate this piece of research and it is expected to serve as a forerunner for further studies in this direction covering more districts at the state level and more states at the national level. Again we have considered only the domestic consumption of energy, similar studies in other sectors like industrial, agricultural and commercial consumption patterns can contribute to the further development of theoretical research in this area. The present study focused on the household energy consumption pattern of Kerala. The study revealed that household energy demand and per capita consumption increase as the household income increases. Significant relationship exists between household income and energy consumption. This indicates that energy demand is income elastic. The result could be useful to evolve strategies to reduce consumption as well as to introduce suitable pricing policies in the household sector. Against the common notion that in Kerala there is hardly any rural urban divide the findings of the study indicate that in this region also there do exist significant differences in the domestic consumption pattern of all energy sources at the aggregate level between the two regions. The earlier studies in the state have studied or analyzed just the energy consumption pattern of rural households, but the present

study, in addition to similar efforts has also investigated into several aspects like comparison of rural and urban households in three districts of Kerala, compare inter-districts differences in energy consumption pattern and demand for energy, energy poverty, energy ladder and the relationship between energy demand and its determinants. It is suggested that future researchers may attempt to have a comprehensive analysis of these diversities with a survey in more districts so that meaningful generalizations can be made regarding the state. Consequently the policies to be framed by the government can be given a region specific outlook in the event of energy management and conservation of non renewable sources. All through our survey we noticed both in the rural and urban areas, the scope for installation of biogas and solid waste management plants. But only a few households in the rural and still fewer in the urban area tapped such alternative energy sources. The local self governing bodies with the financial help of state government can give subsidies to encourage such measures. Even subsidized solar plants can be encouraged to be installed in the households of high income groups if necessary legislations are made in the state legislature. If the government enact such laws many a palatial buildings in Kerala both in the rural and urban area can be turned into power plants. Though the agencies like energy management centre and ANERT are making efforts in this direction, a public awareness campaign is needed to make the households act to become self reliant and follow a green energy consumption patten as it is technically called. Shortage of energy and solid waste management are over and over again considered as instances of government failure. Entrusting the households some accountability in solving these twin problems will definitely be a partial solution. Finding ways and means to dispose at least the domestic wastes at the point of origin itself and generating bio energy thereby simultaneously should be the main concern of the government. Training the public to manage the wastes created by them on their own is a better solution than the government shouldering this entire responsibility. Of course the government or its agencies can act as good facilitators by encouraging and introducing technologies that can turn wastes most often considered as a bane of economic development to gold that is energy, the generation of which is a boon to the development of a nation.

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Miscellany

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