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RESEARCH ARTICLE

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Household energy and its utilization – An analytical study in Jorhat district of Assam

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ABSTRACT

In this paper, an endeavor has been made to analyze consumption of both non-commercial and commercial fuels in household tasks. Data were collected through a survey covering 120 households from six villages categorized as semi urban, rural and interior, characterized by different socio-economic conditions, fuels and devices used, cooking practices, etc. The results revealed that majority of the households were having medium sized family type and belonged to marginal farmers. A substantial proportion of the families (53.33 per cent) were earning monthly income between Rs. 1000-3000 and about 26 per cent of the respondents had education up to High School level. Firewood was the only fuel used by all income groups. Other traditional fuels such as branches, crop residues, etc. and commercial fuels like L.P.G., kerosene and electricity were used with varying degrees of dominance in different income groups and regions for cooking, grain processing and lighting. Per capita consumption of biomass fuels especially firewood were maximum in interior areas due to its abundant availability at free of cost. However, the usage of non-biomass fuels was more in high income group as compared to middle and low income groups which depends heavily on biomass fuels. Regarding extent of conservation practices, more than half of the respondents had good level of conservation practices followed by poor (35 per cent). It was enlightened from the investigation that energy conservation practices were highly influenced by education level of the respondents.

KEY WORDS : Household, Analytical energy, Conservation practice

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INTRODUCTION

Energy has been recognized as sine-qua-non and basic requirement in every aspect of human welfare. It is a fundamental tool for subsistence in the form of cooking, heating and lighting and at the same time it is a necessary input in productive processes such as agriculture, transportation and industry. The household sector is one of the major energy consuming units accounting for half the country's energy demand. Adequate supply of energy at a reasonable cost is a key factor in the economic development of a country. Rural energy occupies centre-stage in rural development issues (Laxmi *et al*., 2003). Accessibility and availability of fuels for domestic purposes are becoming more difficult day by day for poor people, many of whom are outside the modern energy system. In rural areas, domestic sector dominates the energy situation. More than 90 per cent of the total energy consumed in the rural households is spent on cooking and women are in the forefront of the management of domestic energy. The major portion of the total energy consumption in rural areas was met by biomass fuels such as firewood, branches, twigs, crop residues and dung cake. Firewood is the most traditional and predominant fuel for rural cooking. The dependence on firewood to a greater extent has resulted in deforestation, loss of biodiversity, soil depletion and erosion. The biomass resources are being rapidly exhausted. The fast dwindling forest wealth has aggravated the problems of rural development. The growing scarcity of traditional fuels and escalating prices of fossil fuels in addition to inadequate availability in rural areas have made life more miserable for rural community.

Apart from these, the cooking process in traditional devices is characterized by low thermal efficiency having only 10 per cent being actually utilized out of the total fuel energy input. This led to long cooking hours and loss of valuable energy. The growing scarcity of fuel wood and

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the need for improving the quality of life calls for a fuel-saving and smokeless alternative. The need of the hour, therefore, is energy augmentation, its more efficient utilization and reducing the environment degradation caused in the process. The immediate solution of rural energy crisis to a certain extent is energy conservation. Energy conservation is imperative to reduce cost, alleviate shortage, protect human health and strengthen supply of energy sources. This conservation requires considerable discipline and sustained efforts on the part of every household and each family member (Neerja and Ramaiah, 1994). As the women folk in rural domestic sector are invariably involved in energy consumption, they have a greater role as users and conservers of energy, to play at several levels.

Energy consumption and conservation strategy of a household are closely associated with certain factors such as socio-economic condition, place of habitation or regional condition, etc. In this paper, an attempt has been made to analyze fuel consumption pattern in different income groups and in different regions/areas of Jorhat district. This paper also reports on the extent of energy conservation practices followed by the homemakers and the linkage between conservation practices and selected independent variables such as education and family size.

METHODOLOGY

A two stage stratified purposive cum random sampling method was used to obtain representative households. In the first stage, the North-West development (Dhekorgorah) block of Jorhat district was purposively selected and within the block, semi-urban, rural and interior areas were categorized and selected purposively. Two villages from each of the categorized areas were selected by random sampling. Among these villages, Parbatia and Charingia representing the semi-urban, Senchowa and Khongia the rural and Naam Deori and Upar Deori representing the interior areas were selected. Accordingly six villages were selected to get the desired samples.

In the second stage, a list of number of households was collected. Households within a selected village were selected using systematic random sampling method. The selection of the households from each village was done using the probability proportion to size (PPS) sampling method, covering a sample size of 120 households. Since, housewives are invariably involved in energy utilizing activities in households, they formed the respondents of the study. The respondents were contacted with an interview cum observation schedule to generate data regarding socio-economic conditions, type of fuel and devices used for cooking and grain processing, energy consumption pattern and conservation practices followed by the respondents. Quantitative data based on recall method was used to estimate the per capita consumption of energy *i.e.*, the monthly consumed fuel quantities reported by the households were accepted. The data collected were coded and subjected to statistical analysis. Both descriptive statistics like frequency, percentage, mean, standard deviation and inferential statistics like correlation coefficients 'r' and Fisher's 't' test were computed to assess the relationship amongst variables investigated to provide a sound basis for drawing conclusions.

OBSERVATIONS AND DISCUSSION

The results obtained from the present investigation have been discussed in the following sub heads :

Socio-economic characteristics:

The findings showed that more than half of the respondents (58.33 %) belonged to 'General' caste and nearly 65 per cent were from the nuclear family which may be due to certain changes in social system. About 47.5 per cent of the households were from medium sized family having 5 to7 members followed by small sized family (29.16 %) having 2 to 4 members. Maximum respondents (33 %) reported farming as their main occupation of head of the family and the same proportion was headed by marginal farmers. It is well recognized that the income of a family influences the choice and quantity of energy used. With rise in economic status, energy use increases to a great extent. The survey shows that a substantial proportion of families (53.3 %) was earning a monthly income between Rs.1000-3000, that belonged to low income group while about 20 per cent of them fell in high income group (monthly income above Rs. 5000).The level of education among the respondents revealed that nearly 25 per cent had undergone either High School level or had attained up to Primary School level education. About 19 per cent of them had passed matriculation and nearly 16 per cent of the respondents were illiterate. A small fraction (5 %) was found to be graduates (Table 1).

Fuel consumption and related matters:
Types of fuel used in the households:

The households depend on both non-commercial and commercial energy sources for performing their domestic energy use activities such as cooking, grain processing and lighting (whichever energy source is required). It is evident from Table 2 that almost all (97.5 %) of households in the surveyed areas used firewood as fuel for cooking followed by branches (67.5 %) which included mainly twigs

Table 1 : Distribution of households under different socio-economic characteristics

Sr. No.	Characteristics	Frequency	Percentage (%)
1.	**Caste**		
	General	70	58.33
	OBC	20	16.66
	ST	18	15.00
	SC	12	10.00
2.	**Type of family**		
	Nuclear	78	65.00
	Joint	42	35.00
3.	**Family size**		
	Small (2-4 members)	35	29.16
	Medium (5-7 members)	57	47.50
	Large (more than 7 members)	28	23.33
4.	**Occupation**		
	Farmers	40	33.33
	Labourers	18	15.00
	Service	25	20.83
	Petty business	27	22.50
	Any other	10	8.33
5.	**Operational land holding size**		
	Landless	37	30.83
	Marginal farmers	40	33.33
	Small farmers	20	16.66
	Large farmers	23	19.16
6.	**Monthly family income**		
	1000-3000	64	53.30
	3001-5000	32	26.60
	Above 5000	24	20.00
7.	**Educational level of the respondents**		
	Illiterate	19	15.80
	Primary level	30	25.00
	High School level	31	25.80
	Matric level	23	19.16
	Higher Secondary level	11	9.16
	Graduate level	6	5.00

and limb of tree. Crop residues were used by a negligible proportion (1.66 %) as supplementary with the former fuels. Unlike in some rural areas of India, dung-cakes are not used as cooking fuel in Jorhat district, instead dung is used as manure. Even the use of biogas, which provided an alternative source of energy for rural cooking, was not found in a single household of the study area. However, biogas is particularly useful for households that have their own cattle, yielding sufficient amount of dung to produce gas to meet the cooking energy needs. Inadequate availability of cattle dung can be the reason for not adopting biogas technology by the surveyed households. Among 36 per cent of households practicing cattle feed preparation, branches was used extensively for the purpose by 63.63 per cent of the households. The very next fuel used by 45.45 per cent of households being firewood followed by crop residue (43.18 %). Roots as a fuel for grain processing were used by only 9.1 per cent of the families. As firewood was exuberantly available at free of cost in interior areas, the people in those areas used it even for grain processing without any economy. The commercial fuels used in the households for domestic purpose included LPG, kerosene and electricity. Maximum households (63.3 %) cook with LPG in addition to non-commercial fuels followed by meagre proportion (6.6 %) using kerosene for cooking in their kerosene stove. Users of clean fuels (LPG and kerosene) reserve them for immediate cooking needs such as boiling milk, preparing tea and snacks etc., so that 'highly priced' fuel lasts longer. Elaborate and major cooking was done using non-commercial fuels. The use of electricity for cooking was found totally negligible (Table 2).

For lighting purpose, almost all the households (98.33%) used kerosene whereas electricity was limited to only 59.10 per cent of the households. Kerosene is mostly used for lighting, mainly because of erratic and inadequate supply of electricity. It is used as major lighting fuel in the non-electrified households.

Type of devices used for cooking and grain processing :

Fuel consumption pattern is highly associated with the type of devices used to meet energy needs. Table 3 shows that 65 per cent of the respondents used two pot hole traditional chulha followed by 63.30 per cent equipped with gas stove for cooking. A considerable proportions (20.83%) used to cook in one pot traditional chulha and kerosene stove. Most of the homemakers used kerosene and LPG stove for quick cooking tasks- e.g., making tea for a guest, boiling milk and the chulha for cooking regular meals. It is worth mentioning that two pot hole traditional chulhas consume less fuelwood than one pot hole traditional chulhas. On the other hand, it was disappointing to observe that in interior areas, cent per cent of the tribal community entirely depend on one pot hole chulha for cooking. In case of grain processing, a huge fraction (93.10%) of the households used three stoned open chulha and a small proportion (6.80%) used one pot hole chulha.

The results seems to be discouraging as in spite of various energy intervention programmes like National Programme on Improved Chulha, National Project on

Table 2 : Distribution of households using different energy sources for domestic activities

Sr. No.	Type of fuel	Activities		
		Cooking (n=120)	Grain processing (n=44)	Lighting (n=120)
1.	**Non-commercial energy sources**			
	Firewood	117 (97.50)	20 (45.45)	-
	Branches	81 (67.50)	28 (63.63)	-
	Crop residues	2 (1.66)	19 (43.18)	-
	Roots	-	4 (9.10)	-
2.	**Commercial energy sources**			
	Kerosene	8 (6.60)	-	118 (98.33)
	Electricity	-	-	71 (59.10)
	LPG	76 (63.30)	-	-

Numbers in parenthese indicates percentage of households

Table 3 : Distribution of households by type of devices used for cooking and grain processing

Sr. No.	Devices	Cooking	Grain processing
1.	Traditional chulha		
	One pot hole	25 (20.83)	3 (6.80)
	Two pot hole	78 (65.00)	-
	Three stoned open chulha	-	41 (93.10)
2.	Gas stove	76 (63.30)	-

Numbers in parentheses indicate percentage of households

Biogas Development etc., none of the households possessed improved chulha and biogas plant. Considering the low thermal efficiency of the devices at present, there is a scope for improvement. Moreover, lack of knowledge and proper training on use, repair and maintenance of the improved devices are the main contributing factors for not adopting energy efficient devices.

Estimation of per capita energy consumption per household:

The tasks that require energy input determines the quantity and form in which energy resource is consumed and the contribution of each form of energy to the total consumption (George, 1988). In this paper, an attempt was made to analyze energy consumption of various types of fuel required for different energy input household tasks such as cooking, lighting and grain processing. Among these, cooking is the predominant fuel consuming activity in rural areas. Therefore, per capita energy consumption for cooking was discussed more elaborately in different income groups and place of habitation.

The average and per capita energy consumption of firewood was maximum *i.e.*, 9.7 and 1.55 kg/ day/ household. The next common type of non-commercial fuel *i.e.*, branches, was consumed on an average 2.76 kg/day/ household with per capita consumption of 0.41 kg/day/ household (Table 4). In case of commercial fuels, LPG was consumed on an average 0.37 kg/day/household and that of kerosene was 0.07 lit/day/household. The per capita consumption of LPG and kerosene was 0.065 kg and 0.015 l per day per household. In the surveyed areas, people were quite conscious about economy in the use of such highly priced fuels.

Moreover, the quantity of kerosene supplied through ration shops (5l) was not sufficient to meet the requirements. This can be another reason for which consumption of kerosene was substantially less among the households equipped with kerosene stove. The further perusal of Table 4 indicates that average and per capita consumption of electricity was estimated to be 1.42 units and 0.25 unit per day per household, respectively. The next important lighting fuel after electricity was kerosene whose average consumption was 0.25 lit/day/household with per capita consumption of 0.04 l/day/household. In electrified households, kerosene was used as a supplement with electricity because of erratic and inadequate power supply. However, it was used as major source of lighting fuel by the non-electrified households.

Regarding grain processing, average consumption of firewood was maximum (5.04 kg/day/household) with per capita consumption of 0.60 kg/day/household. The number of households using firewood was less as compared to those using branches, whose average and per capita consumption were 2.0 kg and 0.26 kg per day per household, respectively. Branches are the dominating fuel in terms of numbers of households using it rather than in quantitative terms. The superabundantly available of fuel wood in the interior areas was the main reason for high consumption of fuel wood for cattle-feed preparation compared to branches.

Table 4 : Estimation of average and per capita fuel energy consumption per household for domestic activities

Type of fuel	No. of households	Population	Total fuel consumption per month	Average fuel consumption per day per household	Per capita fuel consumption per day per household
Cooking					
Firewood	117	724	33810.90 kg	9.70 kg	1.55 kg
Branches	81	548	6713.70 kg	2.76 kg	0.41 kg
Crop residues	2	11	96.00 kg	1.6 kg	0.29 kg
LPG	76	430	846.70 kg	0.37 kg	0.065 kg
Kerosene	8	36	16.80 l	0.07 l	0.015 l
Lighting					
Kerosene	118	720	871.20 l	0.25 l	0.04 l
Electricity	71	386	3036.50 unit	1.42 unit	0.25 unit
Grain processing					
Firewood	20	167	3024 kg	5.04 kg	0.60 kg
Branches	28	211	1681.50 kg	2.00 kg	0.26 kg
Crop residues	19	148	735.60 kg	1.30 kg	0.16 kg
Roots	4	22	144.90 kg	1.20 kg	0.22 kg

Regional variation in per capita fuel consumption for cooking:

The fuel consumption pattern for cooking was further quantified and extent of variation was studied in various categorized region depending on the habitation of households such as semi-urban, rural and interior areas. The analysis shows that per capita consumption of firewood was highest (2.76 kg/day/household) in interior areas. This can be due to the fact that firewood was available at zero private cost at their vicinity which does not encourage economy of use, coupled with relatively low efficiency of energy using devices (Fig.1). In rural and semi-urban areas, the per capita consumption of firewood was 1.77 kg and 1.07 kg per day per household. The subsequent cooking fuel used was branches, whose per capita consumption was maximum in rural areas (0.54 kg/day/household) as compared to semi-urban (0.40 kg/day/household) and interior (0.32 kg/day/household). Crop residues were found to be consumed by only two numbers of households in semi-urban areas, where per capita consumption was 0.29 kg/day/household. The use of crop residue in semi-urban was mostly meant for supplementing the total cooking fuel requirement. None of the households in rural and interior areas used crop residues for cooking as they did not feel the necessity of such fuel for cooking. The findings indicates the growing scarcity of firewood in semi-urban and to some extent in rural areas which is apparent from their consumption pattern. In relation to use of LPG for cooking, it was analyzed that per capita consumption was highest (0.075 kg/day/household) in semi-urban followed by rural (0.052 kg/day/household) and interior (0.024 kg/day/household). The findings reveal that per capita consumption of such type of commercial fuel increases from one locality to another as the necessity compelled them to use it in that manner. Due to limited availability of firewood and to meet total fuel requirement for cooking in semi-urban areas, people consumed more LPG as compared to other areas. On an average, one LPG cylinder lasts approximately for 36 days in semi-urban, 50 days in rural and 80 days in interior households. Analysis of other commercial sources of energy for cooking shows that kerosene was used only in 8 households. The consumption of kerosene for cooking ranged from 0.0147 (semi-urban) to 0.0144 (rural) lits/day/household, which was used as a supplementary fuel meant for only emergency purposes. These households use kerosene only for emergency purpose. The consumption of kerosene was comparatively less because the quantity supplied through ration outlets was less than 5 litres which was not sufficient to meet the cooking energy demand. In open market, the price of kerosene was usually

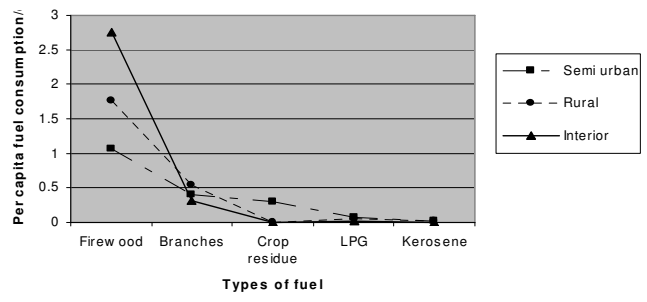

Fig. 1 : Regional variation in per capita fuel consumption for cooking

much higher than the ration price and its availability was also not good.

Variation in per capita fuel consumption in different income groups:

The per capita fuel consumption for cooking in different income groups was further analyzed irrespective of their habitation. The data of 120 households was categorized based on monthly income. Fig. 2 shows that the per capita consumption of firewood ranged from 1.55 (high and low income groups) to 1.58 (middle income group) kgs/day/household. The use of branches was more (0.43 kg/day/household) in low income group so as to attain the total cooking fuel demand along with firewood. In middle and high income groups, the per capita branches consumption was 0.38 and 0.33 kgs/day/household. Among the remaining fuels, the use of crop residue for cooking was confined to only 3.12 per cent of households in low

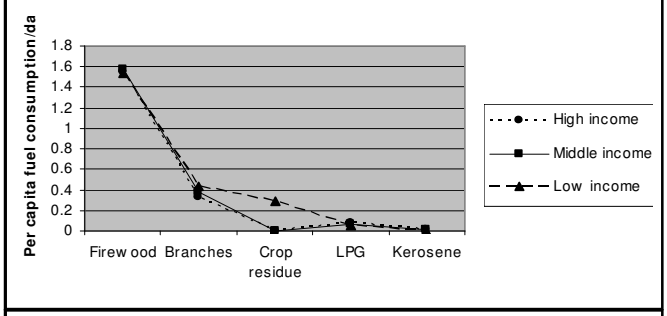

Fig. 2 : Variation of per capita fuel consumption in different income groups

income group where per capita consumption was 0.29 kg/day/household. On the other hand, per capita consumption of LPG was maximum(0.082 kg/day/household) in high income group where cent per cent of the households used it. The high income group felt that it would be more cost-effective to consume LPG if cleanliness and fuel efficiency was considered. However, the extent of use of LPG was 90.6 per cent in middle income and 34 per cent in low income groups where per capita consumption varies from 0.06 (middle income) to 0.048 (low income) kgs/day/household. The use of kerosene was limited to only 5 households in high income and 3 households in middle income categories where per capita consumption was 0.017 and 0.013 lits/day/household, respectively.

The findings thus emerged suggests primarily that the economically better off households had greater access to clean and superior quality fuels (e.g., LPG, kerosene,etc,.) Besides, as income increases, their demand and consumption of various fuel or fuel mixes also increases. On the contrary, low income group depended heavily on inferior type energy sources (e.g., firewood, branches, crop residue, etc.) to meet their overall energy demand due to lack of purchasing power.

Extent of energy conservation measures taken in the households:

There is good potential for reducing energy demand through conservation measures in household sector. A substantial part of the total energy consumed by the household is on cooking and the housewife is solely responsible for its management. Cooking is the most energy intensive activity in a household. Therefore, in the present investigation, the conservation methods practiced by the homemakers during cooking were studied. However, it was observed that the homemakers knowingly or unknowingly and due to their personal habits followed conservation techniques of fuel to a certain extent. It was viewed that more than half of the respondents (54.16 %) followed 'good' level of conservation practices and 35 per cent of them performed 'poor' level of conservation practices. A relatively lower proportion (10.8 %) possesses a 'satisfactory' level of conservation practices of fuel energy (Fig.3).

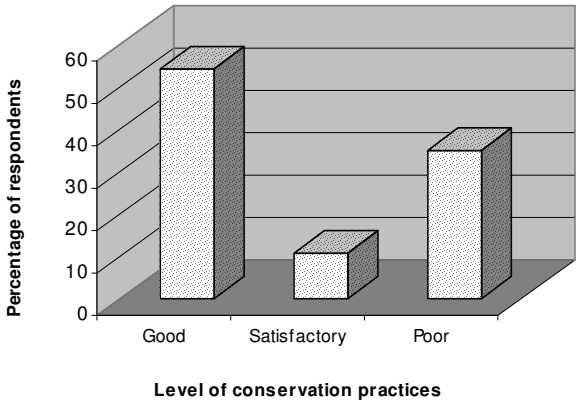

Fig. 3 : Extent of energy conservation practices followed by the respondents

Relationship between energy conservation practices and selected socio-economic variables:

The energy conservation practices are significantly influenced by various socio-economic characteristics of the family (Neerja and Ramaiah, 1994). The management capabilities of the homemaker are the major determinant of the level and pattern of energy consumption and certain independent variables can play a significant role in building up these capabilities. In the present study, the extent of

conservation measures was found to vary from status to status. To find out the linkage between the extent of conservation practices and selected socio-economic variables (for instance, education and family size), Karl Pearson's correlation coefficient 'r' was computed. Fisher's't' test was used to test the significance of relationship.

Table 5 depicts that educational status of the homemakers which was positively correlated (r=0.885) and highly significant at 1 per cent level with energy conservation practices. It implies that higher the level of education better was the conservation practices followed by the homemakers. Family size had no relationship with conservation practices of the respondents. Hence, it can be stated that there was a statistically significant linkage between conservation practice and education.

Table 5 : Coefficient of correlation between the energy conservation practices and selected independent variables

Sr. No.	Independent variables	'r' value	't' value
1.	Education	0.885**	20.70
2.	Family size	-0.269	3.03

** indicates significance of value at P= 0.01

Conclusion:

Taking into account the analysis of the data presented in this study, it can be concluded that energy consumption pattern in the households was dominated by non-commercial energy sources. Firewood was the only fuel used invariably by the people of all income groups and regions under the investigation. Almost all the households used traditional chulha for cooking having very low fuel efficiency. The use of smokeless chulha and bio gas plant, which are considered as improved technology can be owned at lesser cost, were not found in a single household. LPG is gaining popularity among a considerable proportion because of its easy accessibility whereas the per capita consumption of LPG was more in semi urban areas. Further, more than half of the homemakers followed 'good' level of conservation practices which primarily depends on their education. Lack of awareness, proper training and service backup facilities are the main impeding factors for not switching-over to improved energy efficient devices under the aforesaid schemes. The government should thus take necessary steps for propagating those schemes not once but twice and several times unless and until the desired target is achieved. Through extension programme, home scientists can play a crucial role in providing education and demonstration on improved technology in order to make them aware about the present energy situation as well as proper and efficient use of energy. This will immensely help in meeting the household energy demand in a sustainable manner without any damage to ecology and drudgery of women folk.

LITERATURE CITED

George, R. (1988). Household energy consumption. International workshop on women and development-A critical appraisal of household level research methodologies, organized by M.S. University and Illinois University, Baroda, July 5-14, 1988.

Laxmi,V., Parikh, J., Karmakar, S. and Dabrase, P. (2003). Household energy, women's hardship and health impacts in rural Rajasthan, India: Need for sustainable energy solutions. *Energy for Sustainable Development,* **7**(1) : 50-67

Mahananda, M.R., Mohanty, B.P., Mahananda, H.B. and Pradhan, K. (2006). Domestic fuel energy consumption and degradation of forest in ryral ecosystem. *Ecol., Environ. & Conser.,* **12**(4) : 735-742

Nataranjan, I. (1995). Trends in firewood consumption in rural India. *Margin,* **28**(1) : 41-47

Neerja, T. and Ramaiah, V.P. (1994). Awareness of energy conservation techniques among housewives in Guntur district of Andhra Pradesh. *Asian J. Psychol. & Education*, **27**(7-8) : 9-16

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