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Electricity Consumption Pattern in Rural Households

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Abstract

Availability and access to electricity are the fundamental requirements to social and economic development. Affordability has also been a major constraint influence the utilization of electrical energy in the selected villages. This paper aims to assess the scenario of rural dwellers' access to electricity and relationship between household income and family size on electrical energy consumption in rural households. The data on utilization of electricity for lighting collected from total 145 respondents out of 833 households in three villages namely Taku, Pandukhedi and Somalwada Khurd of Kesla tribal block of Hoshangabad district, Madhya Pradesh through personal interaction with them. Electricity is the major energy source used mainly for lighting and running home appliances in the selected villages. Consumption of electrical energy is calculated by the number of appliances, their wattage and running hours of use. The relationship between household income and consumption of electrical energy has shown a linear relationship with equation slope increasing with family size in all three villages.

Keywords: Energy Consumption, House Hold Income, Family Size, Energy Poverty, Electricity.

Introduction

This study was conducted at Taku, Pandukhedi and Somalwada Khurd villages situated in Kesla Block under Itarsi Tehsil of Hoshangabad district of Madhya Pradesh. The geographical location of villages is: latitude 22.7441^0 N and longitude 77.7370^0 E. Village Taku, [Kesla Block] is the most remote village and situated in state dense forest zone where agriculture, cattle rearing and farm related activities are major livelihood options. Income of majority of the households is seasonal and depends on the farming activities and work availability. A vast range of socio economic status is observed in the region selected for the present study. Hence, energy poverty is very common in majority of the households in selected villages. A wide variation in electrical energy utilization pattern by various households under different income categories and family sizes is observed.

India is predominantly an agriculture nation where, more than 74.3 % (Census of India 2011) population resides in rural India with high concentration of people living under poverty. After cooking, lighting is an important household energy end-use that influences the quality of life. As per the Central Electricity Authority (CEA) out of total 29 states of India, only 9 states have achieved 100 percent village electrification in year 2013 [5]. However electricity is the main source of lighting in India, at the all-India level, 72.7% of rural households and 96.1% of urban households used electricity as primary source of energy for lighting (NSS 2012). The remaining households, except for 0.5% in both rural and urban India, used kerosene. Madhya Pradesh was among 12 states achieved 90-99% electrification using electricity as main source of lighting.

Energy is fundamental input for survival, sustenance, social and economic development of society. Adequate availability and accessibility to clean household energy ensures the comfortable living of human being. Abundant and uninterrupted supply of household electrical energy may play as catalyst for social development. Madhya Pradesh ranks at 30^{th}position (Census of India 2011) on Indian states ranked by households having electricity access and consumption. However, the main source for lighting is electricity, though consumption of electricity is very low due to many local constraints in rural areas. The use of electricity as main source of lighting at the state level and rural Madhya Pradesh is 67.1and 58.3 percent respectively. Situation in Hoshangabad district is also not very rosy, it has 78.4% households using electricity for lighting and ranked 14^{th} in the state. Keeping this situation in view, this study aimed to access electricity consumption in

the district as affected by household income and family size. The current study revealed the relationship between the electrical energy consumption and the household income. It is shown in the figures in succeeding paragraphs.

Reviews of literature

Socio economic status is one of the major factors influence the electrical energy consumption in rural parts of the country. Villages selected for the study namely Taku, Pandukhedi and Somalwada Khurd have vast variations in livelihood earning patterns and income hence affordability is a prominent constraint in having access to electricity, electrical appliances and utilization of adequate electrical energy. Bowonder *et. al* (1985) [4] also observed a wide variation in energy consumption in eight rural communities in India and revealed that consumption depends on socioeconomic and agro climatic factors.

Life of village dwellers influenced adversely due to lack of access to modern energy as various constraints deprived the villagers in the selected villages to utilize the adequate electrical energy. TERI (2015) [7] reported that one-fourth of India's population lacks access to modern energy service; in fact, over 306 million people in India are deprived of electricity. Hence, there is a growing focus on energy poverty which implies lack of access to modern energy services. According to Census of India 2011, 55.3% of rural households and 92.7% of urban households, respectively, depend on electricity as primary energy source for lighting. The total electricity consumed by households in India is now more than 50 times that of 1971 due to increased number of households, rising incomes, and significant electrification (Prayas 2016) [6].

Out of three villages selected for the study, Taku is the most remote, least developed village having variations in socio economic status despite the fact, accessibility to electricity is vast and almost all the households have electricity connections. Balachandra, P. (2011) [3] carried out analysis of NSSO Survey, 61st round and found significant increase in the percentage of access to electricity with the rise in income level. Survey also brought out the fact that rural households' electricity access is just 28% at the lowest expenditure class whereas it increases substantially with the rise in expenditure levels to reach 86% of the households.

Objectives of the Study

Following objectives were determined for the present study

1. To assess the household income and family size of the respondents
2. To assess the electrical energy consumption
3. To find out the relationship between the electrical energy consumption and household income.

Hypotheses

Following hypotheses were set for drawing the relationship between electrical energy consumption, household income and family size.

1. Energy consumption depends on household income
2. Family size influence the energy consumption

Methodology

Sample size and data collection techniques

Total 145 households from 833 households were selected randomly from village Taku, Pandukhedi and Somalwada Khurd. These villages were selected through stratified sampling procedure on the basis of their development level (least, medium and highly developed category). Subsequently, the data about household family income and consumption of electrical energy used for lighting and running home appliances was obtained from the respondents through personal interaction. Annual income generated through various livelihood earning activities obtained through personal interaction with the respondents and averaged out and finally the monthly household income by dividing the total annual income by 12 is obtained. The family size was measured by the adult equivalent (AE) developed for this purpose. Each house hold member was quantified based on his age and gender. The average quantified value of the house hold was represented by adult equivalent.

For the purpose of estimating electricity consumption of selected households, duration of use and wattage of the electrical appliances viz. LED/bulbs, fan/cooler, television, Refrigerator, Mixer, electric press (iron), computer and mobile chargers installed in the selected households were taken into account. Households' electrical energy consumption was estimated in Kwh and converted to MJ (Mega Joule) (1Kwh=3.6 MJ).

Tools used

An interview schedule was developed and administered to collect data on various parameters required for the study through personal interaction with the stakeholders.

Statistical Analysis

Correlation between household electrical energy utilization, monthly income and regression coefficient for electricity consumption for various family sizes (AE) have been worked out using SAS 9.3 Soft ware.

Findings

Relationship between electricity consumption and household income in villages Taku, Pandukhedi and Somalwada Khurd have been shown is shown in figures 1, 2 and 3 respectively. Results obtained from analysis of the data is also described in preceding paragraphs.

Household income and number of persons in a household determines the quantum of electrical energy consumed. Based on these two independent variables, consumption of electricity in three villages viz. Taku, Pandukhedi and Somalwada Khurd of Kesla block is shown below:

Taku

There is relationship between electrical energy consumption with households' monthly income (MI) and the family size. The monthly income of the household and daily energy consumption in village Taku varies from Rs. 2400 – Rs. 9000 and 1.64 MJ – 4.03 MJ respectively as shown in Fig. (1)

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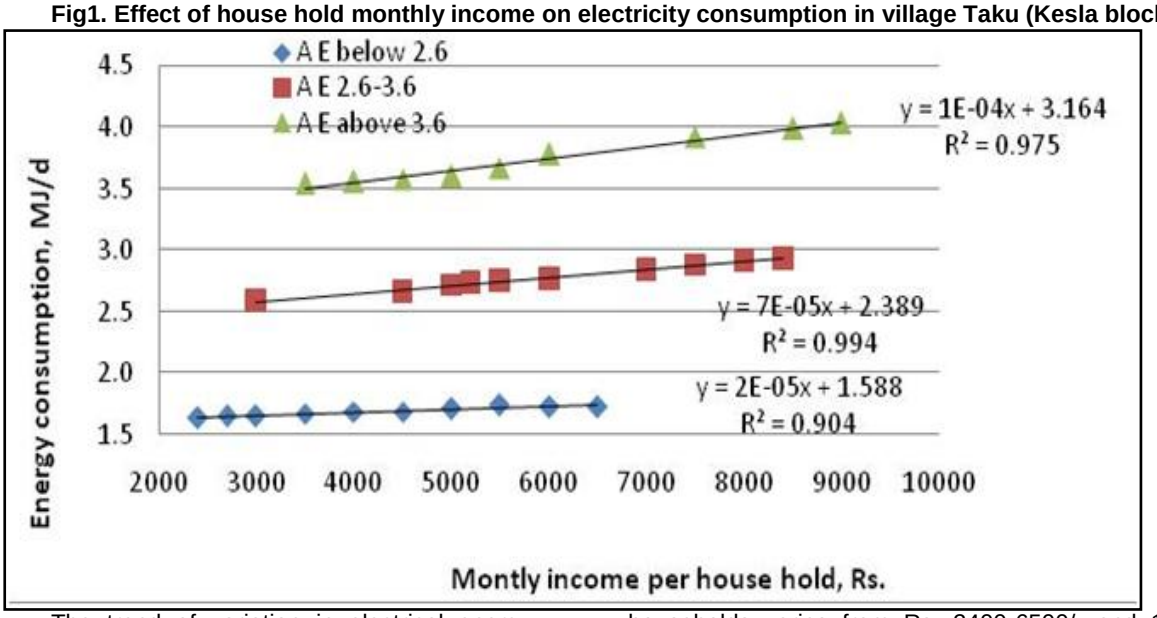
Fig1. Effect of house hold monthly income on electricity consumption in village Taku (Kesla block)



The trend of variation in electrical energy consumption (EEC) with household income in three categories of adult equivalent best fit in linear association with higher values of coefficient of determination (R^2) as follows: (i) EEC = 0.00002 MI + 1.5885 (AE - 2.6), (ii) EEC = 0.00007 MI + 2.3894 (AE - 2.6-3.6) and (iii) EEC = 0.00001MI + 3.1648 (AE > 3.6).

In small family size (AE 2.6), the monthly income and electrical energy consumption in ten households varies from Rs. 2400-6500/- and 1.64-1.73 MJ/d respectively. In medium family size (AE 2.6 -3.6), the monthly income and electrical energy consumption in ten households varies from Rs. 3000-8400/- and 2.59-2.93 MJ/d respectively. In large family size (AE > 3.6), the monthly income and electrical energy consumption in nine households varies from Rs. 3500-9000/- and 3.55-4.03 MJ/d respectively.

Table (1): Regression equation coefficients for electricity consumption in village Taku (Kesla Block)

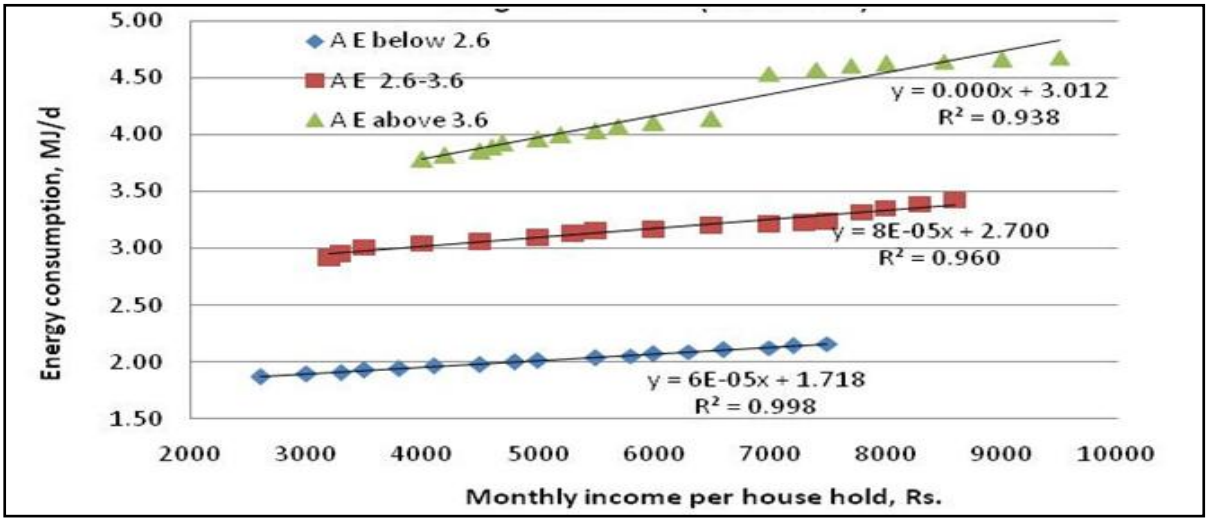
Sl. No.	Adult Equivalent	Regression Coefficient, m	Coefficient of Determination	Intercept
1.	< 2.6	0.00002	0.90	0.9042
2.	2.6-3.6	0.00007	0.99	0.9945
3.	> 3.6	0.00001	0.97	0.9752

It is evident from the data shown in above table (1) that the consumption of electrical energy increases as the adult equivalent (family size) goes up. This is evident from increase in slope of equation from 0.00001 to 0.00007. The high value of R^2(0.90-0.97) also validates the linear association in all family sizes.

Pandukhedi

The monthly income of the household and daily energy consumption varies from Rs. 2600-9500 and 1.87-4.68 MJ/d respectively as shown in fig. (2).

Fig2. Effect of house hold monthly income on electricity consumption in village Pandukhedi (Kesla block)



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The trend of variation in electrical energy consumption with household income in three categories of adult equivalent best fit in linear association with higher values of coefficient of determination (R^2) as follows: (i) EEC = 0.00006 MI + 1.7182 (AE 2.6), (ii) EEC = 0.00008 MI + 2.7007 (AE 2.6-3.6) and(iii) EEC = 0.00002 MI + 3.0121 (AE > 3.6).

In small family size (AE 2.6), the monthly income and electrical energy consumption in seventeen household varies from Rs. 2600-7500/- and 1.87-2.16 MJ/d respectively. In medium family size (AE 2.6 -3.6), the monthly income and electrical energy consumption in seventeen household varies from Rs. 3200-8600/- and 2.92-3.42 MJ/d respectively. In large family size (AE > 3.6), the monthly income and electrical energy consumption in eighteen household varies from Rs. 4000-9500/- and 3.78-4.68 MJ/d respectively.

Table (2): Regression equation coefficients for electricity consumption in village Pandukhedi (Kesla Block)

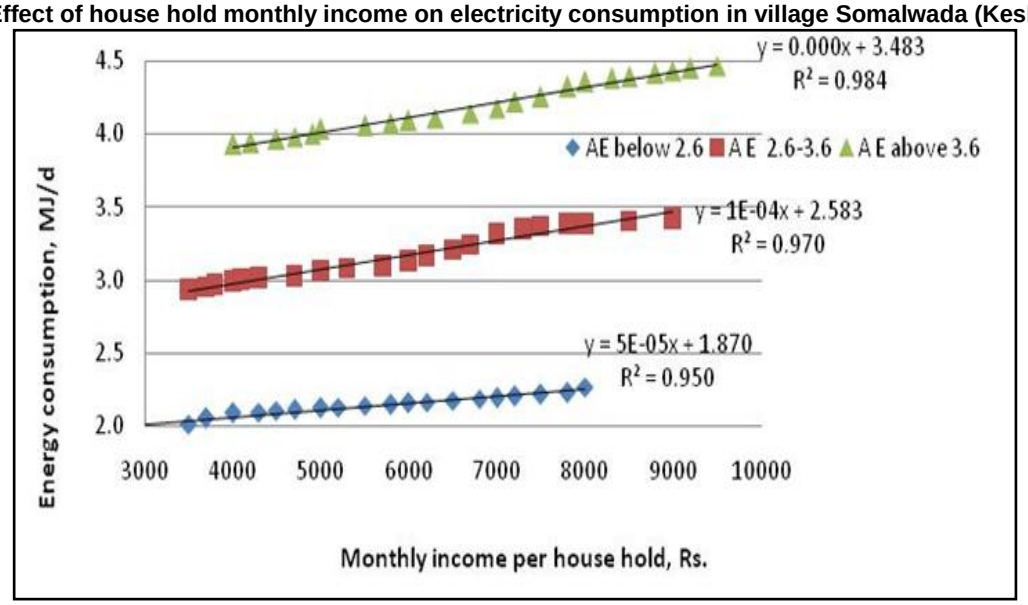
Sl. No.	Adult Equivalent	Regression Coefficient, m	Coefficient of Determination	Intercept
1.	< 2.6	0.00006	0.99	0.9985
2.	2.6-3.6	0.00008	0.96	0.9605
3.	> 3.6	0.00002	0.93	0.9384

It is evident from the data shows in above table (2) that the consumption of electrical energy increases as the (family size) adult equivalent goes up. This is evident from increase in slope of equation from 0.00002 to 0.00008. The high value of R^2 (0.93-0.99) also validates the linear association in all family sizes.

Somalwada Khurd

The monthly income of the household and daily electrical energy consumption varies from Rs. 3000-9500 and 1.98-4.46 MJ/d as shown in fig. (3).

Fig 3. Effect of house hold monthly income on electricity consumption in village Somalwada (Kesla block)



The trend of variation in electrical energy consumption (EEC) with household income in three categories of adult equivalent best fit in linear association with higher values of coefficient of determination (R^2) as follows: (i) EEC = 0.00005 MI+ 1.8704 (AE 2.6), (ii) EEC = 0.00004 MI + 2.583 (AE 2.6-3.6) and (iii) EEC = 0.00001 MI + 3.4832 (Adult Equivalent > 3.6).

In small family size (AE 2.6), the monthly income and electrical energy consumption in twenty one household varies from Rs. 3000-8000/- and 1.98-2.27 MJ/d respectively. In medium family size(AE 2.6 -3.6), the monthly income and electrical energy consumption in twenty one household varies from Rs. 3500-9000/- and 2.93-4.42 MJ/d respectively. In large family size (AE > 3.6), the monthly income and electrical energy consumption in twenty two household varies from Rs. 4000-9500/- and 3.92-4.46 MJ/d respectively.

Table (3): Regression equation coefficients for electricity consumption in village Somalwada Khurd (Kesla Block)

Sl. No.	Adult Equivalent	Regression Coefficient, m	Coefficient of Determination	Intercept
1.	< 2.6	0.00005	0.95	0.9504
2.	2.6-3.6	0.00004	0.97	0.9706
3.	> 3.6	0.00001	0.98	0.984

It is evident from the data shown above in table (3) figure that the consumption of electrical energy increases as the (family size) adult equivalent goes up. This is evident from increase in slope of equation from 0.00001 to 0.00005. The high value of R^2 (0.95-0.98) also validates the linear association in all family sizes.

Per capita electrical energy consumption

Per capita electrical energy consumption in selected villages ranged between (0.71-0.75 MJ/d). The higher per capita elctrical energy consumption in Somanwada Khurd (0.75 MJ/d) could be attributed to higher development level and higher monthly household income.

Conclusion

As far as the households in the selected villages all the households had electricity connection and electrical energy was being utilized for lighting and running home appliances. Amid versatile irregular livelihood earning options a wide range of household income was observed and varies between Rs. 2400-9500. As for electrical energy utilization the value of electrical energy consumption varies from 1.64-4.46 MJ/d. A linear correlation between the household income, family size and electrical energy consumption was noticed. In all three villages, the linear relationship showed very higher value of co-efficient of determination (R^2). This showed a very strong relationship between electrical energy consumption and monthly income of the households. The relationship between electrical energy consumption and monthly income per household also varied with family size (adult equivalent). As the adult equivalent value goes up from less than 2.6 to greater than 3.6, the slope of the relationship also goes up. This shows that as the family size increases, the relationship between electrical energy consumption and monthly income per household also increases rapidly. Per capita electrical energy consumption ranged between (0.71-0.75 MJ/d) in all the selected villages. Higher per capita in village Somalwada Khurd village (0.75 MJ/d) could be attributed to higher monthly household income and higher level of development in this village.

References

1. *Anonymous (2012). Energy Sources of Indian Households for Cooking and Lighting, NSS 68th round, pp 37. Retrieved from http://www.cea.nic.in.*
2. *Anonymous (2013). Analytical Report on Houses, Household Amenities and Assets– Cooking Fuel and Lighting. Census of India, pp 331-376.*
3. *Balachandra, P. (2011). Dynamics of Rural Energy Access in India: An Assessment. Energy 36, pp 5556-5567.*
4. *Bowonder B, Prakash Rao N, Dasgupta B, and Prasad (1985): "Energy Use in Eight Rural Communities in India". World Development Great Britain Vol. 13, No. 12. pp 1263-1286.*
5. *Central Electricity Authority (2013). Annual report Government of India Ministry of Power Central Electricity Authority, July 2013. Retrieved from http://www.cea.nic.in/*
6. *Chunekar, A. Varshney, S. and Dixit S. (2016). Residential Electricity Consumption in India, Prayas (Energy Group), pp 1-60.*
7. *TERI (2015). Analysis of the electrification programme in India using the 'energy plus' framework and the key lessons. Retrieved from http://www.gnesd.org/*