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DOES THE CHOICE OF ALTERNATIVE ENERGY SOURCES OF HOUSEHOLDS AFFECT COST OF COOKING IN RURAL AREAS OF PESHAWAR

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ABSTRACT

This study is based on does the choice of alternative energy sources effect cost of cooking in rural areas of Peshawar. The main objective of the study was to investigate the effect of the choice of alternative energy sources on cost of cooking in the study area. Multi-stage sampling technique was used for data collection. In the first stage, three rural union councils were purposively selected. In the second stage, three villages each from three union councils were selected. In the third stage, the households were selected for data collection regarding the choice of alternative energy sources for cooking in the study area. A sample of 5 percent out of total households which were 512 sample households was chosen randomly. In this study multiple linear regression model and robust regression were also used for the cost incurred on different energy sources. The result of multiple linear regression model indicated that the effect of family size, distance from home to the nearest market, education level and income of the sample households have significant at 0.05 level and positive effect on the cost of energy sources for cooking in the study area. The study concluded that family size has a negative relationship with the use of electricity and firewood while the income of household head, education level of the household head has a positive relationship with the use of electricity, natural gas and firewood for cooking purpose in the study area. The study also concluded that the use of natural gas was less costly as compared to other alternative energy sources like electricity and firewood. The study recommends that government should make out all efforts to ensure the availability of natural gas for the use of cooking purpose in the study area. The government should offer alternative sources, like solar energy for cooking and provide them modern and cheap energy sources.

Keywords: Energy Sources, Cost on Cooking, Regression Model, Robust Regression, Pakistan

INTRODUCTION

Energy sources is a burning issue in developed and as well as in developing countries. The concept of alternative energy sources plays a key role in household consumption, output and in productivity. It is a basic need for cooking, lighting etc. the use alternative energy sources are very important for the sustain improvement in the field of agriculture, industry, electricity generation and transportation.

Energy is the backbone and basic need of economic development for any country. In developing country like Pakistan energy is the basic requirement for their sustainable economic growth. This is the crucial issue in the world because two billion people were use and dependent on traditional energy sources and it is their basic means of energy for cooking (Kowsari & Zerriffi, 2011). Energy consumption of households can be defined as the amount of energy

sources which a household spends on various appliances for domestic purposes. The various energy sources include; waste and biofuel, electricity, Kerosene, petroleum, gas, diesel, and solar energy, (IEA, 2014). Energy refers to one of the most important and refers to the basic aspects of human life. Energy is basically a commodity that is important for the survival of modern life in the world (Eakins, 2013). Energy has a considerable and integrated impact on economic growth and also affects social, human, and environmental components of the development paradigm. Energy has always been multidimensional in terms of its effect as it covers a diverse range of spheres at different levels (Amigun et al, 2011).

In the rural areas of developing countries in the world, more than 95 percent of people are living without electricity. The residents who are living in rural areas in developing countries face energy poverty (International Energy Agency (IEA, 2015)). Energy poverty refers to the lack of access to modern energy services. The absence of proper energy services in the developing world is a major problem in the economic development, prosperity and economic growth of a country (Hepler, 2015). The use of energy sources is rapidly increasing in China, India and Pakistan. The use of traditional energy sources in developing countries comes from polluting fossil fuels. Most of the households in rural areas use unconventional energy sources and traditional biomass (IEA, 2008). Energy processes reflect the main contribution to environmental problems like global climate change and increasing temperature.

Moeen et al. (2016) analyzed that modernization in the agriculture and industry sectors has increased the importance of choice of energy sources in Pakistan. Especially in rural Pakistan households have used alternative energy sources. In Pakistan the households have used both traditional and modern energy sources for the purposes of lighting, cooking and heating in the study areas. The study has used a multinomial logistic regression model. The study findings show that how the households of rural Pakistan can make choices among the available energy sources. The study argues that demand for energy sources has become more than a supply of energy sources. The findings suggest that there is limited access to modern energy sources in rural areas of Pakistan, rural households depend only on traditional energy sources. It may have a negative impact on the environment and sustainable economic growth. Raffia (2016) concluded that the choice of energy sources for households' consumption was a crucial aspect that takes into consideration the socio-economic factors of a household. The prevailing social and economic conditions in a household determine subsequent energy utility in terms of consumption. Households utilize energy sources for domestic use according to their income level and social status. The study concluded that the rational decision-making process regarding the use of alternative energy options whether for cooking, heating, and lighting largely hinge upon the financial status of the households, social standing and family size of a household. The study found that a rational decision-making process proved effective in the proper selection of alternative energy sources for domestic consumption.

Malla & Timilsina (2014) highlighted that it was important to assess and analyze the price of fuels and cook stoves. The study explains that prices complement income which in turn affects affordability issue in determining household's fuel choices. The study explains that there is an effect of prices and income on households' energy choices. The findings show that the household choice about energy sources has a significant effect on the household head income and prices of fuels and cook stoves. The main objective of the study is to investigate choice of various alternative energy sources of households affect cost of cooking in rural areas of Peshawar.

Data and Empirical Methodology

Universe of the Study

Rural areas of district Peshawar constitute the universe of this study. The study focused on rural areas of district Peshawar because of the severe problem of choice of alternative energy sources in these areas. All the villages in district Peshawar of Khyber Pakhtunkhwa was the universe of the study.

Sample Design of the Study

A sample survey of the study was conducted in selected rural areas of district Peshawar. The data related to the study variables was collected from the households in villages of district Peshawar. Primary

data was collected from households in selected villages through the interview schedule. Due to time, labour, financial constraints and limitations of resources, a simple random sampling technique was used for the selection of households from different villages in district Peshawar. The survey was carried out using a multi-stage cluster sampling technique. In the first stage of sampling technique, primary sampling units of rural union councils were purposively selected in the study area. In the second stage of sampling, one village was chosen from each selected rural union councils. In the third stage, the households head were selected for information regarding the choice of alternative energy sources, which were used for cooking and heating purpose in the study area. In this study sample, respondents of the study were household heads in the selected villages. There are a total of 56 rural union councils in district Peshawar. We have selected purposively three rural union council villages and further among these rural union councils, three villages were selected, while among these villages, 5 percent household heads were chosen randomly (Ali et al, 2014).

Table 3.1
Sample Households from Selected Villages

S.No.	Name of selected Villages	Total Population (Households)	Sample Size (5 % of Households)
1	Babu Zai	4210	210
2	Dub Bunyady	3120	156
3	Bela Baramad Khel	2912	146
Total		10242	512

Source: Survey (2022)

On the basis of 5 percent, sample households were selected; i.e. 210 from Babu Zai, 156 from Dub Bunyady and 146 samples from Bela Baramad Khel.

Econometric Model: Empirical Testing
Multiple Linear Regression Model

The study used multiple linear regression model to estimate the relationships between regressand and explanatory variables because the response variable is continuous, which is total cost of energy sources used for cooking and the explanatory variables are gender of household head, income, use of alternative energy sources of cooking, family size, education level and distance from home to the nearest market. This research study explored the total cost of energy sources as a dependent variable (Fechete, 2014). The multiple linear regression models can be written as;

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 D_1 + \beta_7 D_2 + \beta_8 D_3 + \beta_9 D_4 + u_i$$

Y= Total Cost on energy sources in rupees (Rs / month)
β_0= Intercept of the model
β_i = Coefficients of the explanatory variables
X_1 = Age of the household head (years)
X_2 = Income of the household in rupees (Rs / month)
X_3 = Family size of the household (No. of persons)
X_4 = Distance from the nearest market (/ kilometers)
X_5 = Education of the household head (years).
D_1 = Dummy Variable for the gender of household head (D_1 = 1 if male and 0 otherwise)
D_2= Dummy variable for electricity (D_2 = 1 if household use electricity and
If D_2 = 0 otherwise)
D_3 = Dummy Variable for firewood (D_3 = 1 if household use firewood and
If D_3 = 0 otherwise)
D_4 = Dummy Variable for natural gas (D_4 = 1 if household use natural gas and
If D_4 = 0 otherwise)
u_i = Random error

DATA COLLECTION

The current research study was based on cross-sectional data. The primary data were collected by using the interview schedule according to the objectives of the study. Since, the current research study is focusing on does the choice of alternative energy sources (natural gas, electricity, firewood and dung cake) for the use of cooking in rural areas of district Peshawar, thus the data were collected from different households in rural areas of district Peshawar, Khyber Pakhtunkhwa province of Pakistan.

DIAGNOSTICS TESTS

Relevant diagnostics tests for data like normality and others (i.e. multicollinearity and heteroscedasticity) were checked. So, the data was normal and there was no problem with multicollinearity but the problem of heteroscedasticity has occurred in the data. Therefore the robust regression was used to adjust the standard error.

RESULTS AND DISCUSSION

Estimation of Breusch-Pagan test to check the Heteroscedasticity for Cooking Source

Table 4.1 shows that the estimated value of the Breusch-Pagan test to check the problem of heteroscedasticity. Breusch-Pagan test is used for large sample tests and the residuals to be normally distributed. The significance value was 0.000, which is less than P-value (0.05), so it indicates the problem of severe heteroscedasticity (no constant variance) in the error term. To accept the alternative hypothesis of heteroscedasticity, the significance value should be greater than 0.05.

Heteroscedasticity test

H_o: There is no Heteroscedasticity (constant variance)

H_1: There is Heteroscedasticity (no constant variance)

Table 4.1

Breusch-Pagan and Koenker tests for Heteroscedasticity for Cooking Source

Tests for Heteroscedasticity	LM	Sig
Breusch-Pagan test	5185.826	0.000
Koenker test	334.097	0.000

Source: Survey (2022)

Estimated Coefficients of Multiple Linear Regression Model for Cooking Source and its Discussion

Table 4.2 indicates the explanatory variables coefficients and their interpretation. In the proposed model the cost of energy sources as a response variable, while the age of household head, education, gender, family size, income and distance from the nearest market and alternative energy sources such as electricity, firewood and natural gas were the regressors. The R^2 value was 0.481, which means that 48 percent of variations in the dependent variables were explained by the explanatory variables in the model. The F statistic value was 51.734, which was greater than the standard value i.e. 4. The F value suggested that the selected model was overall statistically significant with p-value 0.000. The coefficient of the gender of household heads was 12.048. It means that the gender of the household heads has changed the cost of energy sources by 12.048 rupees. So, if the gender of household heads is male then the cost of energy sources increase by 12.048 rupees. The coefficient of gender (male) was positive, which shows that gender (male) of household heads and cost on heating and cooking source has a positive relationship. The significance value was greater than 0.05, which means that gender (male) of household heads has statistically insignificant effect on the cost of energy sources.

The coefficient of age of household heads was 1.595; it means that with one year increase in the age of household heads the cost of energy sources increases by 1.595 rupees. The table shows that age of household heads also insignificant effect on cost of energy sources. Education level of household heads has a positive relationship with the cost of energy sources, if education level of household heads increases by one year then the cost of energy sources also increases by 5.740. The coefficient of family size was also positive, which means that one member increase in the family lead to an increase in the cost of energy sources by 39.925. The relationship between income of household heads and cost on energy sources was positive; it means that with one thousand rupee increase in household heads income, the cost of energy sources increases by 7.793.The Income level of was found a significant and positive related to the costs of energy sources of cooking by Qasim and Kotani (2014). Their study discussed that income level has direct relationship with costs of energy sources.

The coefficient of distance from the nearest market has a positive relationship, which shows that one-kilometer increases in the distance from the nearest market then the cost of energy sources was increased by 55.641. The coefficient of electricity, which is the alternative energy source, has a positive relationship. It means that if the household heads increase the use of electricity instead of animal dung cake, the cost of energy sources increases by 21.518. Similarly, the coefficient of firewood also had a positive

relationship, which shows that if the household head increases the use of firewood rather than animal dung cake, the cost of energy sources increases by 69.223.Smith and Haigler (2008) also reported similar results. A rural household uses more of bio mass fuel than the costs on sources of energy of cooking and heating also uplift. The use of firewood and animal dung cake increases both economic and environmental costs.

In the case of natural gas, the coefficient was -6.545, which indicates that if the household heads increase the use of natural gas then the cost of energy sources has the probability to decrease by 6.545. The similar results were also found by Khan et al (2015). The table 4.2 concludes that gender (male) of household heads, age (in years), electricity, firewood, and natural gas have statistically insignificant effect at 0.05 level on cost of energy sources, while family size, income (monthly), distance from the nearest market at 0.05 level and education level (yearly) at 0.1 level have significant effect on cost of energy sources.

Table 4.2

Estimated Coefficients of Multiple Linear Regression Model for Cooking Source

Explanatory Variables (Cooking Source)	Unstandardized Coefficients		t-value	Sig
	β	Standard Error		
Constant	141.933	103.733	1.368	0.172
Gender (Male = 1)	12.048	40.829	0.295	0.768
Age (yearly)	1.595	1.544	1.033	0.302
Education (yearly)	5.740	3.084	1.861	0.063
Family Size	39.925	3.970	10.057	0.000
Income (monthly)	7.793	0.584	13.336	0.000
Distance (per km)	55.641	10.663	5.218	0.000
Use of Electricity Dummy	21.518	79.171	0.272	0.786
Use of Firewood Dummy	69.223	47.719	1.451	0.148
Use of Natural Gas Dummy	-6.545	47.797	-0.137	0.891

Source: Survey (2022) F = 51.734
P-value= 0.000
R^2 = 0.481 Adjusted R^2 = 0.472
Jarque-Bera normality test = 0.0468
Note: Significance level at 0.05 and 0.1 levels respectively.
Note: Animal Dung Cake was a reference category.

Estimated Coefficients of Robust Regression for Heteroscedasticity to Adjust the Standard Error for Cooking Source.

Table 4.3 indicates the coefficients of robust regression to adjust the standard error and t value. Robust regression is used whenever the problem of high heteroscedasticity has to occur in the model. In this research study, there was the problem of high heteroscedasticity; therefore the study has used robust regression. The robust regression was used to adjust the standard error suggested by Ahmad daryanto (2005). The results of robust regression show that the coefficients of all the explanatory variables remain the same but standard errors and t-values have changed, which means that it was adjusted by robust regression. Bergh and Ohrn (2011) were also used robust regression to adjust the standard error.

Table 4.3

Estimated Coefficients of Robust Regression for Cooking Source in the Study Area

Explanatory Variables (Cooking Source)	B	Standard Error	t-value	Sig
Constant	141.933	107.541	1.320	0.188
Gender (Male = 1)	12.048	44.409	0.271	0.786
Age (yearly)	1.595	2.466	0.647	0.518
Education (yearly)	5.740	4.647	1.235	0.217
Family Size	39.925	25.686	1.554	0.121
Income (monthly)	7.793	12.203	0.639	0.523
Distance (km)	55.641	45.026	1.236	0.217
Use of Electricity Dummy	21.518	74.730	0.288	0.774
Use of Firewood Dummy	69.223	58.554	1.182	0.238
Use of Natural Gas Dummy	-6.545	89.088	-0.073	0.941

Source: Survey (2022) F = 104.749 P-value = 0.000 R^2 = 0.653
Note: Significance level at 0.05 and 0.1 levels respectively.
Note: Animal Dung Cake was a reference category.

CONCLUSION AND POLICY RECOMMENDATIONS

CONCLUSION

This study determined that the choice of alternative energy sources for cooking had been practiced in the rural area of district Peshawar. It is concluded that mostly sample household heads were males and illiterate. The research study concludes that most of the sample household heads about 45 percent used natural gas for cooking purposes. It means that most

of the household heads had used natural gas for cooking where the natural gas was available; because natural gas is less expensive as compared to other energy sources. The results of multiple linear regression models concluded that the explanatory variables such are education level of household head, family size, income of household head, alternative energy sources for cooking and distance from the nearest market effect the cost on cooking source. The estimated result of the suggested model concludes that education level of household head, family size, income of household head and distance from the nearest market were found to have a significant effect on the cost energy sources for cooking. In the case of heating source the effect of education (in a year), family size and income (per month in rupees) and distance (per km) on the cost of energy sources had significant and positive relationship. It is concluded that when the age of household heads, income, education and family size increase, the cost of energy sources is also increase in the study area.

RECOMMENDATIONS

The study gives the following recommendations on the basis of study conclusions.

This was an exploratory study and the first of its kind in selected villages of district Peshawar. This study should be followed by other such studies for better and informed policy making at respective levels of government.

The use of natural gas is less costly as compared to other alternative energy sources like electricity and firewood, the study recommends that government should make out all efforts to ensure the availability of natural gas for the use of cooking purpose in the study area.

Sample households are facing problems regarding the severe shortage of electricity and natural gas in the study area. So the concerned line departments should take remedial measures to address the concerns and needs of the rural people.

The government should take practical steps for clean and green energy sources to reduce the use of fire wood which direly affects green cover and vegetation. This may be helpful in reducing environmental degradation.

The government should focus to provide modern energy sources like solar energy for cooking in the study area.

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