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EMPIRICAL ANALYSES OF HOUSEHOLD ENERGY EXPENDITURE AND PREFERENCES IN UMUAHIA NORTH LGA OF ABIA STATE, NIGERIA

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ABSTRACT
The study was carried out in Umuahia North Local Government of Abia State, Nigeria.Multistage random sampling technique was used to select 60 households for the study. Data collected were analyzed with Ordinary Least Square and Ordered Probit regression models. The result shows that most of the households used kerosene followed by Liquefied Natural Gas, fire wood and charcoal as their major domestic cooking energy sources. Household energy expenditure was positively and significantly influenced by household size at 10% level of significance, educational level at 10% and frequency of cooking at 5% while it was negatively and significantly influenced by sex at 5% significance level and income at 10%. Results of the ordered probit regression shows that choice of household energy expenditure was positively and significantly influenced by gender at 10% level of significance, household income at 1% , and educational level at 5% level of significance.Based on the findings, it is recommended thatcleaner energy types should be made affordable and accessible. The results therefore call for policies aimed at use of efficient energy that is less adverse impacts on the health and environment. Policies geared towards access to free and affordable education to enable households' access and process information on importance of cleaner energy and benefits to health and environments should be advocated.

Keywords: Household, energy, consumption, and preferences

Introduction

Energy is essential to all human activities and, indeed critical to social and economic development. Energy is only one of the many important inputs for production, conversion, processing and commercialization in all sectors. It is generally recognized that energy plays a significant role in the economic development of a country as it enhances the productivity of the nation. Energy demand is important as it affects the economy which in turn affects people's lives, and their ability to meet basic needs such as the need for infrastructure, education and so on (Kayode *et al*., 2017). Access to energy is particularly crucial to human development as it is indispensable for certain basic household activities, such as cooking, lighting, refrigeration and the running of household appliances (IEA, 2006). Nigeria's households have diversified their energy sources with disparities in the consumption of commercial energy by both urban and rural dwellers (Ibidun and Afeikhena, 2010). Government policies also influence energy utilization coupled with income levels and some other socioeconomic factors. This implies that a price subsidy policy for Liquefied Petroleum Gas (LPG) and cooking stove could significantly decrease the utilization of wood energy. This has brought about the much talked about "energy ladder" where a progression of fuel wood to modern fuels is expected as income rises (Arnold *et al*., 2003). In developing countries, most of the rural communities have less access to modern and clean energy sources and mostly depend on traditional fuel/biomass (woods, twigs, leaves, charcoal, animal dung and crop residual). However, as urbanization and modernization expand to rural environments, there are varied alterations in the expenditure and types of energy consumed by households.

Nigeria consumes over 50 million metric tons of firewood annually; a rate which exceeds the replenishment rate through various afforestation programmes such as Inter-Ministerial Committee on Combating Deforestation and Desertification (ICCDD, 2000). This poses a danger and research challenge based on the numerous health and environment problems derivable from this trend. Sourcing firewood for domestic and commercial uses is a major cause of desertification in the arid-zone

states and erosion in the Southern part of the country (Sambo, 2009). However, it is for research to establish the current status, the economic drivers and what should be done to help households, the environment and the economy at large. There is therefore need to analyze the household energy expenditure and preferences in Umuahia North LGA of Abia State, Nigeria.

Methodology

The study was carried out in Umuahia North Local Government of Abia State, Nigeria. It is one of the 17 Local Government Areas of Abia State. Multi-stage random sampling technique was used to select the respondents. In the first stage, three (3) autonomous communities were selected in Umuahia North L.G.A. The second stage involved random selection of two (2) villages from each selected community. In the third stage, ten (10) households were selected from each of the selected villages giving a total of 60 households for the study area. The regression model for the determinants of household energy expenditure is implicitly stated as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8) + e \quad (1)$$

Y = Household energy expenditure (₦/ month)
X_1 = Age (Years), X_2 = Household size (number of persons), X_3 = Sex (male =0, female = 1) , X_4 = Household income (₦ / month) , X_5=Education (number of years spent in acquiring formal education)., X_6=Marital status (Married = 1, otherwise = 0), X_7=Occupation (Farming = 1, Non farming = 0), X_8= Frequency of cooking (number of times of cooking foods per month), e = error term

Factors that influenced the choice of household energy types in the study area was analyzed with Ordered Probit model. Following Yang and Raehsler (2005), Cuma *et al*., (2007) and Feng *et al*., (2006), the standard ordered probit model is widely used to analyze discrete data of this type and is built around an ordinal regression of the following form:

$$\tilde{y} = X'\beta + \mathcal{E} \quad (2)$$

Where N' and β are standard variables and parameter matrices, and Ɛ is a vector matrix of normally distributed error terms. Obviously, predicted grades ($\tilde{y}$) are as follows; $\tilde{y}_{orderedprobit}$
(3 = kerosene, 2 = Liquefied Petroleum Gas, 1 = firewood, 0 = charcoal)
$X_1 – X_8$ = Variables as specified in equation 1
Ɛi = Error term distributed across observations and is normalized with the mean and variance of zero and one
β's = Estimated coefficients

Results and Discussion

Energy types used by the respondents

The distribution of the respondents according to energy types is shown in Table 1. The energy types mostly employed by households as reported by the respondents in Umuahia North Local Government Area were Kerosene, Firewood, Liquefied Petroleum Gas (LPG) and Charcoal. The level of energy availability per month is represented by their frequencies or percentages. Many of the sampled households (53%) indicated Kerosene as one of the frequently used domestic energy in the study area. Kerosene was mostly available to households in the study area because of easy accessibility, and affordability. This result is in agreement with Onoja (2012) who observed high availability rate of Kerosene in Kogi State.A total of 15.0%, 53.33% and 11.67% of the households indicated Firewood, Liquefied Petroleum Gas (LPG), and Charcoal as their most used domestic energy. The high percentage of LPG (50.00%) among the respondents might indicate that the households' in the study area were relatively moderate-income earners living in areas with some level of urbanization. Many households are gradually moving over to LPG as noted by Njong and Johannes (2011) that the high preference for LPG is due to its clean nature, speed and convenience.

The low percentage of Charcoal (11.67%) implies that the traditional energy sources were gradually reducing in importance in the study area. This decline is as a result of several factors, including increased energy efficiency and saturation with alternative domestic sources. Disparities in household energy use exist between rural and urban populations, between high- and low-income groups within a country, and among countries. The major factors contributing to these differences are levels of urbanization, economic development, norms and living standards.

Factors Influencing Household Energy Expenditure in Umuahia North L.G.A., Abia State, Nigeria

Factors Influencing Household Energy Expenditure in the study area was analyzed using Multiple Linear Regression Model. The result is presented in Table 2. The result shows that five of the eight explanatory variables used in the model significantly affected the household energy expenditure. These variables were household size (X_2), sex (X_3), household income(X_4), education level(X_5) and frequency of cooking (X_8). The F-ratio was 3.08 and statistically significant at 99% level of confidence; which implies that the model has a good fit. The household size of the respondents was positive and statistically significant at 10% level; with a coefficient of 398.726. This implies that an increase in family size of the respondents will lead to a corresponding increase in monthly expenditure of domestic energy. The result denotes that the higher the household size, the more

likelihood of increased expenditure on domestic energy. The sign of the variable conforms to *a priori* expectations. Generally, the more people in a household, the more mouths to feed and this conventionally would require more energy to cook the food hence increase in cooking energy expenditure. This result is synonymous with that of Mekonnen and Kohlin (2008) who noted that the rate of consumption is a function of number of people.

Gender of the households was negative and statistically significant at 5% level with coefficient of -2507.065. This infers that male headed households had lower probability of using household energy. This is expected because females are traditionally responsible for food preparation in many Nigerian States. On the other hand, household income of the respondents negatively influenced monthly domestic energy expenditure in the study area with a coefficient of -0.014. Abdullahi *et al*., (2017) observed that low income households generally use traditional stoves and cooking fuels such as animal dung, charcoal and wood, while those households with higher income used modern cooking technology and fuels. As income increases, households transit from traditional fuels and cooking stoves to modern fuels and cooking technology that may be cost-effective. Also, other already-processed may be purchased more often as income increases.

The educational status of the households was positive and statistically significant at 5% level; with a coefficient of 105.813. This implies that any increase in educational status of the respondents will lead to a corresponding increase in monthly expenditure of domestic energy. A possible reason for this finding is that education enhances individuals' awareness of the detrimental consequences of using some energy types (firewood and charcoal) on people's health and the environment. Hence, the higher monthly expenditure on cleaner energy sources such as LPG or Kerosene.

The frequency of cooking was positive and statistically significant at 5% level; with a coefficient of 87.141. This implies that any increase in frequency of cooking will lead to a corresponding increase in monthly expenditure of domestic energy. The more food a household cooks, the more the energy expended.

Influence of some Socio-economic Factors on the Choice of Household Energy Types in Umuahia North L.G.A., Abia State, Nigeria

The result of the analysis on the factors that influenced the choice of household energy types in Umuahia North LGA, Abia State is presented in Table 3. The household income of the respondents was a significant factor that influenced the choice of household energy expenditure in the study area. The household income was significant at 1% level with a positive coefficient of 8.01. The sign of the variable is in consonance with *a priori* expectation. This denotes that a unit increase in household income will result in 8.01 increase in preference for modern energy sources to others. This implies that domestic energy is a normal good whose expenditures increase with increase in income. The result of this study collaborates with the findings of Wange and Bessler (2006) in which they stated that the incomes of the consumer were significantly related to the choice of domestic energy consumed by the people of southern Nigeria.

The educational level of the respondents was significant at 5% level with a positive coefficient of 3.68. This implies that a unit increase in educational level of the household heads will result in 3.68 increase in choice of domestic energy types in the study area. This result infers that the higher the level of education attained by household head the greater chances for his/her willingness to consume alternative sources of energy for domestic purposes. This suggests that educated household heads are less likely to engage in consuming fuel wood or charcoal, hence, reduces the tendencies of environmental degradation through deforestation and climate change.

Household heads that were not formally educated reported higher likelihoods of using charcoal and fuel wood. Aina (2001) found that irrespective of the educational status of the household heads, economic status was important in determining the choice of energy utilized by the households. Conventionally, household heads with little education are expected to have limited understanding of some environmental and health hazards that are associated with charcoals and fuel wood usage. Gupta and Köhlin (2006) and Baiyegunhi and Hassan (2014) observed in India and Nigeria respectively that a higher educational level induces households to move away from firewood dependence towards the use of Kerosene and LPG. In like manner, Gebreegziabher *et al*., (2012) found in Ethiopia that, the higher the educational level, the less likely the households will choose wood, while the more likely the households will choose modern energy sources.

The gender of the household head was significant at 10% level with a positive coefficient of 1.68. This implies male-headed households may prefer modern energy sources than female- headed households. Adedayo *et al*., (2010) found that fuel wood gathering among women can be linked to their quest for income levels, tradition or convenience.

Conclusion

The traditional energy sources (such as Charcoal and Firewood) have reduced in usage in the study area as there is gradual tilt towards cleaner energy. Household energy expenditure was significantly

influenced by household size, sex, income, educational level and frequency of cooking. Results of the ordered probit regression for the factors influencing choice of household energy expenditure shows that gender, household income, and educational level were the significant variables that influenced the choice of domestic energy types.The households therefore should be encouraged to make fuel substitution that will result in more efficient energy use and less adverse environmental, social, and health impacts. Policies geared towards access to free and affordable education to enable households' access and process information on importance of cleaner energy and benefits to health and environments should be advocated.

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Table 1: Energy Types used by the Households in Umuahia North L.G.A., Abia State, Nigeria

Energy Types	Frequency*	Percentage (%)
(i) Kerosene	32	53.33
(ii) Firewood	9	15.00
(iii) LPG	30	50.00
(iv) Charcoal	7	11.67

* = Multiple Responses. *Source: Computed from field survey data, 2018*

Table 2: Regression Estimates of Influence of Some Socio-economic Factors on Household Energy Expenditure in Umuahia North LGA, Abia State, Nigeria

Variables	Parameters	Coefficient	Standard error	t – value
Constant	β_0	-3433.661	3434.070	-1.000
(X_1) Age	β_1	24.858	44.374	0.560
(X_2) Household Size	β_2	398.726	206.036	1.935*
(X_3) Sex	β_3	-2507.065	1119.327	-2.240**
(X_4) Household Income	β_4	-0.014	0.007	-1.954*
(X_5) Educational Level	β_5	105.813	46.531	2.274**
(X_6) Ma ital Status	β_6	994.120	1417.872	0.701
(X_7) Occupation	β_7	91.136	1059.806	0.086
(X_8) Frequency of Cooking	β_8	87.141	36.356	2.397**
R		0. 571		
F – statistics		3.08***		

**and * denotes significance of coefficient at 5%, and 10% levels respectively

Source: Field Survey Data, 2018

Table 3: Ordered Probit Regression Estimates of Determinants of Choice of Household Energy Types in Umuahia North L.G.A., Abia State, Nigeria

Explanatory Variables	Parameters	Coefficient	Standard error	Z – value
(N_1) Age	β_1	0.0278	0.0179	1.55
(N_2) Household Size	β_2	-0.0112	0.1090	-0.10
(N_3) Gender	β_3	0.5901	0.3502	1.68*
(N_4) Household Income	β_4	8.01E-06	2.78E-06	2.88***
(N_5) Educational Level	β_5	3.6893	1.3297	2.77**
(N_6) Marital Status	β_6	0.2082	0.4351	0.48
(N_7) Occupation	β_7	0.0136	0.0091	1.47
(N_8) Frequency of Cooking	β_8	-0.0019	0.0114	-0.17
Log likelihood		-62. 6517		
Chi Square		23.10***		
Pseudo R – Square		0.1556		

***, **, and * denotes significance of coefficient at 1%, 5%, and 10% level respectively

Source: Field Survey Data, 2018