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Analysis of Household Energy Expenditure in Umuahia North Local Government Area of Abia State, Nigeria

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Abstract

Understanding household energy expenditure is important to encourage policies that support the provision of cleaner, efficient and cost effective sources of energy to households. This project analyzed household energy expenditure in Umuahia North Local Government Area (LGA) of Abia State, Nigeria. The available domestic energy commonly used by the households' was kerosene, firewood, Liquefied Petroleum Gas (LPG), charcoal, and electricity. The most used domestic energy types was kerosene (1st), followed by Liquefied Petroleum Gas (2nd); then firewood (3rd) and charcoal (4th). Multiple regression result for the factors influencing household energy expenditure in the study area shows that five out of eight explanatory variables employed in the model significantly affected the respondent's households' energy expenditure. These variables were household size, sex, household income, education and frequency of cooking. Also, results from the ordered probit model shows that the significant variables influencing the choice of domestic energy expenditure was age and gender of the household head, their income level, educational level and occupation. Lack of financial resources, high cost of cleaner energy types and distance from the place of purchase significantly affected household energy expenditure in the study area. It is recommended that provision of cleaner, efficient and cost effective sources of energy be made available to households.

Keywords: Household Energy Expenditure, Fuel-wood, Liquefied Petroleum Gas (LPG), Ordered probit model, Umuahia North Abia State

Introduction

Energy is a basic necessity of life for meeting domestic, social and industrial needs (Momodu, 2013). Sufficient and steady energy supply for industrial and domestic uses are nuts and bolts for keeping socio-economic life moving. Energy is required at all times for various purposes, particularly at the household and industrial level. Life becomes difficult and meaningless without the availability of adequate and regular energy supply for domestic and industrial uses.

Household energy expenditure refers to the amount of energy resources that are spent by households for cooking, heating, lighting and powering gadgets and other electronic devices. According to the International Energy Agency - IEA, (2014), the various energy resources include: biofuel and waste, kerosene, electricity, gas, petroleum, diesel, and solar.

Household energy can be majorly categorized into expenditure proportions such as; cooking, lightening, heating and cooling, as well as transportation purposes. For satisfying the needs of cooking, the various sources available include; animal dung, plant residues, fuel-wood, kerosene, gas and electricity, (Julius, 2013). For lightening purposes, the various choices mainly include; electricity/solar, petroleum/diesel (used for fuelling generators), kerosene, candles and traditional lamps as well as firewood (Abubakar *et al*., 2015).

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Additionally, for the purpose of space heating and cooling (also drinks cooling), the various energy sources available consist of mainly electricity and petroleum/diesel power generator. Lastly, for transportation purposes the major choice available are; petroleum, kerosene and diesel for fuelling various transport vehicles, aircraft and motor cycles.

However, it is argued that more than 2.5 billion people worldwide depend majorly on traditional biomass fuel as their major source of energy for cooking, heating and lighting (Kowsari and Zerriffi, 2011). Such traditional biomass fuels are widely used particularly in developing countries (Yamamoto *et al*., 2009). A major example is the fuel-wood used in cooking and lighting. To overcome the negative effects of traditional biomass fuels on human health and the environment, and to improve living conditions in developing nations, there is a need for cleaner and efficient sources of energy that do not damage the environment and health of humans and animals. Understanding household energy expenditure is important to encourage policies that can support the provision of cleaner, efficient and cost effective sources of energy. In this regard, research which shows how different socioeconomic factors influence a household‘s energy expenditure is required. Therefore, this project analyzes household energy expenditure in Umuahia North LGA of Abia State, Nigeria.

Objectives of the Study

The broad objective of this study is to analyze the household energy expenditure in Umuahia North LGA of Abia State, Nigeria.

The specific objectives are to:

ι. examine the socio-economic characteristics of the respondents;

ιι. identify the domestic energy types and extent of use in the study area;

ιιι. determine the factors that influence household energy expenditure in the study area;

ιϖ. analyze the factors influencing the choice of household energy types in the study area;

ϖ. examine the constraints faced by household in the use of household energy.

Research Methodology Study Area

The study was carried out in Umuahia North Local Government Area (LGA) of Abia State, Nigeria. The LGA is one of the 17 LGAs of Abia state. It was created by the government of Ibrahim Babangida in August, 1991. Currently, its headquarters is in the city of Umuahia (Capital of Abia State). Umuahia North LGA is located within the tropical rain forest ecological zone of Nigeria. It occupies a land mass of 14,464 square kilometers and has geographical coordinates of $5^0 32^1$ North and $7^0 29^1$ East. The majority of the indigenes are farmers and others are civil servants, teachers, businessmen and craftsmen. The soil type of the area is predominantly sandy loan with some swamp areas especially along the river banks. This support the growing of staple food crops such as cassava, yam, maize, potatoes and vegetables.

Method of Data Collection and Sampling Technique

The study employed primary data. The data was collected through the aid of a well-structured questionnaire administered to the randomly selected households.

Multistage random sampling technique was used to select the respondents. In the first stage, three (3) autonomous communities were selected in Umuahia North LGA. The second stage involved the random selection of two (2) villages from each of selected communities. In the third stage, ten (10) households were selected from each of the villages and these resulted to 60 households' being selected for the study.

Analytical Techniques

Descriptive and inferential statistics was used to analyze the specific objectives of the study. Objective (i) and (ii) was analyzed with descriptive statistical tools such as frequency, mean, percentage and chart.

Objective (iii – factors influencing household energy expenditure) was analyzed with the application of multiple linear regression. The implicit form of the regression model is shown below:

$Y = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8)$ -(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).

Objective (iv): Factors influencing the choice of household energy types was analyzed with an Ordered Probit model. Following Campbell *et al*., (2003), the standard ordered probit model is widely used to analyze discrete data of this variety and is built around an ordinal regression of the following form:

$\tilde{y} = N'\beta + \mathcal{E}$ - - - (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;

$\tilde{y}_{\text{ordered probit}}$

(3 = firewood, 2 = charcoal, 1 = gas cooker/stove)

N_1 = Age (Years),

N_2 = Household Size (Number of Persons)

N_3 = Gender (Female = 1, Male = 0)

N_4 = Household Income (₦/month)

N_5 = Education (Number of years spent in acquiring formal education)

N_6 = Marital Status (Married = 1; otherwise = 0)

N_7 = Occupation (Farming = 1; otherwise = 0)

N_8 = Frequency of cooking (Number of times of cooking food per month)

Ɛi = Error term distributed across observations and is normalized with the mean and variance of zero and one.

β›s = Coefficients

Objective (v) was analyzed with the use of Likert Scale.

In the use of the Likert scale, the researcher considered the mean score of 3.00 to be the accepted constraints; while any constraints below 3.00 were rejected. The score of ***3.00*** was calculated using the weightings attached to the response options of:

Strongly Agree (SA)	= 5
Agreed (A)	= 4
Dis – Agree (DA)	= 3
Strongly Disagree (SD)	= 2
Neutral (NU)	= 1

Hence, $\frac{5+4+3+2+1}{5} = \frac{15}{5} = 3.0$

Results and Discussion

Socio–Economic Characteristics of Respondents

This sub-section presents the findings of the research with reference to socio-economic characteristics that affect the households in the study area.

Table 1. Summary of Socio Economic Profile of Respondents

	Frequency		Percentage (%)
Gender			
	Male	29	48.33
	Female	31	51.67
Total		60	100
Age (Years)			
	25-35	9	15.00
	36-46	21	35.00
Minimum (25)	47-57	12	20.00
Maximum (76)	58-68	12	20.00
Mean (48.87)	69-79	6	10.00
Total		60	100
Marital Status			
	Single	13	21.67
	Married	41	68.33
	Divorced	4	6.67
	Widowed	2	3.33
Total		60	100
Educational Level			
	No Formal Education	12	20.00
	Primary Education	10	16.67
	Secondary Education	25	41.67
	Tertiary	13	21.66
Total		60	100
Household Size (Number of Persons)			
		17	28.33
Minimum (2)	2-4	29	48.33
Maximum (10)	5-7	14	23.34
Mean (6.01)	8-10		
Total		60	100

Source: Field Survey Data, 2018

Table 1 portrays the socio economic profile of the households. The socio-economic characteristics encompass the respondents' gender, marital status, educational level and household size. From Table 1, it is observed that a total of 48.33% of the respondents were males; while 51.67% were females. This result indicate that greater percentage of the household heads were females. This is contrary to the typical and natural household structure in the traditional African setting where most household heads are males. Onoja (2012) observed that females only become the household head in the event of death of their husband, separation or outright divorce. The result infers that females are more involved in domestic energy procurement, as well as cooking in their respective households.

Age is an important criterion in accessing the socio-economic effects of household energy expenditure; this is so because households' heads that are adult are more likely to engage in energy issues than dependent age group. Majority of the respondents were aged 36-46 years (35%). A total of 47-57 years and 58-68 years represented 20% (respectively) of the population sampled. Only 10% of the respondents were aged 69-79 years. The mean age of the respondents was 49 years.

The result implies that preponderance of the respondents were middle aged and productive. This indicates that the household head were adult and within the economically active age group. This result confirms that mainstream of the household head mostly partake in domestic energy utilization. The inference is that the choices over which fuel to use for cooking, lighting or heating in a household are taken by adults.

Expectedly, majority (68.33%) of the sampled households' were married; others were widows (3.33%), divorcees/ separated (6.67%) and 21.67% were single. This connotes a higher level of social responsibility in terms of household energy procurement and utilization among the households.

A total of 20% of the household head had no formal education. Consequently; 16.67%, 41.67% and 21.66% had primary school education, secondary education and tertiary education. This indicates that greater percentage of the respondents have moderate formal education and thus may have knowledge of the use of the various household cooking fuel appliances; and thus, would be able to procure and utilize the various domestic energy types.

The distribution of the household size shows that 28.33% had family size of 2-4 persons, 48.33% had household size of 5-7 persons, while 23.33% had family size of 8-10 persons. The average household size was estimated at 6 persons. This is an indication of a moderate family size. Ibidun and Afeikhena, (2006) posits that the number of persons in a household is expected to influence the amount that would be spent on energy products and food. Therefore, if a household's need of energy is much, alternative sources that are cheaper might be sourced. This suggests that the household size of the respondents determine the quantity of energy to be consumed. Larger households sizes are expected to cook several times; hence, a higher demand for domestic energy.

Available Energy Types and Extent of Use by the Households' in Umuahia North Local Government Area of Abia State

Table 2 shows the domestic energy types and usage by the households in the study area. The domestic energy availability represents the existing domestic energy utilized by the respondents. The rate of usage of the various domestic energy types is represented by their frequencies/percentages. Multiple responses were recorded; this implies that most of the respondents could use one or more domestic energy types concomitantly.

Table 2. Energy Types Availability and Usage by Households' in Umuahia North L.G.A., Abia State, Nigeria

Energy Types	Frequency*	Percentage (%)*
(i) Kerosene	30	50.00
(ii) Firewood	9	15.00
(iii) LPG	32	53.33
(iv) Charcoal	7	11.67
(vi) Electricity	5	8.33
Total Respondent*	60	100

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

Table 2 shows the energy types available and frequency of usage by the households in the study area. We begin the empirical analysis by presenting the distribution of households' choice for energy in the study area. This was done by employing simple descriptive statistic such as table, percentage and frequency count. The available household energy types commonly used by the respondents in Umuahia North Local Government Area were Kerosene, Firewood, Liquefied Petroleum Gas (LPG), Charcoal, and Electricity. The energy usage per month is represented by their frequencies or percentages. The higher the frequency or percentage, the greater the energy usage by the households.

About half of the sampled households (50%) uses Kerosene as their chief domestic energy. A total of 15.0%, 11.67% and 8.33% of the household employ Firewood, Charcoal and Electricity as their domestic energy source. Preponderance of the households (53.33%) in the study area utilizes Liquefied Petroleum Gas (LPG) as their principal domestic energy type.

The higher percentage of LPG (53.33%) usage among the respondents might indicate that the households' in the study area are high income earners. High income earners mostly use LPG which they prefer. Njong and Johannes (2011) observed that the high preference for LPG is due to its clean nature, speed and convenience.

Approximately 8.33% of the households in the study area use electricity for cooking. The results of the analysis indicated that the use of -electricity was very low in Umuahia North due to its irregular supply. Igbinovia and Orukpe (2007) noted that the situation in rural areas is worse, where there are countless uncompleted rural electrification projects. Togola (2005) reported that about 73% Nigerians lack access to electricity, thereby making economic development very difficult. Igbinovia and Orukpe (2007) also observed that utilization of adequate form of energy (such as electric energy for cooking, heating and powering gadgets) is a propellant for job creation and socioeconomic development. Inadequate access to electricity is a major limitation to development cottage industries in Nigeria. Synoptically, the high cost of elctricity tariff, irregularity and risk involved is possibly the reason it is among the least household energy utilized in the study area.

A total of 50% of the respondents in Umuahia North LGA use Kerosene as household energy. Umuahia North LGA

is considered an urban area due to the presence of higher infrastructural facilities and the location of Government house. Kerosene was mostly consumed by the households in the study area because of easy accessibility and its production of cleaner energy compared with the use of fuel wood. Most households in Nigeria use it for cooking through Kerosene stoves and for lighting via Kerosene lanterns. This result is in agreement with Onoja (2012) who observed high utilization rate of Kerosene in Kogi State capital (Nigeria).

The lower percentage of Charcoal utilization for cooking (11.67%) implies that the traditional energy sources have reduced in importance in the study area. Brew-Hammond and Kemausuor (2009) observed that in the absence of affordable modern fuels and electricity, 90% of the Sub-Saharan Africa population relies on traditional fuels for cooking, heating and lighting.

In the case of Firewood, 15% of the households in the study area used Firewood. Onoja, (2012) observed that many households remain subsistently dependent on fuel wood due to socio-economic (e.g. income and wealth), demographic (e.g. family size, household composition, lifestyle and culture) and location attributes (e.g. proximity to sources of modern and traditional fuels) in addition to fuelwood availability. Although the use of fuelwood as domestic source of energy is regarded as an indication of poverty, fuelwood may still be the most readily affordable source of domestic energy for the masses in Nigeria and other developing nations. Sambo (2009) argues that sourcing of household fuel for domestic and commercial uses is a major cause of desertification in the arid-zone states and erosion in the southern part of Nigeria. He further stated that the consumption of firewood is worsened by the inefficient combustion of the wood, producing smokes and sooths which are hazardous to human health, especially to women and children who mostly do the cooking in homes.

Table 3. Daily, Weekly and Monthly Average Energy Utilization by Households' in Umuahia North L.G.A., Abia State, Nigeria

Energy Types	Daily	Weekly	Monthly	Total	Usage
(i) Kerosene	3.0	21.0	90.0	114.0	1st
(iii) LPG	2.7	18.9	81.0	102.6	2nd
(ii) Firewood	1.3	9.1	39.0	49.4	3rd
(iv) Charcoal	0.6	4.2	18.0	22.8	4th

Source: Computed from field survey data, 2018

Statistic for households' choice for cooking fuel in Umuahia North L.G.A., Abia State, was presented in Table 3. The most used domestic energy type was Kerosene (1st), followed by Liquefied Petroleum Gas (2nd); then firewood (3rd) and charcoal (4th).

The most recurrent (daily, weekly and monthly) energy usage by the respondents is Kerosene. The implication of the results showed that the consumption of kerosene had dominated all other domestic energy sources in the study area because of its convenience and diversified use as a source of lighting in Kerosene lanterns and cooking with kerosene stoves. This result is in accordance with Ouedraogo (2006), who stated that Kerosene is the most popular domestic energy in urban Nigeria. Though, fire wood is still a veritable source of domestic energy in the rural areas; kerosene usage is currently more popular due to the problem of fire wood scarcity and the health imperatives of the use of fire wood. This result is in agreement with Chukwuezi (2009), who stated that the utilization of fuel wood/firewood has serious health impact, because open fires in the home produce unventilated smoke. Chukwuezi (2009) also noted that the Nigerian government has put in place distribution mechanisms that ensured availability of Kerosene. However, there had been some perennial scarcity and product adulterations.

The result from Table 3 shows that LPG is the second most used household energy by the respondents in the study area. This could be as a result of the cleaner energy derived from Liquefied Petroleum Gas. Liquid Petroleum Gas if compared to Kerosene or fuel wood, has clear heath, environmental and productivity benefit.

Firewood or fuel wood was the third most used household energy type as against other alternative sources of energy for cooking among the sampled households in Umuahia North LGA of Abia State. This may be influence not only by the availability of forest in the region, rather, prevalence of incidence of poverty in Nigeria. The International Energy Agency (IEA, 2006) stated that about 70% of rural households in sub-Saharan Africa rely on fuel wood as cooking energy. Such high usage of fuel-wood is totally not environmentally friendly. It has negative impact on atmosphere and peoples' lives according to Nlom and Karimove (2014). Apart from deforestation, desertification and soil erosion; the use of fire wood has a very low thermal efficiency and the smoke is also hazardous to human health, especially to women and children who mostly do the cooking in households. In like manner, Chukwuezi (2009) stated that the populace are not aware of the implication of consumption of firewood except the smoke and blackened pots and walls. The associated environmental and health hazard of consumption of fire wood are sore and redness of eye, burning and irritation of the body due to burning of

the biomass; it also lead to exhaustion, tiredness and illness as a lot of enormous physical energy implored in lighting and fanning the wood; as well as discomfort due to heat trapped in the kitchen and smelling of clothes due to settled smoke on it among others.

The use of Charcoal as household energy represents the fourth most preferred domestic energy utilized in the study area. This result implies that Charcoals and fire wood recorded high usage among the sampled households. Similar result had been found by Nnaji *et al*., (2012) who stated that fire wood constitutes about 80% of domestic energy utilization in developing nations. Muller and Huijie (2016) posited that the cause for severe environmental and health problems is the use of firewood and Charcoal. For example, the incomplete burning of these fuels is responsible for indoor air pollution, mostly associated with carbon monoxide, particulate matter, sulphur dioxide and nitrogen dioxide. These pollutants play a major role in generating respiratory diseases and cardiovascular mortality. The consumption of these fuels also spurs climate change by releasing carbon dioxide into the atmosphere. In turn, climate change damages agricultural production and subsequently threatens the nutritional health of human.

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 with Multiple Linear Regression Model of the Ordinary Least Squares (OLS). The result is presented in Table 4.

Table 4. Multiple Regression Result for Factors Influencing Household Energy Expenditure in Umuahia North L.G.A., Abia State, Nigeria

Variables	Parameters	Coefficient	Standard error	t – value
(β_0) 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) Marital 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		
R^2		0.326	3695.760	
F – Statistics		3.08***		

** and * denotes significance of coefficient at 5%, and 10% levels respectively.
Source: Field Survey Data, 2018

Table 4 shows the multiple regression result for factors influencing household energy expenditure in Umuahia North L.G.A., Abia State, Nigeria. The regression analysis was carried out to identify the variables that significantly affected energy use among the households.

The result shows that five out 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 multiple regression for the household energy expenditure in the study area has a multiple determination (R^2) value of 0.326, implying that 32.6 percent of the variation in the exogenous variables (X_1-X_8) was explained by the dependent variable (household energy expenditure). The F-ratio was 3.08 and statistically significant at 99% level of confidence; which implies that the model had a good fit. The constant term (β_0) was not significant, but has a coefficient of -3433.661. This implies that household energy expenditure will decrease by 3433.66 assuming other explanatory variables were held constant.

The household size of the respondents was positive and statistically significant at 10% level; with a coefficient of 398.726. This implies that a unit increase in family size of the respondents will result in 398.72 increase in monthly expenditure of domestic energy usage. 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 mouth 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 opined that the rate of food 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 fetching fuel wood in many

Nigerian States. On the other hand, household income of the respondents negatively influences monthly domestic energy expenditure in the study area with a coefficient of -0.014. Abdullahi *et al*., (2017) observed that low income households uses 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 economically. Also, other already-processed food needing no cooking 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 a unit increase in educational status of the respondents will result in ₦105.81 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 inconducive 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. Lastly, the frequency of cooking was positive and statistically significant at 5% level; with a coefficient of 87.141. This implies that a unit increase in frequency of cooking will result in ₦87.14 increase in monthly expenditure on domestic energy. The more food a household cooks, the more the energy expended.

Factors Impelling the Choice of Household Energy Types in Umuahia North L.G.A., Abia State, Nigeria

The result of the analysis on the factors influencing the choice of household energy types in Umuahia North LGA., Abia State is presented in Table 5

Table 5. Results of Ordered Probit Regression for the Factors Influencing 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

The results of ordered probit for factors influencing choice of household energy types is shown in Table 5. The non-zero censoring coefficients were of positive signs (cut 1, cut 2 and cut 3), with the lower censoring threshold at 2.281 and the upper threshold at 0.5476; each statistically significantly different from zero. The goodness of fit measured by the high Chi-square value of 23.1 which is significant at 99% level of confidence showed that the choice of explanatory variables included in the ordered probit model explained the variation in the choice of household energy types. The value of the pseudo R^2 is 0.1556; which explains 15.56% of factors influencing the choice of household energy types in the study area.

The household income of the respondents was a significant factor influencing the choice of household energy expenditure in the study area. The result of the household income of the ordered probit model was significant at 1% level with a positive coefficient of 8.01. The sign of the variable is in consonance with *a prori* expectations. 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 result infers that as one's economic status increases he/she is less likely to partake in discriminate destruction of natural vegetation for energy consumption. This denotes that fuel wood is mostly patronized by those who fall below the socio-economic status threshold (*i.e.* those who are poor).

The educational level of the ordered probit model was significant at 5% level with a positive coefficient of 3.68. The result infers that the higher the level of education attained by household head the greater chances for his/her willingness to consume cleaner and efficient types 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. Adepoju

et al., (2012) found that irrespective of the educational status of the household heads, economic status was important in determining the choice of energy utilized. Conventionally, illiterate household heads are expected to have limited understanding of some environmental and health hazards that are associated with charcoals and fuel wood usage. They are also likely to have lower income. Gupta and Köhlin (2006) and Baiyegunhi and Hassan (2014) observed in India and Nigeria 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 education level, the less likely the households will choose wood, while the more likely the households will choose electricity and LPG.

The result of the ordered probit regression shows that the age of the household head was significant at 10% level with a coefficient of +1.55. This result suggest that as the age of household head reached certain level he/she will be more likely to use alternative sources of energy (LPG, Kerosene or Electricity) than the fuel wood or charcoal for cooking/ lighting. This infers that there is a particular age bracket that when reached household heads are more conscious about the disastrous effects associated with incessant consumption of fuel wood/charcoal. This is true if their education level is high. Also, the aged households may use his/her life time savings (or retirement benefits) for consumption of refined and cleaner energy types. Contrarily, Baiyegunhi and Hassan (2014) observed that an increase in the age of household head induces Nigerian rural households to shift away from natural gas towards fuelwood or charcoal. On the other hand, Rahut *et al*., (2014) shows that households with older heads prefer fuelwood to electricity in Bhutan, Indian.

The gender of the household head was significant at 10% level with a positive coefficient of 1.68. This result is in agreement with that of Rahut *et al.*, (2014), who observed that female-headed households prefer modern domestic fuels (LPG, Kerosene and Electricity) to traditional fuels (Firewood and Charcoals). This may be attributed to the fact that women are often responsible for household cooking. On the other hand, the result is in disagreement with the findings of Adepoju *et al*., (2012); who observed that female headed households may be poorer than their male-headed counterparts due to low access to production resources as a result of traditional gender issues in resource allocation. This can also be linked to the fact that female members of households are some time ago directly responsible for fuel wood gathering.

Constraints in the Use of Domestic Energy in the Study Area

The constraints associated with the use of household energy in the study area were analyzed with 5 point Likert scale. The following scales were Strongly Agree (SA), Agreed (A), Dis – Agree (DA), Strongly Disagree (SD) and Neutral (NU).

Table 6: Constraints Faced by Household in the Use of Domestic Energy

Responses	SA	A	DA	SD	NU	Mean	Decision
Lack of financial resources	15	35	10	0	0	4.08	Accepted
Scarcity of household energy	12	17	30	1	0	3.67	Accepted
High cost of household energy	12	26	15	5	2	3.68	Accepted
Distance from the place of purchase	8	11	26	15	0	3.20	Accepted
Adulteration	22	4	7	14	13	3.13	Accepted

Source: Field Survey Data, 2018

Table 6 shows the constraints faced by household heads in the use of domestic energy in Umuahia North Local Government Area of Abia State, Nigeria. From Table 4.6, it is observed that all the five constraints (lack of financial resources, scarcity of household energy, high cost of household energy, distance from the place of purchase and adulteration of the energy) significantly affected the household energy expenditure in the study.

In regards to scarcity of household energy, Momodu (2013) observed that energy for domestic purposes is determined by two major factors: availability and affordability. This implies that energy must be readily available and the price must be within the reach of the people especially the poor.

In terms of distance from the place of acquisition of to the place of utilization domestic energy, Abdullahi et al., (2017) noted that the prevailing poor road network of the country inhibits many people from having access to energy goods. Lack of good roads contributed to increase in the prices of goods in the country. This makes prices of kerosene and other energy goods to rise beyond the reach of the poor. The only alternative left for the poor is to adopt fuelwood for their energy needs. Momodu (2013) observed that women and children are involved in the collection and transportation of fuelwood from the bush to their homes. On many occasions depending on the situation, they have to travel far and wasted their time in the process. At times, women have to carry heavy loads to reduce the number of trips required to provide fuelwood for their households. They may head-load fuelwood as heavy as 35 kilogram or more over a long distance of up to 10 km in often difficult terrain. Carrying such heavy loads over long distance has adverse health implications on the women especially those within the child-bearing age. This may damage spice and cause difficulties during pregnancies and childbirth because substantial amount of energy is involved coupled with poor

access to good medical facilities in most of the rural areas in Nigeria.

Relating the issue of high cost of domestic energy; Chukwuezi (2009) noted that the inadequate and poor condition of infrastructure, especially, the energy infrastructure prevents people from getting regular supply of energy in Nigeria. For example, the four public refineries and private ones in the country cannot guarantee adequate production of petroleum products for local consumption.

Conclusion and Recommendation

Preponderance of the respondents was middle aged and productive. The inference is that the choices over which fuel to use for cooking, lighting or heating are taken by the adults.

Majority of the sampled households' were married. This connotes a higher level of social responsibility in terms of household energy procurement and utilization among the households.

Greater percentage of the households' have moderate education and thus may have knowledge of the use of the various household cooking fuel appliances; and thus, would be able to procure and utilize the various domestic energy types.

Results of the ordered probit regression for the factors influencing choice of household energy expenditure shows that gender, age, household income, educational level and occupation were the significant variables influencing the choice of domestic energy expenditure in the study area.

Lack of financial resources, scarcity of household energy, high cost of household energy, distance from the place of purchase and adulteration of the energy significantly affected the household energy expenditure.

Finally, there should be availability and utilization of cleaner energy types such as kerosene and LPG. The cost of kerosene should be further subsidized by the government to make the product affordable since is the most used domestic energy type in the study area. Also, there should be legislation to ensure that the commodity is readily available to households at all times.

Compliance with Ethical Standards

Conflict of interest

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

Author contribution

The contribution of the authors is equal. All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

Ethical approval

Experimental procedures were approved by Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

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