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ANALYSIS OF ENERGY CONSUMPTION AMONG RURAL HOUSEHOLDS IN IBARAPA AREA OF OYO STATE, NIGERIA

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ABSTRACT

Factors that influenced households 'choices of energy use in Ibarapa region of Oyo State were examined in this study. Data were collected through primary sources with the use of structured questionnaire.One hundred and fifty copies of the questionnaire were administered on respondents who were randomly selected from six randomly selected communities of two of the three Local Government Areas of the study area. Descriptive and inferential statistics were employed in the study. The multinomial logistic regression was used to determine the factors that influenced households' choices of energy type. From the results, it was discovered that 38% of the respondents were male while female accounted 62%. From the result obtained for the multinomial logistic regression, it was discovered that household size, monthly income, age, educational status, marital status, as well as frequency of cooking per day, all significantly influenced respondents choice of energy at 5% level of significance. In addition, the respondents asserted that inadequate energy supply, high cost of energy, low quality of energy and inadequate access to energy source were constraints limiting their choices of energy for use. In view of this, it was suggested that governments at all levels should make efforts to ensure that energy sources like kerosene gas and electricity are readily made available to households at reduced and affordable prices. This will therefore reduce the use of fuel wood

and charcoal as sources of energy and by extension, reduce the pressure on our forests by people who are collecting fuelwood or using forest woods to make charcoal as source of energy.

Keywords: Charcoal, Gas, Fuelwood, Kerosene, Multinomial Regression

INTRODUCTION

The importance of energy in the life of any household, whether rural or urban, cannot be overemphasized. It is significantly needed by households in order make life meaningful and enjoyable. It is therefore sufficed to posit that the entire welfare of a household is contingent upon the type and pattern of energy use. Consequent upon this,Abd'rasak*et al*. (2012) described energy as an essential input in production, conversion and commercialization processes. Therefore, energy access, especially electricity, is highly essential to human daily life. This is because electricity is needed for certain basic household activities like refrigeration, lighting and running of other household appliances which cannot easily be replaced by other forms of energy (Babatunde and Isa 2011). According to Adom *et al.,* (2012), energy supply or pricing has great impact on social and economic development as well as the living standards and overall quality of life of the population.

Energy ladder theory (ELT), being one of the theories brought forward to explain the factors that influence the choice of and the type of domestic energy use by households, provides a theoretical framework for explaining the changing to and from the traditional fuels to a modern fuel and devices. This theory states that people with low income tend to use traditional fuels as their main energy source and people with higher incomes move up the ladder to use

modern fuels (Nicolai and Fiona, 2008). Starting from the bottom rung of inefficient traditional fuels (such as fuelwood, charcoal and sawdust) through fossil fuels (like gas and kerosene) to the top rung of efficient modern fuels (e.g. electricity) ,the ladder sets out a progressive ladder where users move away from less efficient and unclean fuels towards what are considered more efficient and clean fuels. The idea behind ELT is based on the economic theory of consumer behavior that when income rises, households will not only consume more of the same goods, they will as well go up the ladder to more modern goods. That is, as household gains socioeconomic status it climbs the ladder to cleaner and more efficient form of energy. Past studies have also revealed some other factors, other than income, that have great influence on the choice of energy use type. Some of these factors, according to Masereaet *al* (2000), are fuel availability, prices, cultural preference, demographic distribution, household characteristics and government policies.

It is noteworthy that household forms an integral part of energy consumption in Nigeria. Studies have shown that in developed countries, the mean per capita household energy use is about nine times higher than in developing countries (Ajah 2013).

A review of literature has shown that quite a number of studies have revealed the influence of socioeconomic variables on the diversity of energy consumption by households. Such identified variables include dwelling type, household size, location, home ownership, income, among others (Sirichotpundit*et al*., 2016; Kavuosian*et al*, 2013; Zhang, 2010; Bedir *et al*, 2013). Others such as attitude,

behavioral control and the level of awareness of members of the households have also been identified as important determinants of energy consumption (Bedir *et al.*, 2013).

In addition, studies by Onyekuru and Eboh (2011) as well as Shittu *et al.* (2004) showed positive relationship between income and improved energy demand. In the study by Adepoju *et al* (2012), the availability, affordability of energy type and the convenience of usage were factors that influenced the demand and choices of energy among households in Ogun State. Also, study by Babanyara and Saleh (2010) showed that rural-urban migration, poverty and hikes in price of kerosene were significant determinant of demand for fuel wood in urban Nigeria. In view of these, this study attempted to ascertain the determinants of rural households' decision on the type of energy to consume among various energy options available to them through the use of multinomial logistic regression. This makes the study different from previous studies. In addition, this type of study and approach had not been conducted in the study area, prior to this study. This study was therefore conducted to identify the different types of energy sources available to the rural households in the study area; examine the factors that determine their choices of energy consumption type and to identifythe challenges confronting the households in their choice of energy type in the study area

Materials and Methods

Considering the fact that households are main consumers of energy, contributing significantly to the aggregate energy consumption in Nigeria, this study decided to focus on household sector. More so, the choice of rural households for the study is because they are arguably the most

affected by the hike in prices of energy sources, due to their relatively low-income status when compared to urban households (Idumah and Awe, 2023).

Study Area

This study was conducted in Ibarapa Area of Oyo State. Ibarapa is located in the South-western part of Oyo State (Abimbola,2006) The name "Ibarapa" is derived from a local cultivar of the melon plant, known locally as *Egusi Ibara*, which was historically acknowledged by neighboring settlements such as the Egbas, Ibadan and Oyos to be extensively cultivated in the area. The Ibaraparegion of Oyo State falls within latitudes 7^0.15' N ; 7^0.55' N and longitudes 3^0E and 3^0.$3^{0'}$ E. It is located approximately 100 Km north of the coast of Lagos, and about 95 Km west of the Oyo state capital and the neighbouring city of Ibadan. They border Yorubas of Onko extraction to the North (Iwajowa, Kajola, and Iseyin LGAs) and Yorubas of Oyo extraction to the East (Ibadan). The Yewas or Egbados to the West, and the Egbas to the South (Abimbola, 2006)The area is approximately 2,496 km² in geographical size and consists mostly of savannah with forests situated along the southern border and in isolated patches along river courses such as the Ogun. The natural vegetation was originally rainforest but that has been mostly transformed into derived type savannah as a result of several centuries of slash & burn Agricultural practices (Abimbola, 2006). Most of the land lies at elevations ranging between 120 and 200 meters above sea level, but rocky inselbergs and outcrops can be seen rising to 340 meters (approx 1,115 ft). Ibarapa land is traditionally made up of 7 principal towns known as the *IbarapaMeje*(Ibarapa Seven), and their surrounding villages and farmsteads. These towns include Igangan, Eruwa, Aiyete, Tapa,

Idere, Igbo-Ora, and Lanlate. Tapa and Aiyete are in Ibarapa North Local Government Area, Igangan, Idere, and Igbo-Ora are in Ibarapa Central, while Lanlate and Eruwa are located in Ibarapa East Local Government (Abimbola,2006). The three local governments were created by the federal government of Nigeria in 1996 when Ibarapa East was carved out from the old Ibarapa Local Government while Ibarapa Central and North were carved out of the former Ifeloju Local Government Area.

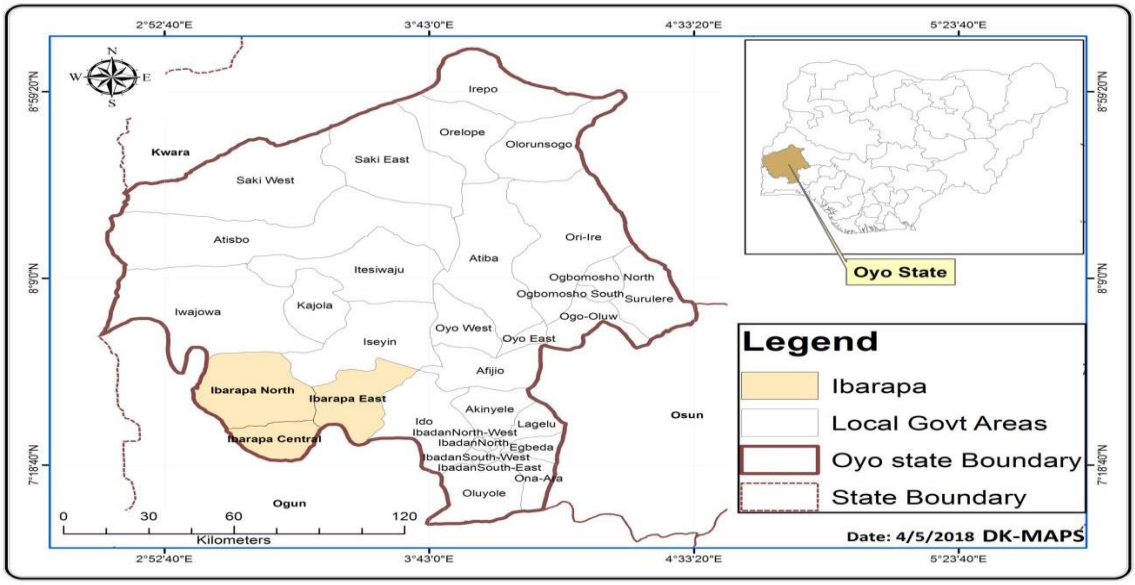

Figure1:Oyo State showing Ibarapa Local Government Areas

Method of Data Collection and Sampling Techniques

Structured questionnaire was used to collect data from respondents in the study area. The items captured in the questionnaire included information on types of energy used, quantity of energy used per month, cost of energy used and sources of energy, among others.

A multistage sampling approach was adopted to choose the respondents for the study. Stage1 was the purposive selection of Ibarapa area of Oyo State. This is due to its rural-urban human composition. The second stage was the random selection of two of the three LGAs that make up the study area. These were Ibarapa East and Ibarapa Central LGAs of the State. Ibarapa East consists of two main towns, namely Eruwa and Lanlate, with the headquarters in Eruwa. This local government has an area of 838Km^2 and an estimated population of 167,500(Brinkhoff, 2022). Ibarapa Central, on the other hand, has Igangan, Idere, and Igbo Ora as its main towns, with the headquarters in Igbo Ora. It has an area of 440Km^2 and an estimated population 147,600 as at 2022. Stage 3 involved the random selection of three communities each from the selected LGAs, making a total of six communities in all. Stage four of the sampling procedure was the random selection of 25 respondents from each of the selected communities, making a total of 150 respondents.

Analytical Tools

Descriptive as well as inferential statistics were used for analysis. The descriptive statistics used included frequency, percentages, bar charts, pie charts, while the inferential statistics used was the Multinomial Logistic Regression.

Multinomial Logit Model

When we have a dependent variable that has more than two options to choose from, Multinomial Logit is appropriate for analysis. Multinomial model can estimate the effect of independent variables on response variable that has multiple options with unordered response categories (Greene, 2000). In view of this, Multinomial Logistic Regression Model was chosen for this study, since the predicted variable has more than two categories. This model was

also chosen owing to the ease of computation as well as its superior predictive ability when compared to Multinomial Probit Model (Keane 1992; Chan 2005).

This study therefore identified five mutually exclusive energy types that are used by the people in the study area. These energy sources are fuelwood, charcoal, kerosine, electricity and gas.

Given that ith respondent is faced with j choices, then the utility choice j can be specified as:

$$U_{ij} = Z_{ij}\,\beta + \varepsilon_{ij} \quad (1)$$ (Greene (2003).

If a respondent makes choice j in particular, then U_{ij} is the maximum among the j utilities. The statistical model is derived by the probability that choice j is made, which is:

$$\text{Prob}\,(U_{ij} > U_{ik}) \text{ for all others } K \neq j \quad (2)$$

Where; U_{ij} is the utility to the i_{th} respondent from using energy type j; and U_{ik} is the utility to the i_{th} respondent from using energy type k. Thus, the i^{th} respondent's decision can be modeled as maximizing the expected utility by choosing the j^{th} energy type among J discrete energy types, that is:

$$\text{Max}_j = E\,(U_{ij}) = f_j\,(x_i) + \text{Ɛ}_{ij}, \quad j=0 \ldots J \quad (3)$$

Now, for an outcome variable with J categories, let the j_{th} energy type that the i_{th} respondent chooses to maximize its utility take the value 1 if the i_{th} respondent chooses j_{th} energy type and 0 if otherwise. The probability that a respondent with characteristics x chooses energy type j, P_{ij} is modeled as:

$$P_{ij} = \frac{exp^{(X'i\beta j)}}{\sum_{j=0}^{J} \exp(X'i\beta j)} \quad j=0 \qquad (4)$$

With the requirement that $\sum_{j=0}^{J} Pij = 1$ for any i

Where; P_{ij} = probability representing the i_{th} respondent's chance of falling into category j; X_i = predictors of response probabilities; and β_j = covariate effects specific to j_{th} response category with the first category as the reference. A convenient normalization that removes indeterminacy in the model is to assume that $\beta_1 = 0$ (Greene, 2000).

The explicit expression of the Multinomial Model is given as

$$Y_i = b_0 + b_1X_1 + b_2X_2 + \ldots + b_nX_n \qquad (5)$$

Where Y_i can be expressed as follows:

Y_1= Fuelwood

Y_2= Kerosine

Y_3= Gas

Y_4= Charcoal

Y_5 = Electricity

Following the concept of Idumah and Awe (2023), Fuelwood as a source of energy was adopted as the reference category for the model. In order to obey the rules of multinomial regression, the study assumed that each of the respondents only used one source of energy for cooking. In view of this, each respondent was required to choose one energy source they considered as the most used for cooking in the study area.

Below are the explanatory variables:

X_1= Age of respondent (in years)

X_2 = Gender of respondent; 1 if male and 0, if female

X_3= Educational status; 1 if educated and 0, if no education

X_4= Main Occupation (1 if farming, 0 if otherwise)

X_5= Marital status (1 if married, 0 if not married

X_6= No of cooking per day

X_7 = Monthly income

X_8= Household size

Results and Discussion

From Table1, it was observed that 38% of the respondents are male while female respondents represented 62%. It was also discovered that the mean age of the respondents was approximately 46 years, with 42% of them above 50 years of age. This implies that most of the people in the study area are still in their active age. In terms of marital status, about 21% are single, while close to 53% of them are married. This implies that majority of the respondents are married.

Furthermore, it was observed from Table1 that about 9% of the respondents had no form of formal education and 44% of them had either primary or secondary education. About 47% of them had more than secondary education. This is in line with findings by Erhabor and Ekmokaro(2017) that rural households have limited access to formal education, with majority of them not having more than secondary education. In addition, the average household size in the study area was estimated to be about 4. The average monthly income of the respondents is N78435.13k. Only 45% of the respondents earned monthly income above N80, 000. In view of the average monthly income of the people in the study area, it can be deduced that people in the study area earn well above the prevailing Minimum Wage of N30, 000 in Nigeria.

Table1: Socioeconomic Characteristics of Respondents

Variable	Frequency	Percentage	Mean
Gender			
Male	57	38	
Female	93	93	
Total	150	100	
Age (in years)		**46.12**	
Less or equal to 30	10	6.67	
31-40	34	22.67	
41-50	43	28.67	
51-60	39	26.00	
61-70	24	16.00	
Total	150	100	
Marital Status			
Single	31	20.67	
Married	79	52.67	
Separated	22	14.67	
Widowed	18	12.00	
Total	150	100	
Educational Status			
No formal education	13	8.67	

Primary education	15	10.00	
Secondary education	51	34.00	
ND/NCE	42	28.00	
Bachelor/HND	29	19.33	
Total	150	100	
Household size			**3.7**
1-5	94	62.67	
6-10	41	27.33	
11-15	15	10.00	
Total	150	100	
Monthly Income (N)			**78435.13**
Less or equal to 40,000	18	12.00	
40,001-50,000	39	26.00	
50,001-60,000	5	3.33	
60,001-70,000	7	4.67	
70,001-80,000	27	18.00	
80,001-90,000	14	9.33	
Above 90,000	40	26.67	
Total	**150**	**100**	

Source: Field Survey, 2022

Figure2 depicts various types of energy used for cooking by respondents in the study area. Forty-four (44%) of the respondents used fuelwood as their source

of energy for cooking, 31% of them used charcoal as source of energy for cooking, while only 4% of them chose electricity as source of energy for cooking. This corroborates work by Idumah and Awe (2023) conducted in Egbeda LGA of Oyo State where majority of households used charcoal as source of energy for cooking and least number of households used electricity as source of energy for cooking. The observed low proportion of households using gas as source of energy for cooking could also be likened to the studies by Aderemi (2012) and Idumah and Awe (2023) where it was stated that the relatively low percentage of respondents using gas as source of energy for cooking may not be unconnected to the recent increase in the price of cooking gas, which has possibly made it unaffordable for some people, especially the low-income earners and the rural dwellers.

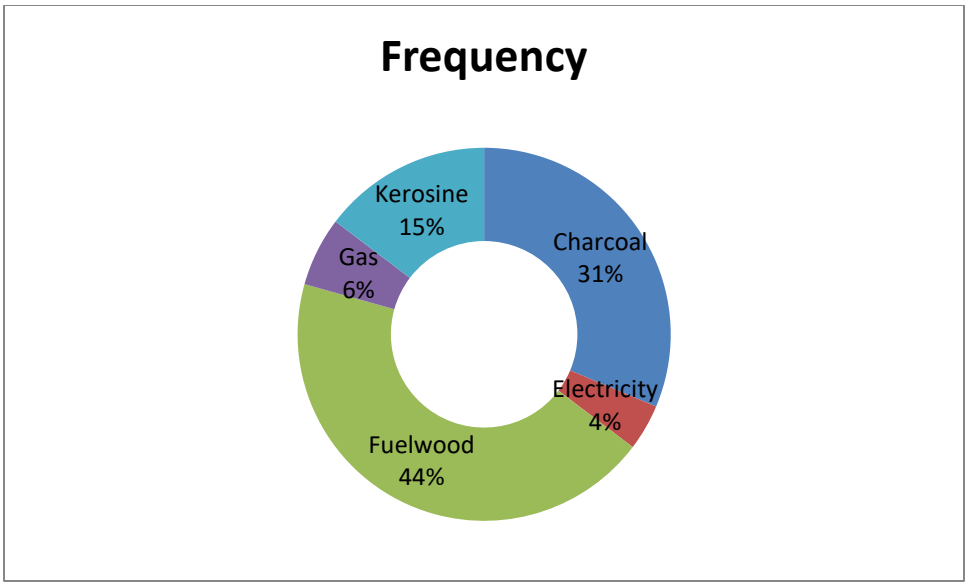

Figure2: Types of Energy used by Respondents

Figure 3 depicts the amount spent on energy by households in the study area. From the figure, it can be observed that about 47% of the respondents spent not

more than N5000 on energy in a month, while only about 13% of them spent more than N15, 000 monthly on energy for cooking. The implication of this is that most of them will likely opted for other energy sources such as fuelwood, that are relatively cheaper when compared to gas, electricity or kerosene, for cooking, so as to avoid spending so much on energy per month.

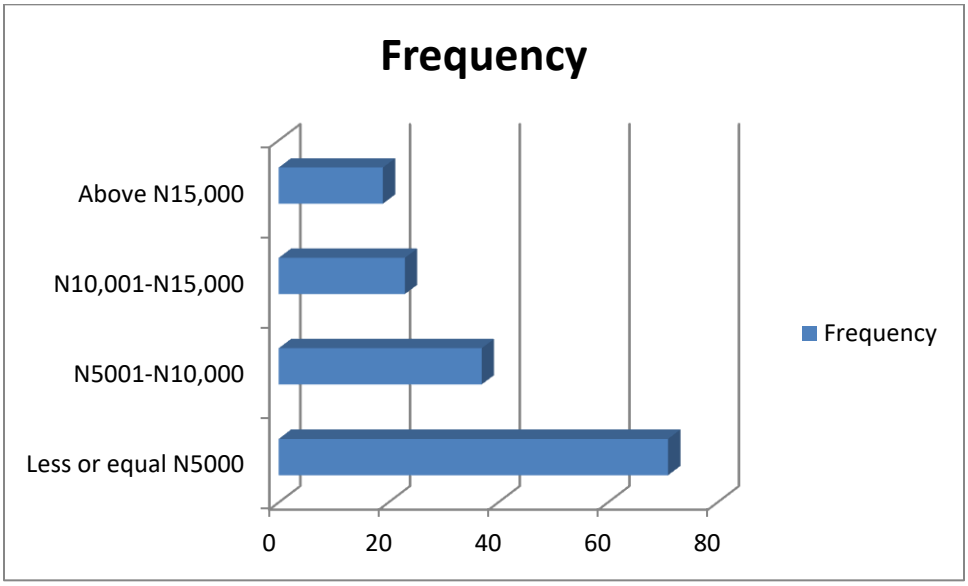

Figure3: *Amount spent on energy per month*

Table 2 shows the Multinomial Logit regression model for the determinants of the choice of energy type for cooking in the study area. From the result, it was discovered that number of cooking per day, household size, monthly income, educational status, and marital status significantly influenced respondents' choice of energy type at 5% level of significance. It can also be observed from the table that 'number of cooking per day' had significant influence on respondents' choice of energy

type for cooking. That is, respondents who cook more than once a day would need more energy for cooking than those who cook once a day. This means that they would need to go for energy type that is relatively cheaper in order to reduce money spent on energy for cooking.

In addition, results revealed that age also significantly influenced choice of energy type among respondents. This implies that as the respondents grow older, the more likely they are to use charcoal as source of energy for cooking over fuelwood. This may likely be connected to the assertion of Idumah and Awe (2023) that higher energy density of charcoal makes it less strenuous for households to prepare their food as well as the emission of marginal smoke than fuelwood that emits considerable amount of smoke which constitutes a lot of health risks to the people. Likewise, monthly income of respondents was also significant in ascertaining the type of energy used for cooking in the study area. Findings revealed that high-income earning households chose the use of gas over fuelwood as the type of energy for cooking compared to those with low monthly income.

Further findings showed that marital status was significant. That is respondents who are married are conscious of the choice of energy they would make to prepare food for their families, in order to reduce cost. In view of this, chances are that married respondents would prefer fuelwood as source of energy for cooking to the use of either kerosene, electricity or gas, due to cheaper cost of fuelwood when compared to prices of kerosene, electricity and gas. It could also be deduced from the results that respondents with education are likely better informed about the best types of energy that can be used for cooking, in agreement with findings by Van Der Kroon

et al. (2013) that individuals with more education possess more knowledge of alternatives to biomass and a stronger understanding of the associated benefits. Therefore, the preference for gas and charcoal by educated respondents as sources of energy for cooking over the use of fuelwood could be attributed to this. Similarly, households with large household size would also prefer using fuelwood for cooking to using kerosene, electricity and gas. This could be attributed to the fact that such households possibly considered fuelwood much cheaper with regard to the worth of energy that would be needed to prepare food for their families.

Table2: Factors Influencing Energy Choice for Cooking among Respondents

Variable	Kerosine		Gas		Charcoal		Electricity	
	Y_2		Y_3		Y_4		Y_5	
	Odd Ratio	*P-Value*	*Odd Ratio*	*P-Value*	*Odd Ratio*	*P-Value*	*Odd Ratio*	*P-Value*
Age (X_1)	1.449	0.557	1.342	0.097	4.321	0.003*	2.041	0.201
Gender (X_2)	1.212	0.210	1.303	0.134	1.561	0.610	2.335	0.476
Education(X_3)	1.902	0.274	3.587	0.000*	1.323	0.025*	1.232	0.082
Main occupationX_4)	4.245	0.183	0.663	0.002*	3.170	0.211	1.751	0.192
Marital status(X_5)	0.727	0.033*	0.516	0.000*	1.092	0.491	0.643	0.020*
No of cooking/day (X_6)	0.911	0.002*	0.688	0.002*	1.011	0.212	0.078	0.004*
Monthly income(X_7	1.655	0.553	5.223	0.000*	0.144	1.810	3.144	0.204
Household size(X_8	0.341	0.000*	0.546	0.003*	1.003	0.542	0.833	0.000*

Stata 12 Output

Table 3 shows the challenges faced by respondents in their choice energy types in the study area. From the table, it can be observed that 50% of the respondents either agreed or strongly agreed that poor quality of energy was a constraint to their utilization of energy type. However, with a mean score of 3.12, it can be deduced that

respondents in the study area are undecided whether poor quality of energy is a constraint or not. Similarly, a mean score of about 4(3.56) shows that the respondents agreed that inadequate supply of energy is a constraint to their choice of energy type in the study area. Furthermore, an average score of about 3(3.37) implies that the households in the study area were indecisive as to whether inadequate access to source of energy was a problem or not. Likewise, a mean score of about 3(2. 56) reveals that the households in the study area could not decide whether high cost of energy was a constraint or not.

Table3: Problems encountered in the Use of Energy Type

S/N	VARIABLE	SA(5)	A(4)	UN(3)	D(2)	SD(1)	AVERAGE
1	Poor quality of energy	31 (16.00%)	51 (34.00%)	15 (10.00%)	30 (26.00%)	21 (14.0%)	**3.12**
2	Inadequate supply of energy	29 (19.33%)	71 (47.33%)	19 (12.67%)	17 (11.33%)	14 (9.33%)	**3.56**
3	Inadequate access to source of energy	28 (18.67%)	60 (40.00%)	20 (13.33%)	23 (15.33%)	19 (12.67%)	**3.37**
4	High cost of energy	13 (8.67%)	20 (13.33%)	45 (30.00%)	32 (21.33%)	40 (26.67%)	**2.56**

SA= Strongly Agree; A= Agree; UN= Undecided; D= Disagree; SD= Strongly Disagree

Likert Scale Analysis

Conclusion and Recommendations

It was discovered from the study that respondents in the study area used different forms of energy for cooking. These energy sources were charcoal, electricity, fuelwood, gas and kerosine. Findings showed that most of the households in the study area chose fuelwood and charcoal for cooking, following rise in prices of other forms of energy, like cooking gas and kerosine. Study further showed that socioeconomic attributes such as age, household size, educational status, among

others, significantly influenced the choice of energy type among households in the study are.

In addition, some constraints facing the respondents in their choice of energy type were also identified; some of which were poor quality of energy and high cost of energy.

Consequent upon this, it is therefore suggested that governments at all levels should endeavor that there is significant reduction in prices of energy sources such as gas, kerosene and electricity, which are almost out of the reach of the rural poor. This help to reduce pressure on the choice of fuelwood as energy source, thereby reducing the growing pressure on the forests in search of wood for fuel. People should also be encouraged and trained by government agencies, like Forestry Research Institute of Nigeria (FRIN), to plant trees so as to ensure and enhance the sustainability of the forests where fuelwood and charcoal are sourced.

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