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DETERMINANTS OF RURAL HOUSEHOLDS' ENERGY CONSUMPTION IN EGBEDA LOCAL GOVERNMENT AREA OF OYO STATE: A MULTINOMIAL APPROACH

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ABSTRACT

This study aimed to examining the variables that influenced choice of energy type for cooking among rural households in Egbeda Local Government Area of Oyo State, Nigeria. A total of one hundred and twenty (120) copies of questionnaire were randomly administered on the respondents through a multi-stage random sampling technique. Both descriptive and inferential statistics were used to analyze the data. The descriptive statistics used were frequency tables, percentages, mean, pie chart and bar chart while the inferential statistic used was Multinomial Logistic Regression. The results indicate that about 49% of the respondents were male while about 51% were female. The result of the multinomial logistic regression model showed age, marital status, educational status, household size, number of cooking per day as well as monthly income were among the factors that influenced respondents' choice of energy type for cooking at 5% level of significance. Some factors were also identified by respondents as constraints to their choice of energy for cooking in the study area. These include high cost of energy, inadequate access to energy source, inadequate energy supply as well as low quality of energy. Consequent upon this, it is therefore recommended that government should ensure considerable reduction in prices of energy sources like electricity, gas and kerosine so as to reduce pressure on the choice of fuel wood as energy source. This will thereby reduce the mounting pressure on the forests in search of wood for fuel. As a corollary, people should also be encouraged to plant trees in order to ensure sustainability of the forests where fuel wood and charcoal are collected.

INTRODUCTION

Energy plays significant role in the life of household. It is an essential commodity needed for the existence of modern household living. There is no denying the fact that the complete welfare of a household is a function of the type and pattern of the household energy utilization. Energy is indispensable to all human activities. It has therefore become an integral part of social and economic development. In the study by Abd'rasak et al. (2012), energy was described as an important input in production, conversion and commercialization processes. Therefore, access to energy, especially electricity, is essential to human development. 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). Energy has become an essential part of growth and development all over the world. Therefore, its broad-range role in the development process cannot be downplayed. Adom et al. (2012) affirmed that energy supply and pricing have great impact on social and economic development as well as the living standards and overall quality of life of the population .

Some theories have been brought forward to explain the factors that influence the choice of and the type of domestic energy use by households prominent among which is the energy ladder theory (ELT) (Nicolai and Fiona, 2008). The theory of energy ladder provides a theoretical framework for explaining the changing to and from the traditional fuels to a modern fuel and devices. Energy ladder 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). Beginning from the bottom rung of inefficient traditional fuels (e.g. sawdust, fuel wood, charcoal) through fossil fuels (e.g. kerosene and gas) 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 concept of ELT is premised 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 move modern goods. In other words, as household gains socioeconomic status it climbs the ladder to cleaner and more efficient form of energy. Nonetheless, studies conducted in the past showed other factors apart from income that have great influence on the choice of energy use type. The factors are demographic distribution, cultural preference, prices, fuel availability, government policies, household characteristics; all these influence energy use and consumption level (Davis, 1998 and Maserea et al., 2000).

It is noteworthy that the energy ladder theory has been criticized by a number of authors who suggested that rural households do not change fuels wholly but that the adoption of modern fuels most times is accompanied by multiple use and greater total energy demand, leading to households consuming a group of energy sources at a one given time which is called multiple fuel use or fuel stacking (Heltberg, 2005; Arnold, et al., 2006 and Brouwer and Falcao, 2004). Going by this model, households do not totally change to other fuels. Instead, they choose to consume a portfolio of energy options at different points along the energy ladder. According to Masera et al. (2000), these portfolios of fuels stand for the different combinations of fuels from both lower and upper levels of the ladder by households.

In Nigeria, household is one of the significant users and consumers of energy. It is also said to be responsible for about 15 to 25% of primary energy use in the Organization of Economic Cooperation and Development (OECD) countries. According to Ajah (2013), average per capita household energy use in developed countries is about nine times higher than in developing countries, though in developing countries, a large share of household energy is provided by non-commercial fuels that are often not reflected in official statistics. In developing countries, about 2.5 billion people, according to Babatunde et al. (2011), depend on traditional fuels such as biomass, fuel wood, animal dung and charcoal to meet their energy needs for cooking. These traditional fuels are said to account for 90% of household energy consumption. Household sector is the largest consumer of energy

in Nigeria, accounting for about a quarter of total commercial energy and over 90% of traditional fuels, particularly fuel wood (Ogwumike and Ozughalu, 2012). Household energy consumption is influenced by individual and household socioeconomic characteristics. Several studies have identified the influence of socioeconomic factors such as income, home ownership, household size, dwelling type/size on the variability of energy consumption by households (Zhang,2010; Rehdanz,2007; Bedir et al., 2013 and Kavuosian et al., 2013). Psychological factors such as attitude, behavioural 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). Physical and structural factors such as house type, location have also been identified to play a crucial role on the type of energy consumed (Sirichotpundit et al., 2016).

Some empirical studies carried out in Nigeria, (Nnaji et al., 2012 and Olatinwo, and Adewumi, 2012) found out that notable socioeconomic factors such as age of the household heads, distance travelled to obtain fuel, low education, high household size and low wealth of farmers were responsible for the differences in the type of energy used among the rural dwellers.

In addition, studies by Adepoju et al., 2012; Onyekuru and Eboh , 2011 and Shittu et al.,2004) sources of energy and those that are responsible for choices made by the households. Others like Onyekuru and Eboh, (2011) as well as Shittu et al. (2004) have found positive relationship between income and improved energy demand. Shittu et al. (2004) found household heads' age as an important factor that influenced demand for biomass fuel in Ogun State. According to Adepoju et al. (2012), the availability, affordability of energy type as well as the convenience of usage were factors that influenced the demand and choice of energy among the respondents in Ogun state. Babanyara and Saleh, (2010) in their work, found that rural-urban migration, poverty and hikes in price of kerosene were critical factors influencing demand for fuel wood in urban Nigeria. This study is different from previous studies in that it tries to estimate the factors that influence the rural households' decision on the type of energy consumed given more than one energy type available by using a multinomial approach.

This study was carried out with the following research objectives:

To identify the different types of energy available to the rural households in the study area.

To identify the factors that determine their choice of energy type consumed.

To ascertain challenges confronting the households in their choice of energy type in study area.

METHODOLOGY

This investigation on the use of energy is restricted to the household sector. Household sector is chosen for this study because households are major consumers of energy and they contribute greatly to the amount of total energy use in Nigeria (Ogwumike and Ozughalu, 2012). In addition, 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. This would therefore help to provide information on the lifestyle of rural

households with respect to their energy use and their overall standard of living, especially in the study area**.**

Study Area

The study was carried out in Egbeda Local Government Area (LGA) of Oyo State. Egbeda is one of the thirty-three (33) LGAs in Oyo State. The LGA is located on Latitude 7022'46.55"N and Longitude 3058'2.88"E. Egbeda has a land area of 191km2 and a population of 281,573(NPC 2006)**.**

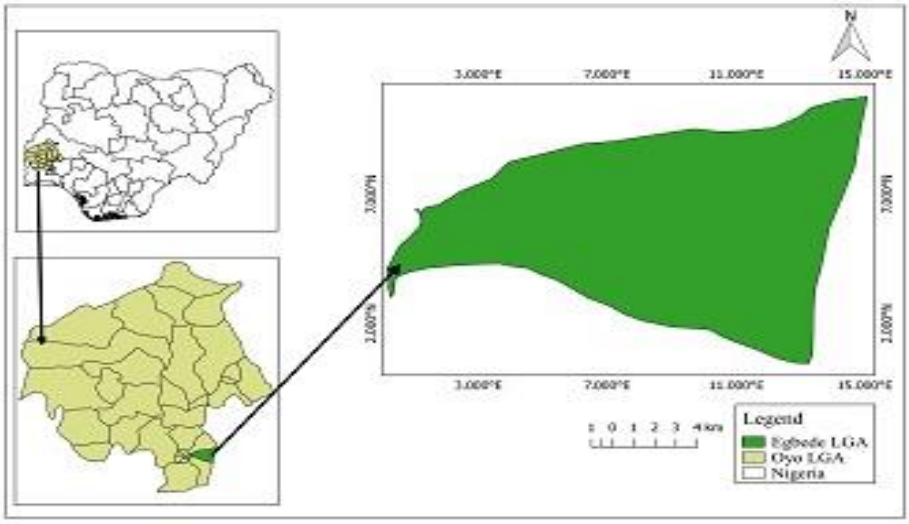

Figure1: Map Showing Egbeda LGA of Oyo State, Nigeria

Method of Data Collection

Data were collected through the use of questionnaire. Information such as types of energy used, quantity of energy used per month, cost of energy used and sources of energy were among the information obtained from the respondents. A multistage sampling technique was used in selecting respondents for this study. The first stage involved the purposive selection of Egbeda LGA because of its rural-urban human composition. The second stage was the random selection of 12 communities from the LGA, while the third stage was the random selection of 10 households from each of the selected communities. In all, a total of 120 households were selected for the study**.**

Method of Data Analysis

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**.**

Specification for Multinomial Logit Model

When we have a dependent variable that has more than two option 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 and 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:

$$Uij = Zij\ \beta + \varepsilon ij \qquad (1)\ \text{(Greene, 2003)}.$$

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

$$\text{Prob}\ (Uij > Uik)\ \text{for all others}\ K \neq j \qquad (2)$$

Where; Uij is the utility to the ith respondent from using energy type j; and Uik is the utility to the ith respondent from using energy type k. Thus, the ith respondent's decision can be modeled as maximizing the expected utility by choosing the jth energy type among J discrete energy types, that is**:**

$$Maxj = E\ (Uij) = fj\ (xi) + Ɛij,\quad j=0\ \ldots.J \qquad (3)$$

Now, for an outcome variable with J categories, let the jth energy type that the ith respondent chooses to maximize its utility take the value 1 if the ith respondent chooses jth energy type and 0 if otherwise. The probability that a respondent with characteristics x chooses energy type j, Pij is modeled as:

$$Pij = \frac{exp^{(x'i\beta j)}}{\sum_{j=0}^{J} exp^{(x'i\beta j)}} \qquad j=0 \qquad (4)$$

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

Where; Pij = probability representing the ith respondent's chance of falling into category; Xij = predictors of response probabilities; and βj = covariate effects specific to jth response category with the first category as the reference. A convenient normalization that removes indeterminacy in the model is to assume that β1 = 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= Charcoal

Y_3= Kerosine

Y_4= Electricity

Y_5 = Gas

Fuel wood as a source of energy was adopted as the reference category for the model. It was also assumed that each respondent only used one of the energy sources for cooking. Consequent upon this, respondents were required to choose one energy source they considered as the most used for cooking in the study area**.**

The explanatory variables are given below**:**

X_1= Gender of respondent; 1 if male and 0, if female

X_2 = Educational status; 1 if educated and 0, if no education

X_3= Age of respondent (in years)

X_4= Marital status (1 if married, 0 if not married

X_5= Household size

X_6= Monthly income
X_7 = Main Occupation (1 if farming, 0 if otherwise)
X_8= No of cooking per day.

RESULTS & DISCUSSION:

Table 1 shows the age of respondents in the study area. The table reveals that the average age of the respondents was approximately 49 years, with about 59% of them not more than 50 years of age. This is an indication that majority of the people in the study area are still in their active age. It can also be seen from the table that 49.17% of the respondents are male while 50.83% of them are female, an indication that there are possibly more females than males in the study area. This agrees with the study by Akpabio et al. (2008) that more male live in rural areas. The marital status of the respondents in the study area revealed that 16.67% are single, 60% of them are married and 11.67% of them each were separated and widowed. This implies that majority of the respondents are married**.**

The table further shows the educational qualification of the respondents. It was observed that close to 8% of the respondents had no formal education and about 39% of them had no more than secondary education. Only about 22% of them had either first degree or Higher National Diploma. 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. Furthermore, the table depicts that the average household size in the study area is about 5 members, with majority (68.33%) of the respondents falling within a household size range of 1-5, while only 7.50% of them are within the household size of above 10 members. This shows that most of the households in the study area had not more than five members. Furthermore, it can be observed from the table that the average monthly income of the respondents is N76, 566.67k. About 39% of the respondents earned monthly income of not more than N55, 000, while 38.33% of them earned monthly income of above N95, 000. The average monthly income of N76566.67k for respondents in this study area is an indication that people in the study area earns well above the prevailing Minimum Wage of N30, 000 in Nigeria.

TABLE 1: Socioeconomic characteristics of respondents

Variable	**Frequency**	**Percentage**	**Mean**
Age (in years)			**48.83**
Less or equal to 30	4	3.33	
31-40	30	24.99	
41-50	37	30.87	
51-60	32	26.65	
61-70	17	14.16	
Total	20	100	
Gender			
Male	59	49.17	
Female	61	50.83	
Total	120	100	
Marital Status			
Single	20	16.67	
Married	72	60.00	
Separated	14	11.67	

Widowed	14	11.67	
Total	120	100	
Educational Status			
No formal education	9	7.50	
Primary education	10	8.33	
Secondary education	37	30.83	
ND/NCE	38	31.67	
Bachelor/HND	26	21.67	
Total	120	100	
Household size			**4.57**
1-5	82	68.33	
6-10	29	24.17	
11-15	9	7.50	
Total	120	100	
Monthly income(N)			**76566.67**
Less or equal to 45,000	13	10.84	
45,001-55,000	34	28.34	
55,001-65,000	0	0	
65,001-75,000	0	0	
75,001-85,000	19	15.84	
85,001-95,000	8	6.67	
95,001-100,000	46	38.33	
Total	**120**	**100**	

Source: Field Data

Table2 shows different types of energy used for cooking by respondents in the study area. Most of the respondents (45.83%) used fuelwood as their source of energy for cooking, while 25% of them chose charcoal as source of energy for cooking. Only about 6% of them opted for electricity as source of energy for cooking. According to Aderemi (2012), 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. This possibly explains why majority (90%) of the respondents only cooked at most twice a day, so as to conserve energy and spend less on energy use. Only 10% of them cooked three times a day, as shown in Figure1 below.

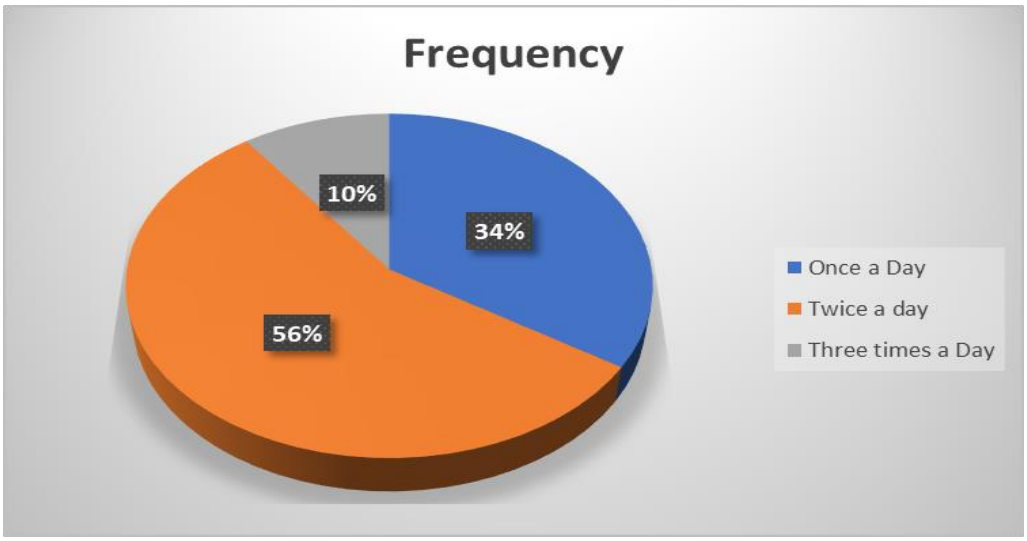

Figure 2: No of Cooking Times a Day

Table2: Types of Energy used by Respondents

Energy Type	Frequency	Percentage
Fuelwood	55	45.83
Charcoal	30	25.00
Kerosine	20	16.67
Electricity	7	5.83
Gas	8	6.67
Total	120	100

It was further discovered from the study that 50% of the respondents spent not more than N5000 on energy in a month, as depicted in Figure2. This explains why majority (93.33%) of them opted for other energy sources, apart from gas, for cooking, so as to avoid spending so much on cooking gas per month**.**

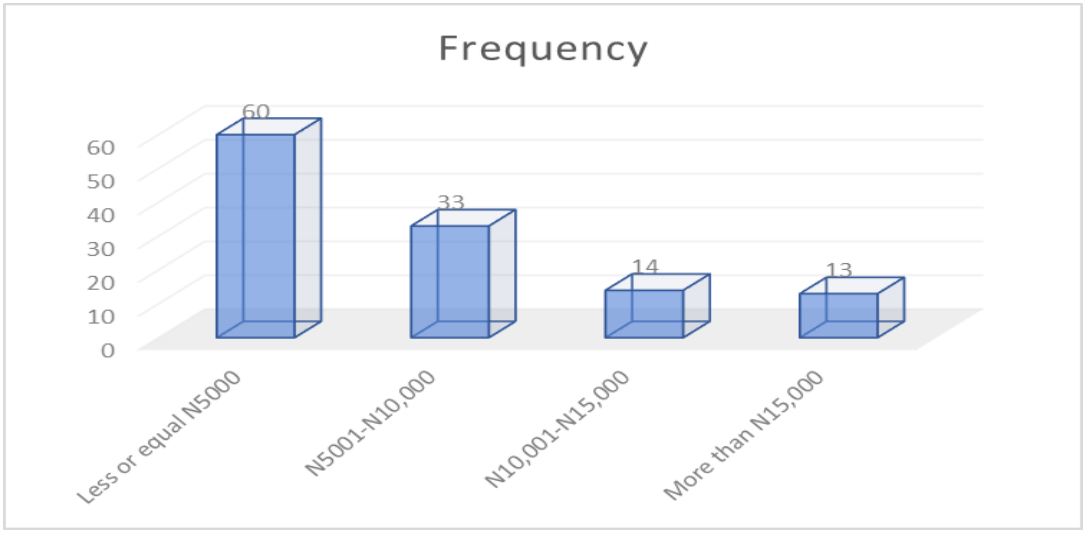

Figure 3: Amount spent on energy per month

Table 3 shows the Multinomial Logit regression model result of the factors influencing the choice of energy type for cooking in the study area. The results show that marital status, household size, age, education, monthly income and number of cooking per day were significant in influencing respondents' choice of energy type at 5% level of significance. However, gender and main occupation of the respondents

had no significant impact on their choice of energy type. The results therefore imply that respondents who are married are not unmindful of the type of energy they needed to prepare food for their families, so as to save cost. In view of this, respondents who are married would prefer using fuelwood as source of energy for cooking to the use of either kerosine, electricity or gas, due to relatively cheaper cost of fuelwood when compared to prices of kerosine, electricity and gas. Likewise, respondents with relatively large household size would also prefer using fuelwood for cooking to using kerosine, electricity and gas, because they considered fuelwood much cheaper when they put the amount of energy that would be needed to prepare food for their family into consideration. It can also be observed from the table that 'number of cooking per day' influenced respondents' choice of energy type for cooking. Respondents who cook more than once a day would need more energy for cooking than those who cook once a day. They would therefore need to opt for energy type that is comparatively cheaper in order to reduce amount spent on energy for cooking. This possibly informed the preference for fuelwood as source of energy for cooking over kerosine, electricity and gas by the respondents in the study area **.**

Furthermore, results showed that age as well as level of education were significant in determining the type of energy used for cooking by respondents in the study area. What this implies from Table3 is that as the respondents grow older, the more likely they are to prefer charcoal as source of energy for cooking over the use of fuelwood. The preference for charcoal over fuelwood by older respondents may not be unconnected to the higher energy density of charcoal which makes it less strenuous for them to prepare their food and the emission of marginal smoke than fuelwood that emits considerable amount of smoke which constitutes a lot of health risks to the people. The distance from the source of fuelwood may also be a limiting factor for the older people. This is in line with study by Nyarko et al. (2021) on the uniqueness of wood charcoal and why it is preferred to other renewable and non-renewable energy sources **.**

Likewise, people with education are likely better informed about the best types of energy that can be used for cooking. Van Der Kroon et al. (2013) suggests that individuals with more education possess more knowledge of alternatives to biomass and a stronger understanding of the associated benefits. This possibly explains why respondents who are educated preferred the use of gas as well as charcoal as sources of energy for cooking over the use of fuel wood. In addition, the monthly income of respondents was also significant in determining the type of energy used for cooking in the study area. Results revealed that respondents with high income preferred the use of gas over fuelwood as the type of energy for cooking compared to respondents with relatively low monthly income who would rather opt for energy types like fuelwood or better still, charcoal, for cooking, given consideration to the current high price of cooking gas in the country**.**

Table3: Determinants of Energy Choice for Cooking among Respondents

Variable	**Charcoal Y_2**		**Kerosine Y_3**		**Electricity Y_4**		**Gas Y_5**	
	Odd Ratio	*P-Value*	*Odd Ratio*	*P-Value*	*Odd Ratio*	*P-Value*	*Odd Ratio*	*P-Value*
Gender (X_1)	1.762	0.512	1.413	0.112	2.545	0.437	1.201	0.115

Educational status (X_2)	1.524	0.021*	1.822	0.154	1.237	0.091	4.977	0.000*
Age (X_3)	3.221	0.002*	1.569	0.654	3.040	0.108	1.247	0.093
Marital status(X_4)	1.012	0.424	0.557	0.031*	0.855	0.022*	0.595	0.002*
Household size (X_5)	1.000	0.345	0.213	0.000*	0.781	0.002*	0.627	0.005*
Monthly Income (X_6)	3.144	0.110	1.569	0.543	2.172	0.103	4.125	0.002*
Main occupation (X_7)	4.165	0.114	6.244	0.157	1.633	0.120	4.210	0.135
No of cooking per day (X_8)	1.001	0.102	0.875	0.002*	0.064	0.006*	0.779	0.004*

Table 4 shows the problems encountered by respondents in the use of their energy types in the study area. The table reveals that 22.5% of the respondents either strongly agreed or agreed that the high cost of energy was a problem encountered in their use of energy type. About 28% of them could not decide whether high cost of energy was a problem or not. With a mean score of about 3(2.55), it could be concluded that the respondents were indecisive as to whether high cost of energy was a problem or not. The table also depicts that 23.33% of the respondents strongly agreed that inadequate energy supply was a problem encountered in their use of energy type for cooking, 41.67% of them also agreed to this. Considering a mean score of about 4(3.60), it can be said that the respondents in the study area agreed that inadequate energy supply is a problem encountered in their use of a particular energy type**.**

In addition, the table shows that 15.83% of the respondents strongly agreed that inadequate access to source of energy was a problem encountered and 40.83% of them also agreed to this. Going by a mean score of about 3(3.30), it can be concluded that the respondents could barely decide whether inadequate access to energy source is a problem or not in the study area. More so, the table depicts that, 16.67% of the respondent strongly agreed that low quality of energy is a problem encountered in the study area while 15% of them strongly disagree on this. Therefore, considering a mean score of 3.12, it could be concluded that respondents in the study area could not decide whether low quality of energy was either a problem or not in the study area. In terms of quantity of energy supplied, 16.67% of the respondents also strongly agreed that low quantity of energy supply was a problem while 9.17% of them strongly disagreed to this view. However, with a mean score of about 4(3.53), it can therefore be concluded that the respondents in the study area agreed that low quantity of energy was a problem encountered in the study area.

Table 4: Problems encountered in the Use of Energy Type

S/N	Variables	SD (1)	D (2)	UN (3)	A (4)	SA (5)	Mean
1	High cost of energy	31 (25.83%)	28 (23.33%)	34 (28.33%)	17 (14.17%)	10 (8.33%)	**2.55**

2	Inadequate energy	12 (10%)	9 (7.5%)	21 (17.5%)	50 (41.67%)	28 (23.33%)	**3.60**
3	Inadequate access to source of energy	16 (13.33%)	19 (15.83%)	17 (14.17%)	49 (40.83%)	19 (15.83%)	**3.30**
4	Low quality of energy	18 (15%)	30 (25%)	12 (10%)	40 (33.33%)	20 (16.67%)	**3.12**
5	Low quantity of energy	11 (9.17%)	14 (11.67%)	15 (12.5%)	60 (50%)	20 (16.67%)	**3.53**

CONCLUSIONS

This study revealed that most of the respondents in the study area were still in their active age. Study also showed that most of the respondents were female and used different forms of energy for cooking and other household needs. Study showed that majority of the respondents resorted to fuelwood for cooking, owing to hike in price of other forms of energy, especially the cooking gas. It was also discovered that respondents faced some constraints in their choice of energy type. These included high cost of energy, inadequate access to energy source, inadequate energy supply as well as low quality of energy.

In view of this, it is therefore recommended that government, through the Ministry of Power and Energy and Ministry of Petroleum, should ensure considerable reduction in prices of energy sources like electricity, gas and kerosene so as to reduce pressure on the choice of fuel wood as energy source. This will thereby reduce the mounting pressure on the forests in search of wood for fuel. People should also be encouraged by Forestry Research Institute of Nigeria to plant trees in order to ensure sustainability of the forests where fuel wood and charcoal are collected.

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CONFLICT OF INTEREST

الخلاصة

تهدف الدراسة الحالية الى فحص المتغيرات التي تؤثر على اختيار الطاقة (الوقود)المستخدمة في الطبخ في البيوت الريفية في Egbeda في مقاطعة 040 – بنيجيريا. تم توزيع 120 نسخة استبيان عشوائياً على المشاركين في عينة البحث ومن خلال التقنية المتعددة المراحل العشوائية. وتم تحليل البيانات بطريقتين احصائيتين: طريقة وصفية تضمنت جداول ونسب مئوية والرسم البياني باي والرسم البياني بار. وطريقة استدلالية تضمنت الاختبار الانحدار الرمزي متعدد الحدود. بينت نتائج الانحدار المتعدد الحدود ان اهم العوامل المؤثرة على اختيار مصدر الطاقة للطبخ هي العمر والحالة الزوجية والمستوى التعليمي وعدد افراد الاسرة وعدد مرات الطبخ اليومي والدخل الشهري. وأشارت الدراسة الى بعض العوامل التي تعيق المستخدمين من اختيار بعض مصادر الطاقة واهمها الكلفة العالية لمصدر الطاقة وعدم توفر هذا المصدر بشكل كاف وانخفاض نوعية مصدر الطاقة. وبناءً على هذه النتائج توصي الدراسة بضرورة خفض أسعار الكهرباء والغاز والنفط وهذا يقلل من

الضغوط المتزايدة لاستخدام اخشاب الغابات كمصدر للطبخ ويحافظ على الغابات، وكذلك توصي بضرورة تشجيع الناس على الاهتمام باستدامة أشجار الغابات وخصوصا في المناطق التي تعتمد على الاخشاب والفحم كوقود للطبخ.

الكلمات المفتاحية: وقود الخشب، الفحم، الغاز، الكيروسين.

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