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EVALUATION OF HOUSEHOLDS COOKING ENERGY CHOICE DECISIONS IN AKWA IBOM STATE, NIGERIA

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ABSTRACT
Household surveys across Akwa Ibom State, an oil-rich State in Nigeria that include questions on energy use, show that the most cited primary energy for cooking is fuelwood, followed by liquefied petroleum gas (LPG) and then Kerosine. Household cooking energy accounts for a significant part of the total energy consumed in Nigeria. The study investigated the factors influencing the Household choice of cooking energy and the type preferred in Akwa Ibom State, Nigeria. Data were obtained through oral interviews and the administration of structured questionnaire on 160 randomly sampled households from the study area. Descriptive statistics and a multinomial logistic regression model were used to analyze the data. The results showed that half of the population utilized fuelwood. On the other hand, only a small proportion used kerosene (15.0%), liquefied petroleum gas [LPG] (31.9%) and charcoal (3.1%) for their daily cooking. The most preferred cooking energy was LPG (65.5%), followed by kerosene (25.6%), fuelwood (6.4%), and charcoal (2.5%), respectively. The coefficient of household size ($p<0.05$), level of education ($p<0.01$), location ($p<0.01$), and homeownership ($p<0.01$) had a negative and statistically significant relationship with households' preference for charcoal and fuelwood compared to LPG. Age ($p<0.01$) had a positively and significant influence on the household's decision to use fuelwood and the type preferred. Sensitizing households on importance and use of clean and sustainable cooking energy sources is necessary to achieve sustainable development in the area.

Keywords: Fuelwood; Consumption; Choice; Households; Sustainability; Nigeria.

INTRODUCTION
Household cooking energy accounts for a major part of the total energy consumed in Nigeria. Most Nigerian households lack access to clean, affordable and sustainable energy source; hence, they rely on fossil fuel for their cooking activities. A sustainable, secure, sufficient, and accessible supply of affordable cooking energy is very crucial for the growth and sustainability of modern societies. However, access to clean, affordable, and efficient energy has become a challenge for most low to medium-income households in developing countries (Kimemia and Annegarn, 2012). According to World Health Organisation (WHO, 2016), about three billion people (more than 40% of the global population) are dependent on solid fuels like firewood/fuelwood, coke, dung cakes, coal, and agricultural residues around the globe. This imposes severe challenges, especially to low- and middle-income countries (Pachauri, 2013), where most households do not have the means to satisfy their basic energy needs (Okon *et al.*, 2016).

Household energy consumption as a concept focuses mainly on the energy used for cooking, washing clothes, lighting houses, heating and cooling, and running appliances (United States Energy Information Administration [USEIA], 2018). Household energy demand and

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consumption have increased substantially and are expected to continue rising. This rising demand has led to overdependence on solid fuel by poor households causing severe health challenges to women and children, especially in developing countries and climate.

Residential cooking, domestic heating, and lamps account for more than half of global anthropogenic black carbon emissions and contribute a significant share of ambient air pollution in the developing world. In 2016, approximately 2.6 million people in the developing world died prematurely from exposure to household air pollution (World Health Organization, 2019). Additionally, each year, tens of millions are sickened, injured, or burned due to using biomass as fuel. Fuelwood collection for cooking and heating contributes to forest degradation, land-use changes, and climate change. Women and children spend more time indoors than men, and they experience a disproportionate share of the health impacts from solid fuel for domestic purposes. Because they spend more time indoors, women and children are also more vulnerable to high exposure to household air pollution and the risk of kerosene cooking and lighting explosions. In addition to the direct health impacts from the use of traditional cookstoves, heat stoves, and open fires, women, and girls who must collect biomass fuel far from the safety of their homes are at high risk of gender violence and physical injury. They are negatively impacted by the loss of economic productivity and educational opportunities from time spent gathering solid fuel for their families. The gathering of solid fuels has adverse effects on health. Also, the use of some solid fuels has been associated with indoor pollution and unsafe toxic emission levels (Emagbetere *et al.,* 2016). It has also led to environmental pollution and forest degradation due to excessive cutting of trees as fuelwood; it has also contributed to climate change.

Globally, about 1.3 million deaths per year are attributed to indoor pollution from solid fuel utilization (IEA, 2006). The deaths from indoor pollution are more than those of malaria, estimated at 1.2 million per annum (Faizan & Thakur, 2019). In 2019, CNN reported that in Africa, 90,000 women die yearly from using charcoal. Also, the World Health Organization (WHO, 2019), reported that 4 billion deaths occurred due to household air pollution in low and middle-income countries.

In Akwa Ibom State, many poor rural households still depend on fuelwood either as a source of livelihood or as cooking energy. Most households have made the use of solid fuel their major energy source. This over reliance on solid fuel has resulted in various negative externalities and sometimes life-threatening. Also, efficient household cooking energy could contribute to productivity and general economic development and growth. In order to achieve the sustainable development goal of ensuring “access to affordable, reliable, sustainable and modern energy for all". Assessing the factors that influenced households’ choice of cooking energy becomes a prerequisite. To date, there is scarce information on household cooking energy choices in Akwa Ibom State. This study was designed to bridge this information gap by providing explicit answers to the following research questions. What are the various types of cooking energy used by households in the study area? What is the most preferred type of cooking energy among households in the study area; and what factors influence households cooking energy choices in the study area.

MATERIALS AND METHODS

The Study Area

The study was conducted in Eket agricultural zone in Akwa Ibom State, Nigeria. Eket is the second-largest city in Akwa Ibom State, Nigeria. The name also refers to the indigenous ethnic group of the region and their language. The zone covers the following local government

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areas; Eket, Esit-Eket, Eastern Obolo, Ibono, Ikot Abasi, and Mkpat Enin Local Government Areas. Eket, as the headquarters of the zone is located in latitude 4°39'N and longitude 7°56'E with a population of over 200,000 people [National Population Commission (NPC, 2006)]. The zone is in the rain forest belt of South-south Nigeria and has an average annual rainfall of about 2500mm to 3000mm, sunshine of about 3.15hours per day, mean annual temperature ranges of about 26°C-28°C and is prone to oil spillage, acid rain and increasing ocean encroachment. Some of the common food crops grown in the area are; cassava, plantain, waterleaf, fluted pumpkin, white yam cocoyam, maize, okro, potatoes and banana. The cropping pattern in the area is dominated by mixed cropping, although sole cropping is also practiced. Some farmers keep livestock like goats, pigs, sheep, rabbit and poultry. However, poor farming practices are depleting soil nutrients on many farms and plots in the study area.

Sampling Procedure

Multi-stage random sampling procedure was employed in selecting respondents in Eket agricultural zone. In the first stage, four out of seven Local Government Areas (blocks) were randomly selected (Eket, Ikot Abasi, Mkpat Enin and Onna Local Government). Secondly, four (4) clans were selected from each LGA, making a total of 16 clans from the chosen four LGAs. The third stage involved a random selection of 10 respondents from each clan, making a total of 40 respondents for each LGA and a grand total of 160 respondents for the study.

Estimation Techniques

Descriptive statistics and multinomial logistic regression model were employed. The Multinomial Logit Regression Model (MNL) was applied. The probability of a household choosing any cooking energy was hypothesized to be influenced by the household's socio-economic characteristics. Hence, the usual modeling approach involving multiple choices in decision process is Multinomial logit model (MNL). The Multinomial logit model analyzes a choice between three or more alternative responses. It allows for analysis of decisions and facilitates the determination of choice probabilities for livelihood categories (Nkamleu & Keilland).

In this study, households' choice from among the four fuel types was estimated within the multinomial logit (MNL) framework (Gujarati & Porter, 2009). The MNL model was used to analyze the factors influencing households' choice of cooking fuel (fuelwood, kerosene, liquefied petroleum (LPG) gas and charcoal). The MNL model has been commonly applied to analyze discrete choice data (Farsi *et al.*, 2007; Rao and Reddy, 2007). It is suitable because it allows the analysis of decisions across more than two types of cooking energy. The response variable includes four distinct unordered alternatives: fuelwood, kerosene, natural gas and charcoal. Hence, this study specifies MNL model (discrete choice method) as follows (Greene, 2003); with j =1, 2, 3 (1):

where; Yi is the dependent variable representing the fuel type chosen by a household and takes the values of 1, 2, or 3 if the household chooses kerosene, natural gas or charcoal. LPG is used as the reference category. Xi represents a vector of explanatory variables that includes socio-economic characteristics, fuel attributes, market and agro ecological factors affecting a household fuel choice. βi represents vectors of estimated coefficients. The results of MNL model are interpreted in terms of the t-values, i.e. the probability of choosing one outcome category over the reference category.

These values are defined as: a positive parameter indicates that the relative probability of choosing other fuel type over LPG increases relative to the probability of choosing LPG over the other fuel types (kerosene, fuelwood and charcoal). Here, the marginal effects from the MNL, which measure the expected change in probability of a particular choice being made

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with respect to a unit change in an independent variable. The cooking energy choices adopted by households were grouped into four categories as thus: category 1, if using firewood as source of cooking energy; category 2, if using kerosene as source of cooking energy; category 3, if using natural gas as source of cooking energy; category 4, if using charcoal as a source of cooking energy. In other words, the factors influencing the choice of cooking energy can be a function of socio-economic characteristics of the household as explanatory variables for the Multinomial logit model. These variables are: X_1 = income of the household (in Naira), X_2 = age of household head (in years), X_3 = sex of the household head (if male 1; 0 if female), X_4 = marital status (if married 1, otherwise 0), X_5 = education of household head (years), X_6 = household size (number of individuals in the family), X_7 = house ownership (if own house 1; 0 otherwise), X_8 = location (if rural 1; 0 if urban), X_9 = distance (in Km).

RESULTS AND DISCUSSION

In Table 1, many of the respondents (58.1%) were female while (41.9%) were male. This probably reflects that female are more involved in cooking in the study area. This result is in agreement with the findings of (Adeyemi & Adereleye 2016). The mean age of the respondents was 40. 13 years, this indicates that majority of the respondents were in their active and productive age. This suggests that the respondents could take active part in household's decision making concerning the choice of cooking energy in the study area. The marital statuses of the households in the study area showed that majority (71.3%) of the respondents were married while 28.7% were single. This implies that married couple would have more responsibilities of providing for dependent household members. This could mean choosing affordable and/or available cooking energy sources in the study area. The implication is that married households may not be able to afford cleaner energy sources due to high cost. This result lends credence from the findings of Chidiebere-Mark *et al., (*2018), who observed that most couples in Imo State did not use cleaner and efficient sources of energy.

Educationally, respondents were considerably educated. About 96.2% attended various schools while 3.8% did not have any formal education. The mean year of formal schooling was about 14 years, indicating that an average had at least secondary education. Further breakdown of this figure shows that about 60.5% attended tertiary institution, 28.8% attended secondary school and 6.9% attended primary school. The implication of high level of educational attainment by sampled households is that they would be in a better position to adopt clean and reliable non fossil fuels in the study area. In other words, the higher the level of education attained by household head the greater chances for his/her willingness to consume cleaner sources of energy for domestic purposes. This suggests that educated household heads are less likely to consume fuel wood, hence, reduces the tendencies of environmental degradation through deforestation in search for energy.

Household size could have positive or negative influence on the type cooking energy used by the respondents. For instance, where the majority of household members comprise working adults, the probability of using cleaner energy could be high. Similarly, if the majority of the household members are dependents on the household head, the probability of using less efficient energy will be very high. About 49% of the respondents comprised household whose sizes ranged from 1-4 persons, about 46% had household whose sizes ranges between 5-8 persons while only 5% of the sampled households were above 8 persons. The mean household size was about 5 persons. Nnaji *et al.* (2012) suggested that an increase in the number of persons (especially, dependent household members) increased the probability of using firewood as the main source of cooking energy.

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Table 1: Socioeconomic Characteristics of Household Cooking Energy

Variables	Frequency	Percentages	
Sex			
Female	93	58.1	
Male	67	41.9	
Total	**160**	**100**	
Age			
≤30	45	28.1	
31-40	42	26.3	
41-50	37	23.1	**Mean = 40.1**
51-60	27	16.9	
Above 60	9	5.6	
Total	**160**	**100**	
Marital Status			
Single	46	28.7	
Married	114	71.3	
Total	**160**	**100**	
Educational Status			
No formal	6	3.8	
Primary	11	6.9	
Secondary	46	28.8	**Mean = 13.6**
Tertiary	97	60.6	
Total	**160**	**100**	
Household Size			
≤4	79	49.4	
5-8	73	45.6	**Mean = 4.7**
Above 8	8	5.0	
Total	**160**	**100**	
Income			
≤30,000	57	35.6	
30,001-50,000	54	33.8	
50,001-100,000	33	20.6	**Mean = 31,500**
Above 100,000	16	10.0	
Total	**160**	**100**	
Major Occupation			
Civil Servant	46	28.7	
Self Employed	52	32.5	
Trading	28	17.5	
Farming	25	15.6	
Others	9	5.7	

Source: Field survey, 2021

The Table 1 further shows that 35.6% of the respondents were within the income category of less than or equal to ₦30,000, (33.8% were within the income category of between ₦30,001 and ₦50,000, while 20.6% of them fell within the income category of ₦50,001 and ₦100,000. Only 10.0% of the respondents were within the income category of above ₦

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100,000. The mean monthly household income was ₦31,500, suggesting that the sampled respondents had monthly income that is below the national minimum wage of ₦33,000 in Nigeria. The Table also showed that majority 28.7% of the respondents were civil servant, 32.5% were self-employed, 17.5% were traders, and 15.6% were farmers while 5.7% are unemployed and could do other things for a living.

Types of Cooking Energy Utilized by the Households in Eket Agricultural Zone

Table 2 showed that 50% of the household utilized fuelwood as major source of cooking energy, 15% utilized kerosene, and 31.9% used gas while 3.1% used charcoal. This shows that fuelwood is the major source of cooking energy in the study area. This is in line with the findings of Abudullahi *et al.* (2017) who observed that about 76% of the sampled households depended largely on solid fuels. The dominant use of fuelwood for cooking may be as a result of availability and cost, and not necessary because of the perceived benefits over more modern and cleaner sources like kerosene and LPG.

Table 2: Types of Cooking Energy by Household in the Study Area

Types of Cooking Energy Used	Frequency	Percentage
Fuelwood	80	50.0
Kerosene	24	15.0
LPG	51	31.9
Charcoal	5	3.1
Total	**160**	**100**

Source: Field survey, 2021

Preferred Type of Cooking Energy by households in the Study Area

Table 3 showed that 65.5% of the household preferred liquefied petroleum gas as cooking energy, 25.6% preferred kerosene, 6.4% preferred fuelwood while only 2.4% preferred firewood to others. The high preference for LPG is due to its clean nature, speed and convenience.

Utilization of preferred cooking energy by households in the study area was reported in Table 3. The results showed the level of utilization of preferred cooking energy by households. Majority (75.6%) of the sampled households adjudged that they were not privileged to use their most preferred source of cooking energy. This could be due to affordability, availability and many other reasons, while only 24.4% of the respondents were adjudged to have had access their preferred cooking energy source.

Effects of income on household preference was presented in Table 3. Table 3 further showed that 62.5% agreed that income greatly affected the choice of cooking energy made while 37.5% believed that income is not the reason for choice of cooking energy used rather other factors like nearness to source, availability of basic facilities in the house etc. Table 3 similarly showed that household size less than three people 83.1% do not receive monthly income while only 16.9% are households with monthly income in the study area. This showed that as households" income increases, choice of cooking energy changes. It tends move from fuelwood with minimum cost and maintenance to gas and electricity with higher cost and maintenance; but with high comfort and safety. High income earners used kerosene as the last choice of cooking energy when there is power failure or the cylinder got exhausted unaware. The reverse was the case for low-income earners who chose fuelwood as the main cooking energy. Most of the low-income earners do not always considered gas while only few occasionally used electricity when power supply is available. The result in table 3 supports

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Zaku *et al.,* (2013) who stated that poverty rate strongly suggests the use of wood fuel as cooking fuel. As household income increases, a transition occur which is often referred to as the "fuel ladder". Fuel ladder is described as the situation where fuel wood and charcoal, which occupy the lower rungs of the ladder, are then substituted by kerosene, gas and commercial electricity as you rise up through the rungs (Brawler & Falcao, 2004).

As presented in Table 3, it is indicated that 66.3% of the households lives closer to the clean energy cooking sources which is less than two Kilometers from their homes. 28.8% lives from 2.1-5 kilometers away from their home, 4.4% were living from 5.1-10 Kilometers while only 0.6% was above Kilometers away from their home. An average distance from household dwelling place to cooking energy source was 2.33%. This indicates that the closer to cooking energy source, the tendency of households partaking in the use of clean and efficient cooking energy sources.

Table 3: Preferred Type of Cooking in the Study Area

Preferred Energy	**Frequency**	**Percentage**
LPG	105	65.5
Kerosene	41	25.6
Fuelwood	10	6.4
Charcoal	4	2.5
Total	**160**	**100**
Utilization of Preferred Cooking Energy		
Yes	39	24.4
No	131	75.6
Total	**160**	**100**
Dwelling Place		
Single room	44	27.5
A room and parlor	40	25
2/3-bedroom flat	29	18
Duplex	4	2.5
Detached houses	43	27
Total	**160**	**100**
Income		
Yes	100	62.5
No	60	37.5
Total	**160**	**100**
Distance in Kilometers		
<2	106	66.3
2.1-5	46	28.8
5.1-8	7	4.4
Above 8	1	0.6
Total	**160**	**100**

Source: Field survey, 2021

Factors Influencing Choice of Cooking Energy Type

The result of the multinomial logistic regression model on factors influencing choice or usage of specific cooking energy by respondents is presented in Table 4. The log likelihood (-118.95607) and the likelihood ratio statistics of 141.69 was significant at the 1% level of

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probability. The results from the fitted model showed that the coefficient of age was positive and significant ($p<0.01$) with respect to the usage of firewood ($p<0.01$), kerosene ($p<0.01$) and charcoal ($p<0.05$) as main cooking energy in comparison with use of LPG. These results imply that the probability of using firewood, kerosene and charcoal as main cooking energy instead of LPG increases as the age of the household heads increases. A possible explanation to this is that, as the age of the household heads increases, there is a shift in preference from LPG to firewood, kerosene and charcoal. This is to be expected because older household heads may not be economically active to have many other sources of income to afford the prevailing high cost of LPG in Nigeria. Also, the reality of low, delayed and/or unstable income (for pensioners) which is prevalent in many parts of Nigeria may have a negative effect on the standard of living of households with older heads. Additionally, older people are known for their conservatism, these habits could make them accustomed to the use of traditional cooking energy sources like firewood and charcoal and they are less likely to change to modern and cleaner energy usage. This finding is consistent with the finding of Mensah & Adil (2015) who observed that older household heads are not willing to use modern and cleaner cooking energy sources.

Also, in comparison with LPG as a cooking energy source, the coefficient of educational level had negative and statistically significant relationship with household preference for firewood, kerosene and charcoal as major cooking energy sources. This implies that increases in educational attainment among farm households, increases their chances of using LPG as main cooking energy while in contrast, it reduces the likelihood of using firewood, kerosene and charcoal as the main source of cooking energy *ceteris paribus*. This is to be expected because higher educational attainment could lead to positive returns on employment opportunities, which increases income and overall standard of living. It generally results to economic affordability of better and clean energy sources for cooking and other domestic uses.

The coefficient of household size is negative and has a statistically significant relationship with household preference for charcoal in comparison with LPG. This is counter intuitive as it could be expected that bigger households may use cheaper and affordable energy sources like firewood, kerosene and charcoal. A plausible explanation to these findings is that large household size in this regard may comprised many employed adults who may pulled their resources (income) together to afford a better and cleaner energy such as LPG for cooking. This finding contradicts that of Karimu (2015) and Chidiebere-Mark *et al.*, (2018) who reported that large family size had preference for cheaper energy sources like firewood and charcoal.

Table 4 also showed that location of house had a negative and significant relationship with the probability of the household using firewood as a main cooking energy in comparison with LPG. The implication of this result is that households located in urban areas used LPG in comparison with firewood. This is to be expected because considering the modern realities, urban farm families preferred and could afford more efficient cooking energy sources than their rural counterparts. Ownership of house had a negative and statistically significant relationship with the preference or choice of kerosene as a cooking energy source. The implication of this is that house owners (landlords) will prefer using LPG as their major cooking energy source.

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Table 4: Factors Influencing Household Cooking Energy Choices

Variables	Firewood			Kerosene			Charcoal		
	Coefficient	Standard Error	Z Value	Coefficient	Standard Error	Z Value	Coefficient	Standard Error	Z Value
Constant	7.42252	.072971	3.58***	3.596018	2.005697	1.79*	2.656713	2.794788	0.95
Sex	.2523126	.5847587	0.43	-.3110437	.5839248	-0.53	1.050258	.8933531	1.18
Age	.0988777	.0347563	2.84***	.1246466	.0344456	3.62***	.0946099	.0407152	2.32***
Marital Status	-.2327998	.7983698	-0.29	-.8766795	.7754334	-1.13	1.221388	1.314775	0.93
Education	-.5074081	.1027229	-4.94***	-.4120749	.1043736	-3.95***	-.4184329	.1166553	-3.59***
Household Size	-.1129171	.1615337	-0.70	-.1230658	.1589009	-0.77	-.5749889	.2502514	-2.30**
Monthly Income	-.0000203	.0000159	-1.28	-4.98e-06	.0000144	-0.35	-.000011	.0000209	-0.53
Location	-2.8d6525	.6791827	-4.22***	-1.178787	.6341567	-1.86*	-.8801413	.8434472	-1.04
Personal House	-.4094474	.645719	-0.63	-1.506995	.6668225	-2.26**	.5924613	.955307	0.62
Distance	.1689684	.1755013	0.96	.0710332	.1897255	0.37	-.1910063	.2639796	-0.72
Regression diagnostics									
Log likelihood	- 118.95607								
Prob > Chi^2	0.0000								
LR Chi^2 (27)	141.69								
Number of obs	160								

Note: *** = Significant at 1% level of probability, ** = Significant of 5% level of probability and * = Significant of 10% level of probability

Source: Field survey, 2021

CONCLUSION AND RECOMMENDATIONS

The findings above suggest that households' socioeconomic characteristics strongly influence the choice of cooking energy in Akwa Ibom State. Although the adverse effects on ecology and health connected with traditional cooking fuels push countries/economies to work hard to transition to sustainable cooking technologies through various strategies, such as cultural drives, improved cookstoves, etc. However, selecting the best cooking method when encouraging energy change necessitates a deeper understanding of the socio- economic factors that influence household energy choices. In this regard, information about the factors that influence household decisions on types of cooking energy and the most preferred cooking in Akwa Ibom State, Southern Nigeria, is still limited based on available studies, so more empirical evidence would aid in developing adequate energy and environmental strategies. This study investigated the determinants that influence household cooking energy choice and household preferences to explain how well they explain the observed behavior of household energy choices in economies like Nigeria. This study showed that older household heads preferred traditional cooking energy sources like fuelwood/charcoal, and bigger households preferred cleaner energy sources like LPG. In addition, educated household heads utilize more efficient and clean energy sources. In addition, households in urban centres use cleaner energy such as gas (LPG), and landlords/house owners prefer LPG (clean energy) to cheaper energy sources. Recommendations were:

1. Government and other stakeholders should sensitize older household heads on the negative effect of fuel wood utilization, as this will effectively reduce indiscriminate destruction of forest for fuelwood in the study area.
2. There is a need for vigorous policy toward reduction of incidence of poverty through provision of rural electrification and adoption of a policy that will improve the living condition of the vulnerable groups (older household heads).
3. In addition, it is imperative to develop and integrate renewable energy technologies in Nigeria's energy mix, as this will reduce overreliance on fossil fuel for cooking and other household activities.

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