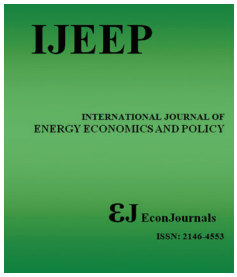

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Household Cooking Energy Situation in Nigeria: Insight from Nigeria Malaria Indicator Survey 2015

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ABSTRACT

The lingering electricity energy crisis in Nigeria which is beyond the control of most households necessitates making decision and choice on alternative energy pathways for households' sustenance and welfare. This study assessed households' energy situation with respect to choice of cooking fuel and cooking energy poverty status in Nigeria. Further investigation was sought to isolate the main factors influencing households' choice of individual fuels as main cooking fuels using data from Nigeria's Malaria Indicator Survey of 2015 with the application of descriptive and multivariate probit analyses. Findings revealed that wood and kerosene fuels remain the major fuels utilized by most households in Nigeria for cooking purposes. Meanwhile, level of education, household size, wealth status and regional factors are significant predictors driving choices of fuels among households, though the impact of these factors differs across the highlighted choices. Based on these findings, mass enlightenment campaign on the safe use of clean energy is recommended while the need for economic diversification by rural households to aid their wealth status is also emphasized. Also, there is need to gear up corporate social responsibilities by the available private establishments in ensuring rural accessibility, availability and affordability of modern and cleaner fuel (such as LPG).

Keywords: Cooking Energy Choice, Multivariate Probit Model, Nigeria
JEL Classifications: D10, I30, Q40

1. INTRODUCTION

The energy sector is widely acknowledged to be indispensable for the smooth sailing of any economy; it is a vital element in human life and a pivotal input for social and economic development (Brew-Hammond, 2010). This suggests that a sustainable, secure, sufficient, affordable and accessible supply of fuel as well as affordable use of energy is very crucial for the growth and sustainability of modern societies. Hence, it is central to addressing many of today's development challenges which are centered on human health, inequality, unemployment, education, climate change, food security and general household welfare (Bazilian et al., 2012; Varun and Bhat, 2009). The motivation for and satisfaction derived from energy demand is not the same for economic agents (household and productive users) (Bhattacharyya and Timilsina, 2009), while households use energy for cooking, heating, lighting and, cooling systems to obtain the greatest degree of satisfaction, businesses on the other hand demand and use it as part of production input which account for business economic profitability or loss. Hence, this account for differentials in its demand, availability, affordability and use. Despite these differences energy use type and pattern have development implications.

Energy use at the household level remains a serious challenge which many developing countries have continued to grapple with (Hou et al., 2017), this is so because it has continued to reflect poor access to clean energy, hence energy poverty. It often

highlight heavy reliance on alternative energy options-solid fuels (mainly biomass and coal) which are not environmentally sustainable and energy efficient and when used does have harmful effect on the health and productivity of those in the household (IEA, 2017). Its' health hazards affect the vulnerable (females and children) the most because of many hours spent while cooking near exposed fire-flames (Hou et al., 2017). An annual premature death of 2.8 million people was recently reported due to smoky environments caused by burning solid biomass in inefficient stoves and or from combustion of kerosene or coal for cooking (IEA, 2017). Furthermore, overreliance on traditional energy sources like wood and agricultural residues has been identified as a leading cause of deforestation (Bisu et al., 2016).

Access to clean reliable and modern energy sources is a daunting task confronting the African continent at large (Baiyegunhi and Hassan, 2014). In Nigeria, the situation is paradoxical in nature, in that despite enormous natural resources that could be utilized for energy generation purposes, the ranking of the country as the 6th largest oil exporting nation and an estimated 187 trillion standard cubic meters of liquid natural gas reserve, which is the largest reserve in Africa and 9th largest reserve in the world according to (IEA, 2014), yet the country is still faced with energy crises that have been existing for more than a decade, remain unabated and with no of the crises in sight. These crises include shortage of supply where the demand for electricity far exceeds currently installed and generation capacities, frequent power outage, inadequate and delayed maintenance of facilities and occasional collapse of national grid among others. These energy crises without doubt have links with population expansion, security issues, poor investment, corruption, and inconsistent and lack of continuity in energy sector initiatives by various governments. These crises have implications for household welfare, industrialization, employment generation and economic growth and development in general. For instance, World Bank (2018) reported a national electricity access of 59.3% and low per capita consumption for Nigeria of 144.5 kWh per capita in 2016 and 2014 respectively. Aside, household sector which is the largest consumer of electricity energy in Nigeria, and also play a dominant role in energy-related sustainability and conservative issues have to result in the reliance and usage of various alternative options that are readily available to meet their various electricity energy demand especially cooking which account for about 80% of the total domestic energy consumption (Oyedepo, 2012; Gujba et al., 2015).

Providing solution to electricity issues in the country is out of the scope of this study, rather the study focused on households alternative energy use in the face of persistent energy challenges. Paucity of studies that offer comprehensive nationwide analysis on the dynamics of household cooking energy situation in the country in Nigeria using most current information where possible, which could reflect the effect of time and relevant government policies and also needed for energy planning in the country motivated this study. Hence, in light of the above facts, the aim of this paper is to answer the following research question;

1. What is the pattern and trends of households cooking energy situation and is any improvement observed?
2. Which current socioeconomic statuses explains the use of specific cooking energy options by households.

It is envisioned that this study will assist in the formulation of effective energy policies that could have positive impact on household behavior with respect to cooking energy in Nigeria. The rest of the paper is organized as follows; Section 2 contains literature review while Section 3 focuses on the research methodology and data. Section 4 presents the results and discussion while Section 5 is the conclusion.

2. LITERATURE REVIEW

Energy is consumed at the household level for purposes of cooking, heating, lighting and powering machines where necessary (Ogwumike and Ozughalu, 2012). Energy type consumed by households for cooking, heating and lighting can broadly be categorised into traditional, transitional or modern energy sources. Hence, conceptually, it is the type of energy consumed that determines whether a household is energy poor or not, although there are no universally accepted definition of energy poverty. Household energy poverty is therefore conceptualized as a situation where there is inadequate access to sustainable, cleaner and modern energy sources (IEA, 2017; Sesan, 2012; Bouzarovski, et al., 2016). These cleaner energy sources are fuels which are more environmentally sustainable, energy efficient and when used does not have any harm on the health of those in the households (IEA, 2017), and they include improved biomass, gas, biogas, solar cooker and electricity (IEA, 2017; Ekouevi and Tuntivate, 2012). Contrariwise, households who can only access or use traditional energy sources and non-clean fuel are regarded as being energy poor. This entails the use of energy sources which are of very low technological-based such as firewood (traditional biomass), charcoal, kerosene, plant residue and animal waste (IEA, 2017; Ekouevi and Tuntivate, 2012). In addition, household is considered energy poor when it has to spend more than 10% of its disposable income to meet it energy need (Teller-Elsberg et al., 2016; Ismail and Khembo, 2015).

Various theories have been postulated in order to explain household energy choices in energy poverty studies. The theory of 'energy ladder model' has been extensively used in such studies. The theory states that households gradually climb an energy ladder in three phases. They begin with traditional energy sources and transitioning to commercial fuels and eventually to the use of advanced fuels such as electricity (Bisu et al., 2016). The transition through these three stages is guided by household income and fuel prices. The model assumes a linear progression pattern of households as they move along the imaginary energy ladder, switching completely from traditional fuels as their income increase. However, the energy transition theory has been criticized by various recent studies that have found out that as household income increases, traditional fuels are not discarded completely rather they are used conjointly with other energy sources and that income alone does not influence household fuel use, thus negating the energy ladder model. The weakness of the "energy ladder" model led to proposition of alternative models like the fuel stacking model (Masera et al., 2000). The "fuel stacking" model assumes that the transition of households to clean energy is not

linear, rather households just increase number of energy sources used without necessarily forgoing completely the old ones (Bisu et al., 2016). Here, energy use patterns of households is guided by many factors which include cultural, social, economic and even personal preferences and not only income (Bisu et al., 2016). Other theories used in literature include the poverty-environment and the theory of utility maximization in consumer behaviour (Joshi and Bohara, 2017; Ogwumike and Ozughalu, 2016).

Empirically, this study acknowledge the existence of several studies (including Ogwumike et al., 2014; Oyekale, 2012; Mensah and Adu, 2015, Karimu, 2015; Rahut et al., 2016; Rahut et al., 2017; Nlom and Karimov, 2015; Makonese et al., 2018) that have examined the factors influencing household cooking fuel choice at both local and national perspectives. These studies applied different analytical techniques with majority applying Chi-square analyses, multiple regression, multivariate probit regression, Seemingly Unrelated Bivariate Probit regression, multinomial probit, ordered probit model and multinomial $\log_{it}$ in this regard. Evidences from these literatures shown that specific choice of household main cooking fuel is influenced by both households' economic and non-economic factors. The economic factors include income and expenditure of household, and prices of fuel. While on the other hand, non-economic factors include socio-economic characteristics such age, gender, household size, education, distance to fuel source, type of dwelling, location and distance to fuel source. However, the dimension and extent of influence of these factors on household's choice of fuel type vary across type of fuel source. This study further observed while majority of studies carried out in Nigeria were found to have been carried out in a few local government areas, not even regional let alone the whole country as a whole, the four studies (Oyekale, 2012; Ogwumike and Ozughalu, 2012; Ogwumike et al., 2014, and Ogwumike and Ozughalu, 2016) that looked at it from a nationwide perspective utilized data for 2008, 2004 and 2004 respectively. One most recent study by ifegasan et al., (2016) Where 2013 nationwide survey data was used has a flawed methodological approach. The multiple regression approach used by ifegbasan et al., (2016) In addressing their study's research question on whether socio-economic characteristics predict household choice on the type of fuel being used for cooking is inconsistent and inappropriate because there is no clear conceptualization of the response variable. Besides in similar studies like this response variables are categorical, this violates the criteria of multiple regression/ols that response variable should be continuous. Type of cooking fuel in ifegbasan et al., (2016) Are not in continuous form, hence the application of multiple regression and subsequent inferences are flawed. Yet, comprehensive current and nationally representative information where possible in this regard that could reflect the effect of time and relevant government policies is however needed in understanding the dynamics of household cooking energy situation in the country for better energy and environmental planning.

3. MATERIALS AND METHODS

3.1. Study Area, Data Source and Sampling

Nigeria is a West African country located approximately between latitudes 40 and 140 North and longitude 30 and 150 East (Ifegbesan et al., 2016). Nigeria is bordered by Benin to the west, Cameroon to the east, Niger Republic on the northern side and the Atlantic Ocean on the Southern side. The country consists of 36 states as well as a federal capital territory (FCT) which are divided into six geopolitical zones South-South, South-West, North Central, North East, North West and South East. The country's population is estimated to be 191 million (UN, 2017).

The study used the Nigeria Malaria Indicator Survey (NMIS) data that were collected from October 2015 through November 2015. The NMIS was implemented by National Malaria Elimination Programme (NMEP), the National Population Commission (NPopC), and the National Bureau of Statistics. The Population and Housing Census of the Federal Republic of Nigeria (NPHC) conducted in 2006 by the NPopC was used as the sample frame for the 2015 NMIS. Samples were selected using stratified two-stage cluster design consisting of 329 clusters. A two-stage sampling strategy was adopted for the 2015 NMIS. In the first stage, nine clusters (EAs) were selected from each state, including the FCT. In the second stage, 25 households were selected in each cluster by equal probability systematic sampling. Details of the sampling procedure can be found in (NMEP et al., 2016). The sample selection was done in such a way that it was representative of each state. 7,745 household were successfully interviewed, yielding a response rate of 99% (NMEP et al., 2016). This study utilized information on demographic and socioeconomic characteristics of households and type of cooking energy.

3.2. Analytical Techniques

3.3.1. Descriptive analysis

Descriptive analysis was used to describe the pattern and trend of household usage of cooking fuel sources and consequently cooking energy poverty. Basically, frequencies, percentages, tables and charts were used.

3.3.2. Multivariate Probit regression

The factors influencing choice of main cooking fuel are not uniform among different households. To this effect, a multivariate probit model was employed to analyse the determinants of household's cooking energy choices. The study focused on four main specific cooking fuels (LPG, kerosene, charcoal, and wood fuels) which together accounts for about 94.9% of total cooking fuel used in the study area. The rational for analysing the individual fuel energy option was to avoid the aggregation problem. One advantage of the multivariate probit model is that, unlike single-equation probit and $\log_{it}$, and multinomial $\log_{it}$ models, it simultaneously analyses the choice of energy types thus allowing for non-zero covariance across cooking energy types. Estimating the models independently may generate biased and inconsistent coefficients, though, as the error terms are likely to be correlated across activities. As dependent variables, we use dummies for usage of a specific type of cooking fuel, specifically kerosene, wood, natural gas, and charcoal. Households that use a type of fuel for as main fuel for cooking are scored 1 and those that do not use such as main fuel are scored 0. Following (Rahut et al., 2017), the multivariate model for determining factors that influence household cooking energy choice is stated as follows;

Table 1: Specification of multivariate $prob_{it}$ regression explanatory variables

Variables	Description	Type of data
Gender	1 if male, 0 if otherwise	Dummy
Age	Age of household head	Continuous
Household size	Number of people in the household	Nominal
Education	1 if higher degree, 0 otherwise	Dummy
Number of children	Number of children<5 years in the household	Nominal
Location	1 if rural, 0 otherwise	Dummy
Region	1 if northern, 0 otherwise	Dummy
Electricity Access	1 if having access, 0 otherwise	Dummy
Wealth status	1=Poorest; 2=Poorer; 3=Middle, 4=Richer; 5=Richest	Categorical

Table 2: Demographic and socioeconomic characteristics of respondents

Gender of head	Frequency (%)
Male	6547 (84.53)
Female	1198 (15.47)
Age of household head (years)	
≤30	1659 (21.42)
31–50	3499 (45.18)
51–70	1963 (25.35)
≥71	624 (8.06)
Educational attainment of head	
No education	2645 (34.15)
Primary	1528 (19.73)
Secondary	2253 (29.09)
Higher	1286 (16.6)
Household size	
1–5	4950 (63.91)
6–10	2363 (30.51)
Above 10	432 (5.58)
Access to electricity	
Yes	4247 (54.84)
No	3498 (45.16)
Wealth index	
Poorest	1058 (13.66)
Poorer	1351 (17.44)
Middle	1676 (21.64)
Richer	1844 (23.81)
Richest	1816 (23.45)
Location	
Urban	3166 (40.88)
Rural	4579 (59.12)
Geopolitical region	
North central	1385 (17.88)
North East	1200 (15.49)
North West	1547 (19.97)
South East	1002 (12.94)
South South	1281 (16.54)
South West	1330 (17.17)

Source: Computed by authors

$$Y_{im}^{*} = \alpha_m X_{im}^{*} + e_{im} \quad (1)$$

$$Y_{im} = 1 \text{ if } Y_{im}^{*} > 0 \; and \; 0 \; if \; otherwise$$

Where Y represents the dependent variable which is the four main cooking fuels (m = 1, 2, 3, 4) used by the i^{th} household (i = 1,…., 7745). X is the vector of explanatory variables that influences choice of cooking fuel by i^{th} household, α is the vector of unknown parameters, and e is the vector of unobserved error term. The explanatory variables are described in Table 1. The variables were recoded where necessary in order to carry out this analysis.

4. RESULTS AND DISCUSSION

4.1. Socio-economic Characteristics of Respondents

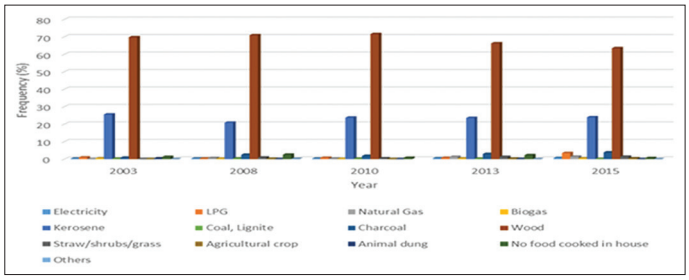
Table 2 presents the socio-economic characteristics distribution of the households. The result shows that 84.53% of the household heads are males, Educational distribution of household head reveal that while a higher proportion (34.15%) of the respondents have no education, 19.7 and 29% attained primary and secondary education respectively. Geopolitical distribution of respondents shows that there is almost an equal representation of respondent in the survey. Majority (59.12%) of the respondents live in the rural settlements, while 40.88% live in the urban settlement. In terms of wealth status, 31.1% of the aggregated respondents are considered to be in poor category while 21.6% are in the moderately poor category and 47.3% are found to be in the non-poor category.

4.2. Pattern and Trends of Households Cooking Energy Situation

Most national censuses on household surveys have only recently integrated questions relating to household energy usage. It is therefore difficult to draw solid conclusions on a time series trend of household energy use over a longer period of years. However, in an attempt to only spot-light the trend of use of cooking fuel types, this study utilized available information from Demographic and Health Surveys carried out in Nigeria between 2003 and 2015. A comparative distribution of household choice of fuel for cooking in this regard is presented in Figure I. From the Figure I, it can be deduced that there has not been significant positive development in the use of improved energy sources (for instance, electricity and LPG) for cooking. Wood and kerosene also are clearly revealed as the main choice of fuel energy for cooking by most households in Nigeria over the years represented. Although, there are slight changes in the proportion of household using these two sources of energy sources as major fuel for cooking, the continual dominant nature and use of wood fuel for cooking is worrisome. This questions the effort, determination and investment by the Nigerian government in improving the standard of living of the people through poverty reduction (energy poverty inclusive) and providing a sustainable environment.

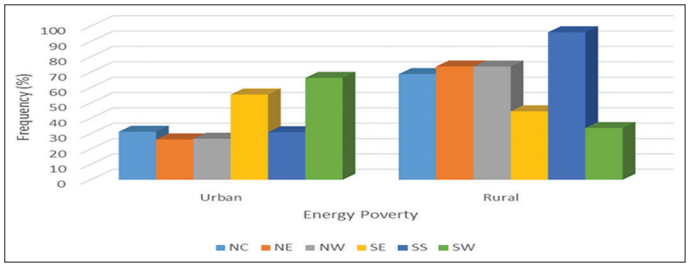
In the same vein, it can further be deduced that the non-usage of LPG as seen in Figure 1 could be as a result of fear of possible inferno, poor knowledge of reduced pollution advantage, a high

Figure 1: Trends in type of main cooking fuel use



Source: Generated by Authors. NB: LPG and Natural gas were categorized together in 2003, same as firewood and straw

Figure 2: Cooking energy poverty by geopolitical zone and location



Source: Generated by Authors from Nigeria Malaria Indicator Survey, 2015

initial cost associated with acquisition of LPG gas ancillaries (i.e., cooker, gas cylinder, re-filling of the gas cylinder as needs demand) which is considered high considering the minimum wage in the country and the traditional perception of high cost and that usage of LPG gas is meant for the rich in the society. This can be further deduced from current price of LPG which is estimated to be about 23.7% of current minimum wage in Nigeria.

Figure II presents a comparative distribution of cooking energy poverty status by geographical locations (i.e., urban and rural) with respect to geopolitical zones of households. It is clearly shown that among urban households, cooking energy poverty is prevalent in the South West and South East geographical regions of the country accounting 66.33% and 55.47% respectively. This is so because rural-urban migration is higher in these regions. Thus several households end up not having access to cleaner cooking fuels. Contrarily, the South East and the Northern regions have higher proportion of households in the rural area that are cooking energy poor as shown in the Figure II. It is however puzzlingly to note that the Northern region collectively is the most wood deficient in the country; where deforestation and desertification is prevalent and which threaten the living conditions of the inhabitants in these areas, yet as noted by Sa'ad and Bugaje, (2016) the region have the highest prevalence of traditional biomass usage than any other region in the country.

4.3. Determinants of Cooking Fuel Type Multivariate Probit Regression Result

The result of the multivariate probit regression model on factors influencing choice or usage of specific cooking fuel by respondents in the study area is presented in Table 3. The variables used in this result were subjected to test of multicollinearity in order to avoid a spurious and misleading results. The multicollinearity test examined the appropriateness and reliability of the choice of variables included in the multivariate probit model through the variance inflation factor (VIF) statistics and tolerance level. From the multicollinearity test conducted none of the variables have a VIF >10. Also, the average VIF of 1.69 for the model depicts an overall tolerance of about 59.2%, which is a favourable indication that multicollinearity is not a serious problem in the fitted model.

The findings from the fitted model revealed that the coefficient of gender of household head (base reference-male) is negative and significant with respect to the usage of charcoal and firewood as main cooking fuels. This indicates that having a man as the head of the households reduces the probability of a household using charcoal or firewood as cooking fuel energy options. Alternatively, the result does imply that usage of the two significant solid fuels (charcoal and firewood) increases with having female as the head. This is not unexpected in developing Africa countries context where female are decision makers with respect to cooking which is a part of house chores, and are often saddled with the duty to collect firewood from the forest for their cooking activities. Additionally, the low economic status of female headed households compare to male headed ones make such households to be utilizing less expensive fuel (charcoal) for cooking, even if such fuel is dangerous to human health. This further point out to the vulnerability to poverty and lower standard of living nature of women and consequently such households they head. Generally, female heads and consequently their households are economically vulnerable because of poor access to employment opportunities and resources. This finding agrees with other studies such as (Ogwumike et al., 2014; Rahut et al., 2017).

Also, the coefficient of age of household head is negative and significant with respect to the use of kerosene, but positive and significant for firewood. This result implies that probability of using kerosene as cooking fuel decreases as the age of household head increases when other variables are held constant while it increases for firewood. This result is similar to the findings of (Baiyegunhi and Hassan, 2014) who all reported a shifting to firewood consumption or preference for firewood as the age of the household head increases. This arises due to reduction in income of the head when he or she is no longer economically active coupled with the fact that such household head might not have any other source of income, either through remittances, pension or other income sources. The reality of low or no and unstable income (for pensioners) which is prevalent in Nigeria is seen to have lowered the standard of living of households with older heads. Other reason for high preference for firewood by households with older heads is due to the old habit or conservatism associated with older people. In this case, old folks may have become accustomed to the use of traditional fuel energy source(s) and thus are less willing to change towards modern reality of energy usage (Mensah and Adu, 2015).

Likewise, from Table 3, while a negative and significant relationship between household size and use of LPG and kerosene as main cooking fuels was observed, the relationship was positive for usage of wood as main cooking energy. The result suggests a reduction in the probability of a household using LPG and kerosene for cooking as household size increases. This is majorly due to

Table 3: Multivariate $prob_{it}$ estimates of factors influencing choice of cooking energy fuel

Variables	LPG		Kerosene		Charcoal		Wood	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std Err.
Constant	−5.1135	0.3696	−2.5533	0.1475	−2.5053	0.1926	1.1462	0.1089
Gender	0.0399	0.0963	−0.0019	0.0520	−0.2192**	0.0839	−0.1348*	0.0479
Age	−0.0006	0.0025	−0.0072*	0.0013	−0.0019	0.0020	0.0089*	0.0011
Household size	−0.0589*	0.0198	−0.0763*	0.0105	0.0115	0.0117	0.0710*	0.0077
Education	0.6326*	0.0728	−0.2128*	0.0493	−0.3357*	0.0821	−0.1551*	0.0466
Number of children	−0.0548	0.0481	0.0810*	0.0248	0.0064	0.0314	−0.0476**	0.0195
Residence (Rural)	0.0776	0.0866	−0.1072**	0.0459	−0.5714*	0.0788	0.3267*	0.0394
Northern Region	−0.0799	0.0807	−0.6626*	0.0465	0.9059*	0.0726	0.1896*	0.0397
Access to electricity	−0.1379	0.1349	0.1008**	0.0604	0.1285	0.0887	−0.0524	0.0467
Wealth status	0.8027*	0.0786	0.7155*	0.0324	0.1682*	0.0369	−0.5806*	0.0225
Log likelihood		−6697.7315						
Wald χ^2 (36)		3548.29						
Prob.>χ^2		0.0000						
Number of obs.		7745						

Source: Computed by Authors from STATA 12

the amount of energy required for cooking for large number of persons and the consequent cost implication associated with it, which is higher for larger households. It is expected that larger household will prefer to use firewood because it requires a large amount of fuel energy in aggregate to meet the family needs. In line with the submission of (Pundo and Fraser, 2006), it is comparatively affordable to use firewood for large family than kerosene and charcoal because its rate of consumption per unit of time is low. Again, the cheapness of firewood would require that households with large family size use huge amount of it for their cooking activities. Suffix to say that, this positive and significant estimated coefficient for family size was not unexpected and it is in line with (Karimu, 2015).

The findings from Table 3 also shows a negative and significant relationship between education and kerosene, charcoal and wood fuels but a positive and significant relationship with LPG. This indicates that, increase in education attainment increases the chances of a household using LPG as main cooking fuel while on the other hand, it reduces the likelihood of using kerosene, charcoal and wood as main coking fuels as expected, ceteris paribus. A positive and higher return to education can be deduced in this regard; that is, positive returns on employment opportunities, income and standard of living generally resulting to economic affordability of better and clean fuel energy options for cooking and other domestic uses. This is supported by the studies from (Bisu et al., 2016; Mensah and Adu, 2015). Likewise, the coefficient of under 5 years in Table 3 is positive and significant for kerosene fuel preference but negative for firewood usage. This thus implies that households with more children under the age of 5 years are more likely to use kerosene fuel energy and less likely to use solid wood fuel as main cooking energy. This is because of the inability of the mothers in rural area to collect firewood at this nursing stage. This inability arose from more time used to attend to other pressing house chores especially as it pertains to taking care of the little children most often in cases where there are no older children in the house to assist. Hence, it becomes imperative and a justification for the use of kerosene as an alternative fuel energy which is more easily accessible.

Furthermore, the result in Table 3 shows that there is a significant and negative relationship between rural dwelling and usage of kerosene and charcoal as main cooking fuel choices; this does imply that, living in rural areas reduces households' chances of using kerosene or charcoal for cooking. The result is however positive for the use of firewood which by extension suggests that rurality significantly increases the probability of the using of wood for cooking. This is mainly due to easy accessibility of firewood in the rural areas unlike urban areas where development in all forms has led to major deforestation; thus, various forms of improved cooking fuel energy are available to choose from, Thus, the significant use of firewood is not unexpected. This finding is similar to the submission of (Ogwumike et al., 2014) where urban sector (location variable) was found to be negatively related to household firewood consumption. Likewise, there is a negative relationship between rural dwelling and usage of kerosene as main cooking fuel which also suggests that living in rural areas reduces household chances of using kerosene for cooking. This is largely a result of little supply of kerosene fuel energy, distance, low economic benefit of supply of kerosene to rural areas and mostly, the easy accessibility and availability of alternative fuel energy options in the rural areas.

It is also seen from the Table 3 that the geopolitical variable (northern region) is positive and significantly related to usage of charcoal and firewood as main cooking fuel but negatively related to use of kerosene for cooking. This is expected considering the high poverty rate in the northern part of Nigeria. Oyekale (2012) buttressed on this that, when the households are struggling to meet basic needs for food, demand for improved energy sources for cooking will never be an importance. This positive relationship with use of solid fuels as noted by (Sa'ad and Bugaje, 2016) could also be as a result of the belief by northern households that the food cooked on woods would be testier than the one cooked with aluminum pots in a kerosene stoves; hence, the preference by majority of the northern households for firewood fuel energy source. The coefficient of electricity access is positive and significantly related to kerosene fuel. This suggests that households are more likely to combine both kerosene and electricity for cooking. However, the use and preference for kerosene as cooking

fuel energy option despite having access to electricity is as a result of the deplorable and unreliable state of the power sector in Nigeria till date and kerosene being a relatively clean and fairly accessible fuel energy source was opted for as a back-up plan for inconsistent electricity supply.

Lastly, the coefficient of wealth status shows a positive relationship with all the cooking fuels considered except for firewood which is significant negatively. The implication of the significant relationship between LGP, kerosene and wealth is that non-poor households who are mostly found in urban areas have a higher probability of using LPG or kerosene as the main cooking fuel energy sources majorly due to affordability and availability. This further attests to the fact that firewood which is cheap and readily available in the rural areas is mostly used by rural and agrarian households who are generally conceptualized to fall within the poorer category of households. From this, it can be implied that LPG is more of a luxury item than necessities in Nigeria. This however ought not to be so considering the abundance of natural gas resources and endowment in Nigeria. This finding is also in line with (Rahut et al., 2016).

It can be inferred that the effects of each of the fitted explanatory variables differs across the choice and use of specific cooking fuel; hence, the significant explanatory variables fitted in the multivariate probit model explain the variation in the preference and use of alternative fuel energy options across different categories of households in Nigeria.

5. CONCLUSIONS

This paper provided a nationwide information about current patterns and trends of households cooking fuel energy use as well as households' energy poverty using the survey data from NMIS 2015. Multivariate probit model was further employed to analyse the determinants of households' use of main cooking fuel choices. The descriptive analysis of trends and patterns of household energy choice clearly show that the proportion of households using wood and kerosene is still very high in the country and consequently cooking energy poverty situation is high as well. This dependence on wood harvesting negatively affects the environment because it links into drivers of deforestation, reduced crop productivity and increasing desertification rates especially in the north of Nigeria. This trend implies there is need for urgent action by the government in promoting access to modern fuels for cooking. The result of the multivariate probit model revealed that gender, age, household size, education, number of children, location (rural or urban), access to electricity, region and wealth status significantly affect households' energy choices. Based on these findings, the following policy statements are suggested: There is need for enlightenment on the long term economic and environmental cost-benefits of LPG usage, pricing, and appropriate safety measures in the process of using LPG for cooking. There should be intensive, monitored and sustainable development programme targeted at rural areas in Nigeria and most especially in northern geopolitical region of the country. These programmes should include massive deployment of infrastructures which will aid easy access to cleaner cooking fuel energy for households use. The Nigerian government could partner with the private sectors in the distribution of low cost technology accessories and ancillary materials needed for the use of LPG for cooking in the country. As well as in investments in renewable energy sources such as biogas, improved biomass, solar and energy efficient stoves as obtainable in the developed countries. This could be seen as public-private sector initiative or private sectors' corporate and social responsibilities to assisting the government in the fight against households' energy poverty. Such investment today is needed to improve access to and affordability of modern and more efficient clean fuel and at the same time achieve a pollution free environment which in the long run will have a positive spill-over effects on health and general well-being of the populace.

REFERENCES

African Development Bank Group. (2014). West Africa Monitor Quarterly, 3, 14-15.

Baiyegunhi, L.J.S., Hassan, M.B. (2014), Rural household fuel energy transition: Evidence from Giwa LGA Kaduna State, Nigeria. Energy for Sustainable Development, 20(1), 30-35.

Bazilian, M., Nussbaumer, P., Rogner, H., Brew-Hammond, A., Foster, V., Pachauri, S., Kammen, D. (2012), Energy access scenarios to 2030 for the power sector in Sub-Saharan Africa. Utilities Policy, 20(1), 1-16.

Bhattacharyya, S.C., Timilsina, G.R. (2009), Energy Demand Models for Policy Formulation. A Comparative Study of Energy Demand Models. Washington D.C: World Bank Policy Research Working Paper No. 4866.

Bisu, D., Kuhe, A., Iortyer, H. (2016), Urban household cooking energy choice: An example of Bauchi Metropolis, Nigeria. Energy, Sustainability and Society, 6(1), 15.

Bouzarovski, S., Herrero, S.T., Petrova, S., Ürge-Vorsatz, D. (2016), Unpacking the spaces and politics of energy poverty: Path-dependencies, deprivation and fuel switching in post-communist Hungary. Local Environment, 21(9), 1151-1170.

Brew-Hammond, A. (2010), Energy access in Africa: Challenges Ahead. Energy Policy, 38(5), 2291-2301.

Ekouevi, K., Tuntivate, V. (2012), Household Energy Access for Cooking and Heating: Lessons Learned and the Way Forward. A World Bank Study. Washington, DC: World Bank.

Gujba, H., Mulugetta, Y., Azapagic, A. (2015), The household cooking sector in Nigeria: Environmental and economic sustainability assessment. Resources, 4(2), 412-433.

Hou, B.D., Tang, X., Ma, C., Liu, L., Wei, Y.M., Liao, H. (2017), Cooking fuel choice in rural China: Results from microdata. Journal of Cleaner Production, 142, 538-547.

IEA. (2014), Africa Energy Outlook- A Special Report in the 2014 World Energy Outlook Series. Paris: IEA.

IEA. (2017), Energy Access Outlook 2017: From Poverty to Prosperity. World Energy Outlook Special Report. Available from: http://www.iea.org/energyaccess.

Ifegbesan, A.P., Rampedi, I.T., Annegarn, H.J. (2016), Nigerian households' cooking energy use, determinants of choice, and some implications for human health and environmental sustainability. Habitat International, 55, 17-24.

Ismail, Z., Khembo, P. (2015), Determinants of energy poverty in South Africa. Journal of Energy in Southern Africa, 26(3), 66-78.

Joshi, J., Bohara, A.K. (2017), Household preferences for cooking fuels and inter-fuel substitutions: Unlocking the modern fuels in the Nepalese household. Energy Policy, 107, 507-523.

Karimu, A. (2015), Cooking fuel preferences among Ghanaian households: An empirical analysis. Energy for Sustainable

Development, 27, 10-17.
Makonese, T., Ifegbesan, A.P., Rampedi, I.T. (2018), Household cooking fuel use patterns and determinants across Southern Africa: Evidence from the demographic and health survey data. Energy and Environment, 29(1), 29-48.
Masera, O.R., Saatkamp, B.D., Kammen, D.M. (2000), From linear fuel switching to multiple cooking strategies: A critique and alternative to the energy ladder model. World Development, 28(12), 2083-2103.
Mensah, J.T., Adu, G. (2015), An empirical analysis of household energy choice in Ghana. Renewable and Sustainable Energy Reviews, 51, 1402-1411.
National Malaria Elimination Programme (NMEP), National Population Commission (NPopC), National Bureau of Statistics (NBS), ICF International. (2016), Nigeria Malaria Indicator Survey 2015. Abuja, Nigeria, and Rockville, Maryland, USA: NMEP, NPopC, and ICF International.
Nlom, J.H., Karimov, A.A. (2015), Modeling fuel choice among households in Northern Cameroon. Sustainability, 7(8), 9989-9999.
Ogwumike, F.O., Ozughalu, U. (2012), Energy consumption, poverty and environmental linkages In Nigeria: A case of traditional and modern fuels for cooking. In: Adenikinju, A., Iwayemi, A., Iledare, W., editors. Green Energy and Energy Security: Options for Africa. Ibadan: Atlantis Books. pp.235-254.
Ogwumike, F.O., Ozughalu, U.M. (2016), Analysis of energy poverty and its implications for sustainable development in Nigeria. Environment and Development Economics, 21(3), 273-290.
Ogwumike, F.O., Ozughalu, U.M., Abiona, G.A. (2014), Household energy use and determinants : Evidence from Nigeria. International Journal of Energy Economics and Policy, 4(2), 248-262.
Oyedepo, S.O. (2012), Energy and sustainable development in Nigeria: The way forward. Energy, Sustainability and Society, 2(1), 1-17.
Oyekale, A.S. (2012), Assessment of households' access to electricity and modern cooking fuels in rural and Urban Nigeria: Insights from DHS data. Life Science Journal, 9(4), 1564-1570.
Rahut, D.B., Behera, B., Ali, A. (2016), Household energy choice and consumption intensity: Empirical Evidence from Bhutan. Renewable and Sustainable Energy Reviews, 53, 993-1009.
Rahut, D.B., Mottaleb, K.A., Ali, A. (2017), Household energy consumption and its determinants in Timor-Leste. Asian Development Review, 34(1), 167-197.
Sa'ad, S., Bugaje, I.M. (2016), Biomass consumption in Nigeria: Trends and policy issues. Journal of Agriculture and Sustainability, 9(2), 127-157.
Sesan, T. (2012), Navigating the limitations of energy poverty: Lessons from the promotion of improved cooking technologies in Kenya. Energy Policy, 47, 202-210.
Sher, F., Abbas, A., Awan, R.U. (2014), An investigation of multidimensional energy poverty in Pakistan: A province level analysis. International Journal of Energy Economics and Policy, 4(1), 65-75.
Teller-Elsberg, J., Sovacool, B., Smith, T., Laine, E. (2016), Fuel poverty, excess winter deaths, and energy costs in Vermont: Burdensome for whom? Energy Policy, 90, 81-91.
Varun, P.R., Bhat, I.K. (2009), Energy, economics and environmental impacts of renewable energy systems. Renewable and Sustainable Energy Reviews, 13(9), 2716-2721.
World Bank. (2018), Database World Development Indicators Access to Electricity (% of population). Available from: https://www.data.worldbank.org/indicator/EG.ELC.ACCS.ZS. [Last accessed on 2018 Jul 16].
World Bank. (2018), Database World Development Indicators Electric Power Consumption (kWh per capita). Available from: https://www.data.worldbank.org/indicator/EG.USE.ELEC.KH.PC. [Last accessed on 2018 Jul 16].