DETERMINANTS OF HOUSEHOLD CHOICE OF COOKING ENERGY IN NASARAWA STATE, NIGERIA

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Abstract

The objective of the study is to investigated the determinants of household choice of cooking energy in Nasarawa State. A multistage random sampling technique was used to select 400 respondents for the study area. Questionnaire was used as the main instrument for data collection. Data collected were analyzed using descriptive statistics and Multinomial Logit Model. The result showed that price of cooking energy, income of household, household's size, employment status and nature of dwelling unit were major determinants in the study area while the level of education and ownership of dwelling unit has insignificant impact on choice of cooking energy. The revealed preferences of the households for cooking energy material in the study area were fuel wood (60.82%), kerosene (30.61%) and Liquefied Petroleum Gas (8.56%). It is recommended that measures aimed at increasing household's income levels should be put in place by the government and the development of affordable, modern and cleaner cooking energy materials to reduce the negative effect of fuel wood use on the environment should be promoted.

Keywords: Cooking energy, households, firewood, electricity, charcoal, kerosene

JEL Codes:

I. INTRODUCTION

Households require energy for cooking and this need for cooking energy is sacrosanct giving the basic requirements of man for food. Therefore, households generally use a combination of energy sources for cooking categorized as traditional (dung, agricultural residues and fuel wood), intermediate (charcoal and kerosene) or modern (such as LPG, biogas, ethanol gel, plant oils, dimethyl ether (DME) and electricity). The terms traditional, intermediate and modern relate to how well-established a fuel is and do not imply a ranking. Evidence from Nasarawa State demonstrate that a considerable number of households still remain consistent on fuel wood energy consumption. The reasons for this heavy dependence on biomass energy for cooking has been

attributed to many factors, prominent among which is inadequate income to purchase modern and cleaner cooking energy materials. In developing countries like Nigeria, most of the rural as well as urban communities have less access to modern and clean energy sources and mostly depend on biomass fuels (woods, leaves, twigs, animal dung, charcoal and crop waste) for virtually all their energy needs (Bello, 2010). This view was supported by Sambo (2009), who argues that sourcing of fuel wood for domestic and commercial uses is a major cause of desertification in the arid-zone states and erosion in most part of Nigeria. The consumption of firewood is worsened by the widespread use of inefficient cooking methods that are hazardous to human health, especially to women and children who mostly do the cooking in homes. The use of firewood for cooking contributes to the causes of some major health problems in the developing countries due to indoor air pollution (Bruce, 2000). The consumption of fuel wood which is a rural practice seems to have now gained acceptance in urban areas in a manner to which its demand is leading to the harvest of both dry and wet wood. This study is therefore, motivated by the need to encourage households to make fuel substitution that will result in more efficient energy use and less adverse environmental, social, and health impacts, but this requires a research and analysis of the factors that affect or determine household choice of cooking energy in the study area. It is therefore, against this background that this study is out to investigate the determinants of household choice of cooking energy in Nasarawa State, Nigeria.

Statement of the Problem

In Nigeria in general, and Nasarawa state in particular, the problems relating to fuel wood as energy source has been an issue of concern for more than four decades or more. Efforts at encouraging households to make substitution that will result in more efficient energy use and less adverse environmental, social, and health impacts are advocated both in developed and developing countries. Many policies have been implemented by public authorities to decrease household wood-energy consumption in the state and to substitute it by alternative conventional fuels. But despite all the policies, the rate of consumption of wood-energy (and other biomass fuels) and its attendant negative environmental and health impacts are still alarming in Nigeria in general and Nasarawa State in particular. The choice of domestic cooking energy in Nigeria is an issue for addressing deforestation, and health hazards resulting from indoor air pollution, as result of fuel wood consumption calls for urgent attention especially developing economies like ours. The real effect of this problem is that the government understanding of fuel sector and the ability to predict and plan household fuel agenda is woefully inadequate and deserves urgent needs to curb the menace. As a matter of fact, energy consumption pattern and level in Nigeria have

produced a serious exploitative and disruptive environmental stress (Nnaji, Ukwueze & Chukwu, 2014).

It was estimated that approximately 45 million people in Nigeria rely on biomass fuels to meet their cooking needs and Nasarawa state is not in isolation. An increase in the proportion of households using wood fuel sources was reported in Nasarawa State in Nigeria between 2002 and 2006 against a background of supply challenges for biomass sources of energy in the town's vicinity due to deforestation (Fidelis, Uchechukwu & Gabriel, 2014). Compare this on a global perspective, availability of wood was reported to have increased between 2002 and 2022, its utilization rose by about 40 percent by 2020 (Aisha, Shakirat, Muyinatu, Adefunke & Kehinde, 2018). Despite all these problems, it has been reported by Okunade (2010) that fire wood is still the predominant fuel for cooking in cities, towns and villages in Nasarawa State.

Consequently, the households in Nasarawa state find it difficult to adopt modern sources of cooking fuels due to the problems of voltage fluctuation, power supply inconsistency, family size, income, home nature and attendant electric shock is another discouraging factor towards use of electricity (electric stoves) for cooking even in urban areas. Based on the problems stated above, this study is intended to provide answers to the following research questions;

i. What is the impact of income on household choice of cooking energy in Nasarawa State?
ii. What is the impact of price on household choice of cooking energy in Nasarawa State?
iii. What is the impact of level of education on household choice of cooking energy in Nasarawa State?
iv. What is the impact of level of employment on household choice of cooking energy in Nasarawa State?

II LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Household Choice of Cooking Energy

Households require energy for cooking and this need for cooking energy is germane giving the basic requirements of man for food. Energy requirements for cooking account for 90% of all household energy consumption in developing countries (Adeyemi & Adereleye, 2016). Chidiebere-Mark, Agunanne & Anyawu (2018) observed that households generally use a combination of energy sources for cooking and this can be categorized as traditional (dung, agricultural residues and fuel wood), intermediate (charcoal and kerosene) or modern (such as LPG, biogas, ethanol gel, plant oils, dimethyl ether (DME) and electricity). The terms traditional, intermediate and modern relate to how

well-established a fuel is and do not imply a ranking. This implies that the use of various energy sources for cooking by households demonstrates a ladder. Okunade (2010) demonstrated that a shift from one level to the other is influenced by socio-economic characteristics of the household, supply factors and government interventions that influence price of energy options.

Abott (2001) define energy as something that appears in many different forms which are related to each other by the fact that conversion can be made from one form of energy to another. According to Dave (2004), energy is a property or characteristic (or trait or aspect) of matter that makes things happen, or, in the case of stored or potential energy has 'the potential' to make things happen. Bruce (2000) defines energy as a measure of the ability of a body or system to do work or produce a change, expressed usually in joules or kilowatt hours. Energy source can be classified as renewable and nonrenewable forms. Renewable energy sources are those which cannot be exhausted. It includes geothermal, solar energy, water, wind energy, and crop residues while the non-renewable forms are mainly those which can be exhausted after some years. It includes petroleum products such as kerosene, petro, liquefied natural gas and coal.

Biomass fuels

Biomass energy refers to the energy of biological system such as wood and waste. The biomass resources of Nigeria can be identified as wood, forage grass and shrubs, residues and waste (forestry, agricultural and industrial) as well as aquatic biomass (Gumau, 2007). According to the World Bank (2003), many urban households use biomass fuels for cooking in Nigeria. Biomass fuel is largely free and relatively available to most communities. In the context of energy production, it is a matter from recently living (but now dead) organisms which is used for bioenergy production. Examples include wood, wood residues, energy crops, agricultural residues including straw and organic waste for industry and households (Darby, 2014).

Kerosene

Kerosene is one of the main fractional distillates of petroleum. It is a mixture of hydrocarbon that contains 12-18 carbon atoms per molecule and it boils between 190-250oC. It is a fairly volatile liquid widely used by many household as the main source of energy for cooking, lighting lamps, burning bush, fuel for automobiles (Darby, 2014).

It is also used as insects repellant because of its odour. This means that kerosene is a combustible hydrocarbon liquid which is derived from petroleum. It is widely used as fuel in aviation as well as households.

Liquid petroleum gas

It is a well- established fact that Nigeria petroleum resources kept in cold are richer in gas than in crude oil (Darby, 2014). Despite its convenience, there is a great feeling of insecurity in relation to safety issues and the cylinder being stolen act as a barrier to the use of gas fuel. A fear about explosion is a concern raised by many people in relation to hazard and indoor air pollution effects.

Electricity

Electricity is a secondary fuel dependent on the transformation of other sources of energy and required a high-tech environment. The infrastructure involved in the generation and distribution of electricity is enormous and costly. Electricity is used for a number of purposes that include industrial, commercial and household purposes (Babatunde & Shuaibu, 2010).

Determinants of Household Choice of Cooking Energy

The determinants of household choice of cooking energy are fast out spacing its availability and the demand and supply is seriously constrained by the rising population (Fidelis, Uchechukwu & Gabriel, 2014).

According to the study conducted by Adeyemi & Adereleye (2016), the level of income, employment status of the head of the family, owning of the house in which the family resides, monthly expenditures and educational status of the household head are major determinants for the choice of cooking energy. It is necessary to that the proxy for cooking energy used for the study is income level of the household. From the study of Francis, Geofrey & Gemma (2014) which seeks to examine the determinants of household choice of cooking energy source, it is also observed that several factors are responsible for the choice of cooking energy by household. These factors include; location of household head, i.e either urban or rural area, level of education of household head, income level of household head, household size, and distance between household and cooking energy source. In their study, the energy sources categorized a biomass, charcoal, animal dung and firewood. From the various studied reviewed, there are several factors that have been responsible for household choice of cooking energy as follows;

i. Location of household i.e either in urban or rural
ii. Level of educational of household head
iii. Income level of household head
iv. Household size

v. Distance between household and cooking energy source
vi. National governments commitment to infrastructural development
vii. Employment status of the head of the family
viii. Owing of the house in which the family reside
ix. Monthly expenditures
x. Gender
xi. Kitchen type
xii. Number of cars
xiii. Source of energy
xiv. Type of food commonly cooked

EMPIRICAL REVIEW

Several studies related to household choice of cooking energy were reviewed for the purpose of establishing clearer understanding of the issue at hand. Adeyemi & Adereleye (2016) examined the factors determining the choice of cooking energy in Ondo state, Nigeria. Random sampling technique was used to sample 409 households in the study area. The data used for the study were obtained with the use of well-structured questionnaires. Descriptive statistics and multinomial logit were employed for the analysis. Descriptive analyses show that the energy sources available for the use in the study area are kerosene (45%), firewood (43%) and cooking gas (12%). The analysis shows further that 63.7% of the rural populace and 22.9% of people in urban areas utilize fuel wood for cooking in the study area. The results of the multinomial logit show the household income, level of education, household size, occupation of the respondent, nature of the dwelling house and ownership of the dwelling house are the significant factors influencing fuel choice. The study concludes and recommended that in order to encourage households to make fuel substitution that will result in more efficient energy use and less adverse environmental, social, and health impacts, a promotion of higher level of education and a promotion of general economic development could be effective instruments. Njong & Johannes (2011) examined the determinants of Domestic Cooking Energy Choices in Cameroon. The study attempted to cast light on the distribution of households by cooking energy types and by region or zone of residence and investigate the main determinants of cooking energy choices in Cameroon. The study employs a multinomial logit model to test the statistical significance of the social and demographic factors that determine household cooking fuel choice in the country. Variables captured are: household size, occupation status, nature of the dwelling houses (proxy by wall materials), education, ownership of the dwelling house, and the distance of household from urban Centre. Empirical results indicate that the level of education, distance of the household from urban centres, whether

or not the household owns the dwelling unit and whether or not the dwelling unit is traditional or modern type are important factors that determine household cooking energy choice. The study also reveals that fuel wood is the principal cooking fuel for the majority of households in Cameroon. Mekonnes & Kohlin (2008) is another empirical work titled "Determinants of Household Energy Choice in major Cities in Ethiopia". The determinants of household choice of energy consumption were investigated using multinomial logit model. Variables captured are: household total expenditure on energy, family size, level of education, age of household head and household location. The results suggest that as households' total expenditures rise, they increase the number of fuels used, even in urban areas and they also spend more on the fuels they consume. This study shows the relevance of fuels stacking (multiple fuel use) in urban areas in sub-Saharan Africa. While income is an important variable, the results of this study find other variables such as family size, household location and level of education as important determinants of household fuel choice in Ethiopia. Adamu, Adamu, Ade & Akeh (2020) investigated various cooking energy sources for household consumption and the implications of their dependence on traditional energy sources as well as the energy ladder model as a concept widely used by scholars in describing the role of income in determining energy use and choices. It further explains the consumption behavior of households in relation to the major assumptions of the model. The study observed that the dependence on energy sources at the lowest rung of the energy ladder by most households in Nigeria is accentuated by rising poverty level consistent with the energy ladder hypothesis but disagrees with the notion of complete fuel substitution given that most households tend to have a mix of energy sources for their activities It recommends that government and other stakeholders should formulate policies that will foster the use of modern energy sources with a view to mitigating the environmental and health externalities of traditional energy use as well as improving the quality of human lives.

THEORETICAL FRAMEWORK

For the purpose of this study, among all the theories reviewed, the study adopts the energy ladder theory which was developed by Harold K. Schneider in 1993.

Energy Ladder Theory

The concept of the energy ladder was first proposed by Harold K. Schneider in 1993. He described the idea in a paper titled "Energy Resources and Energy Consumption in the Developing World" published in the journal World Development. The energy ladder theory refers to a concept in development economics that explains the transition of households' primary sources of energy as they move up the socioeconomic ladder. The theory suggests that households in

developing countries typically rely on traditional and inefficient energy sources, such as biomass (wood, crop residues), animal waste, or traditional stoves. As households' income and living standards improve, they are likely to switch to more modern and cleaner energy sources, such as liquefied petroleum gas (LPG), kerosene, or electricity. This transition is driven by factors like urbanization, rising incomes, infrastructure development, and policy interventions. The energy ladder theory argues that as households move up the socioeconomic ladder, they also shift from using energy sources associated with indoor air pollution and other health risks to cleaner and safer alternatives. This transition can have positive impacts on the environment, health, and overall well-being (Barnes, 2011).

However, it is important to note that the energy ladder theory has received some criticism. Critics argue that it oversimplifies the complex dynamics of energy transitions and fails to account for cultural, social, and political factors that influence energy choices. Additionally, the theory does not necessarily guarantee that households will move to the cleanest energy sources available, as there may be various barriers, such as affordability and availability, which prevent them from doing so. The model has, however, been criticized for focusing only on income to the detriment of social and cultural factors on fuel choice, and the consumer rationality assumption of linear path movement from one fuel source to another. It has however yielded significance input to economic literature.

III. METHODOLOGY

The study employed both qualitative and quantitative methodology in sourcing, collecting and analyzing the data collected for this study. Therefore, the study employed the use of questionnaire as the instrument of data collection and Taro Yamane sampling technique to determine the sample size from the population. The estimation of the Logit model was carried out by utilizing the maximum likelihood (ML) estimation technique through Statistical Package for Social Sciences (SPSS) software to run the regression. The justification for the use of ML method is that it gives parameter estimates that are asymptotically efficient, consistent and normal and the analogue of the regression Z-test can be applied. Moreover, the Logit model is a binary nonlinear model which is suitable for estimates using ML estimation technique.

MODEL SPECIFICATION

The model for this study is adapted from the work of Nauges & Whittington (2010) which utilizes the Multinomial Logit regression model which belongs to the families of qualitative (binary choice) response model where the dependent variable takes on dummy values of 0 and 1 with 0 indicating absence of an attribute or a factor while 1 implies presence of such an attribute/factor. The explanatory variables in the Logit model could be exclusively qualitative or quantitative, or

mixture of both (Gujarati & Porter). Therefore, the Multinomial Probit model for this study is specified as follows;

$y^*_{ij}=\ln P_i/(P_i)=\beta_0+\beta_1 PCE_i+\beta_2 IHH_i+\beta_3 EHH_i+\beta_4 EMHH_i+\beta_5 ODH_i+\beta_6 NDH_i+\beta_7 HOS_i+\varepsilon_{ij}$.(1)

Where; y = the natural log of the odds ratio or probit

PCE= Price of the cooking energy

IHH = Income of the Household

EHH = Education of the Household

EMHH = Employment status of the household

ODH = Ownership of dwelling house/unit

NDH= Nature of the dwelling house/unit

HOS= Household size

β_0, β_1, β_2, β_3, β_4, β_5, β_6 and β_7 are the parameters of the model to be estimated; and ε_j is the error term. *A priori,* $\beta_1 < 0$, β_2 β_3, β_4, β_5, β_6, $\beta_7 > 0$ are expected to sign positive to household choice of cooking energy. That is to say, according to economic theory there should be inverse relationship between price of the demand for it, while we expect positive relationship between income, education, employment, ownership and nature of the dwelling unit and household size with the demand of cooking energy.

IV REGRESSION RESULTS

This section deals with the analysis of the logistic regression model results obtained using Statistical Package for Social Sciences (SPSS 20) to run the results. Below is the summary of the results.

Determinants of Household choice of cooking energy	Coefficients	P-value	Odd Ratio
PCE	0.331	0.000	2.007

IHH	0.011	0.211	1.200
EHH	-0.101	0.003	2.110
EMHH	1.020	0.000	1.044
ODH	-0.012	0.210	0.302
NDH	0.021	0.008	1.423
HOS	0.022	0.001	0.623
Constant	-1.101	0.000	0.012
Cox & Snell R Square		0.114	
Nagelkerke R Square		0.134	

Source; Computed by Author using SPSS, 20

Table 2; Results of the Logistic Regression Model

From table 2 above, the odd ratio of 2.0 for price shows that the price of a household heads is more than 2 times more likely to determine the choice of cooking energy in Nasarawa state. In other words, as household price increases by 1, the probability of the household choosing cooking energy increases by 2.007 times. For this, the probability of a household with high price choosing cooking energy is 72.90%. The finding of this study corroborate with that of Bello (2010) that price is major determinant of household switching to other sources of energy.

Similarly, with an odd ratio of 1.200 for income of household, it implies that the income of a household is less likely to determine a household's choice of cooking energy in Nasarawa state. In other words, a one-unit increase in income of household makes slightly more than a proportionate increase in the likelihood of household choosing cooking energy. From this finding, the probability of a household with high income choosing cooking energy is 52.00%. This means that there is a significant demand for cooking energy in Nasarawa state. The finding of this study corroborate with that of Arowosoge & Faleyimu (2011) that income is major determinant of household switching to other sources of energy.

Education has odd ratio of 2.110 demonstrating that the level of education of the household is more than 2 times more likely to determine the choice of cooking energy in the study area during the period under investigation. When the probability is taken, the chance of a household having post-secondary education in choosing cooking energy is given as 65.72%. This implies that there is a significant demand of cooking energy in Nasarawa state. The finding of this study corroborate

with that of Njong & Johannes (2011) that education is not a major determinant of household choice of cooking energy.

The odd ratio for employment is 1.044 indicating that the employment of a household head is slightly more than 1 times more likely to determine the choice of cooking energy. In other words, if this variable "employment" increases by one, the probability of a household choosing a cooking energy over other sources of energy increases by 1.044. The probability of household with employment choosing cooking energy is 50.55%. This implies that there is significant consumption of cooking energy in Nasarawa state.

Ownership of dwelling unit has an odd ratio of -0.012. This means that household heads who own their residence units more than 0.012 times more likely to choose cooking energy over other sources of energy. In other words, as ownership of dwelling unit increases by 1, the probability of the household choosing portable drinking water increases by 0.012 times. For this result, the probability of a household head who owns their dwelling unit choosing cooking energy is 72.47%. This implies that there is significant demand for cooking energy in Nasarawa state. The finding of this study corroborate with that of Njong & Johannes (2011) that ownership of dwelling unit is not a major determinant of household choice of cooking energy.

The odd ratio for nature of dwelling unit is given as 0.021 which implies that as the nature of dwelling unit of a household head increases by 1, the probability of the household head choosing cooking energy increases by 0.021 times. In other words, nature of dwelling unit is 0.021 times more likely to determine a household's choice of cooking energy in Nasarawa state. From the result above, the probability of a household head with or who owns dwelling unit and choosing cooking energy is obtained as 45.78%. This demonstrates that no significant demand for cooking energy in Nasarawa state.

Similarly, with an odd ratio of 0.022 for household size, it implies that the size of a household is less likely to determine a household's choice of cooking energy in Nasarawa state. In other words, a one-unit increase in the number of people per household makes slightly more than a proportionate increase in the likelihood of household choosing cooking energy. From this finding, the probability of a household with high household size choosing cooking energy is 52.00%. This means that there is a significant demand for cooking energy in Nasarawa state. The finding of this study corroborate with that of Adetunji & Adeiyan (2007) that household size is major determinant of household switching to other sources of energy.

V. CONCLUSION AND RECOMMENDATIONS

CONCLUSION

The finding of this study revealed that price of household head, income of a household head, nature of dwelling unit, household size and employment are major determinants of demand for cooking energy while the level of education and ownership of dwelling unit are less likely to determine choice for cooking energy with level of education and ownership of the dwelling unit of household head being the least significant. In other words, household head with high income tends to choose cooking energy over than household head with lesser income. The study concluded that income of a household head; price, nature of dwelling unit and household size has significant impact on the choice of cooking energy. The study further concluded that price and income are a major determinant of household choice of cooking energy. To this end, the study revealed that measures aimed at increasing household's income levels should be put in place by the government and the development of affordable, modern and cleaner energy materials should be promoted to reduce the negative effect of fuel wood use in the study area.

RECOMMENDATIONS

Based on the analysis and the findings of this study, the following recommendations are made;

The government and relevant policymakers ought to seriously consider the effects of rising cooking energy. Price on household's cooking energy choice and demand in the study area in particular and Nigeria in general. Hence, there is urgent need for the government to brace up and initiate policies such as subsidization to ameliorate the effect of rising cooking prices on household's pulse. Many household's use various cooking energy and a higher proportion use fuel wood, in spite of the consequences of health and environment.

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