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DETERMINANTS OF COOKING ENERGY CONSUMPTION AMONG FARMING HOUSEHOLDS IN OWERRI AGRICULTURAL ZONE, IMO STATE, NIGERIA

Chidiebere-Mark N.M[1], Agunanne U.T[2] and Anyanwu U.G[3]

[1]Department of Agricultural Economics, Extension and Rural Development, Imo State University, Owerri, Imo State, Nigeria.
[2]Department of Agricultural Extension and Management, Imo State Polytechnic, Umuagwo, Imo State, Nigeria.
[3]Department of Agricultural Economics, Federal University of Technology, Owerri, Imo State, Nigeria.

ABSTRACT: *The 7th goal of UN Sustainable Development Goals targets ensuring access to affordable, reliable, sustainable and modern energy for all. The study investigated the determinants of cooking energy consumption among farming households in Owerri Agricultural Zone, Imo State. A multistage random sampling technique was used to select seventy-two respondents for the study. Questionnaire was the main instrument for data collection. Data collected were analyzed using descriptive statistics and ordered probit analysis. The result showed that the average age of the farmers, household size, and years of farming experience were 49.4years, 8 persons, and 20 years respectively. Majorities (73.62% and 97.23%) of the respondents were females and married. The revealed preferences of the households for cooking energy material in the study area were fuel wood (70.83%), kerosene (23.61%) and Liquefied Petroleum Gas (5.56%). Empirical results from the marginal effects after the ordered probit analysis indicates that sex and household's income are the major determinants of cooking energy choice. 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, Farming Households, Consumption, Fuel wood, Preference.

INTRODUCTION

Households require energy for cooking and this need for cooking energy is invaluable giving the basic requirements of man for food. Energy requirements for cooking account for 90% of all household energy consumption in developing countries (GTZ, not dated). Households generally use a combination of energy sources for cooking, and IEA (2006) categorized it 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.

In developing countries, especially in rural areas, 2.5 billion people rely on biomass, such as fuel wood, charcoal, agricultural waste and animal dung to meet their energy requirements for cooking (IEA, 2006). Household use of biomass in developing countries alone accounts for almost 7% of world primary energy demand (IEA, 2006). An estimated 72% of Nigerians depend solely on wood as a source of fuel for cooking (NBS-CNB-NCC, 2011). The use of traditional energy sources for cooking like fuel wood is prevalent in the rural areas and is the

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only affordable energy source for some households. Though, these households who are dependent on fuel wood for cooking still make use of kerosene (an intermediate source) to light the fuel wood in the study area.

Evidence from Nigeria indicates that a considerable number of households still remain consistent on fuel wood energy consumption (Nnaji *et.al*., 2012; Onyeneke *et. al*., 2015). In the absence of new policies, the number of people relying on traditional biomass (such as fuel wood, charcoal, etc) to meet their energy needs for cooking globally, will increase from 2.5 billion today to 2.7 billion by 2030 (IEA, 2007). 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. Use of fuel wood raises concerns because it is harvested unsustainably, combustion technologies are inefficient and there are serious adverse consequences for health, the environment and economic development (IEA, 2006). Time and effort allocated to fuel collection by mostly children and women in these farming households could be used for other activities like education or income generation. Environmental damages such as land degradation, deforestation and air pollution may arise from the unsustainable cutting of trees for fuel wood as well as emissions from the biomass cooking source. Inefficient energy use is a dominant contributor to climate change, accounting for around 60 per cent of total global greenhouse gas emissions.

Various theories have been propounded on cooking energy use. The energy "ladder" model presupposes that households switch from traditional energy sources to modern energy sources (up the ladder) at the speed and extent allowed by factors such as rising socioeconomic status (Dickinson, 2015). The opportunity cost of women's time particularly for those women who work outside the household has also being shown to have a major impact in fuel switching (Masera *et. al.,* 2000). The energy ladder theory assumes that all forms of cooking devices (traditional and improved) are available, that there is a universal set of stove preferences, and that households will choose to move up the ladder as soon as they can afford to do so. However, the energy ladder theory assumes a linear progression which implies moving up the ladder and a corresponding abandonment of the lower level cooking energy sources. This model assumes implicitly that households use a single energy source for cooking at any given time (Dickinson, *et. al.,* 2015). The use of traditional sources of energy or fuel wood illustrates energy poverty among households and is associated with the lowest scale of the ladder. This traditional energy source is associated with higher levels of indoor pollution, wasted time especially by women and children for collecting firewood, unreliability of supply and local environmental degradation.

An analysis of the pattern and determinants of household cooking energy consumption has been the focus of previous studies. These studies have shown that rather than moving linearly up the ladder, households often use multiple cooking energy materials (energy stacking) to meet their cooking needs at a particular time (Masera *et.al.,* 2000; Elias and Victor, 2005; Dickson, *et. al.,* 2015). This energy 'stacking' allows households greater flexibility and they can use different types of stoves for different purposes or alternate among different fuels (moving up and down the ladder) depending on availability and cost (Dickson, *et. al.,* 2015).

Farming households in this study are regarded as families whose major occupations are farming. In Nigeria, farmers make up to 60% of its population and they reside in the rural areas. These farmers are comprised of both subsistence and small scale farmers. Their contribution to agricultural production though little with regards to individual efforts are

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significant as a group. The time and energy spent on cooking with inefficient fuel sources reduces the time and energy that could be spent on other productive activities. More so, women and children also suffer most from indoor air pollution because they are traditionally responsible for cooking and other household chores, which involve spending hours by the cooking fire exposed to smoke (Ishaya, 2009). Goal 7 of the UN Sustainable Development Goals targets ensuring access to affordable, reliable, sustainable and modern energy for all. Against this backdrop, this study seeks to ascertain the determinants of farming households' preference for various cooking energy materials; estimate the quantity of various cooking energy used by the farming households, as well as determine the socio-economic factors influencing their use of various cooking energy sources. For this study, the household cooking energy sources considered were; fuel wood (firewood and charcoal), kerosene and Liquefied Petroleum Gas (LPG).

MATERIALS AND METHOD

The study was carried out in Owerri Agricultural Zone of Imo State located within the rainforest zone of Nigeria. Owerri Agricultural Zone is among the three Agricultural Zones in Imo State, namely Okigwe, Orlu and Owerri Agricultural Zone. Owerri zone is made up of eleven Local government areas. The total population of Owerri Agricultural zone is 1,663, 361 (NPC, 2006) with an area of about 1700sqkm. The area has two main seasons, namely, dry and rainy seasons. The annual rainfall is between 1,900mm – 2,200mm while the mean annual temperature is 20^{o}C. It has an annual relative humidity of about 75%. The zone is rich in fertile land which is suitable for the growth of crop products.

Owerri Agricultural zone was purposively chosen for the study because of the existence of various cooking energy materials and farming households in the area. A multistage random sampling technique was adopted for the study. First, three Local Government Areas (L.G.A.'S) were randomly selected from the eleven L.G.A.'s that make up the agricultural zone. From each of this selected L.G.A., two communities were selected, and two villages were also selected from each community randomly to give 12 villages. Samples of six farming households were randomly selected from each of the villages to give a total sample size of seventy-two (72) respondents. Primary data was used for the study and was collected by the use of structured questionnaire.

The data collected were analyzed using descriptive statistics such as frequency, percentages and pie chart, as well as the ordered probit model. In statistics, ordered probit is a model that is used to predict the probabilities of the different possible outcomes of a categorically distributed independent variables, given a set of independent variables (which may be real-valued, binary- valued, categorical- valued, etc). The ordered probit model was stated as follows:

$$\text{Prob}\,[yi = j] = \frac{\exp(\beta i\, Xi)}{1 + \exp(\beta i\, Xi)} \quad \text{..... eqn i}$$

Where:

βi = parameter estimates.
Xi = vector of independent variables.

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j = 0, 1, 2 = cooking energy material
Where,
0 = fuel wood (i.e. firewood and charcoal)
1 = kerosene
2 = liquefied petroleum gas.
Xi = X_1……X_6
X_1 = Age (years)
X_2 = Marital status (1-married, 0=single)
X_3 = Educational level (years)
X_4 = Household size (No. of persons)
X_5 = Sex (1=female, 0=male)
X_6 = Income (Naira)
Reference category was fuel wood which is the traditional cooking energy source.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Farmers

The socioeconomic characteristics of the respondents are shown on table 1. The table reveals that 37.50% of the farmers were within the age bracket of 41-50 years, with an average age of 49.4 years. This means that these farmers were still in their active years. The result shows that majorities (73.62%) of the farmers were females and 26.38% of the farmers are males. This is expected because decisions in the household on what to cook, energy source to use for cooking and actual cooking is the exclusive prerogative of females in the study area.

The result of the marital status of the farmers in the study area reveals that majority (97.23%) of the farmers were married while the remaining 2.78% of the farmers were single. This shows that the vast majority of the households are complex, with parents and children. About 52.78% of the farmers have household size of 6-10 persons and 12.50% of the farmers have 11-15 persons in their households. The mean household size was 8 persons. A large number of persons living in a household imply that more energy will be spent on cooking. It is also imperative for these farming households to use more efficient and affordable energy sources to save time and money.

The result on level of education indicates that 98% of the farmers received formal education. About 45.83% of the farmer's attained secondary education while 43.05% had primary education. Following this result, it could be said that farmers in the study area are literate and are presumed to be aware of the different energy sources and the implications of use, with regards to efficiency, effect on environment and health. About 59.72% of the farmers had farming experience of over 20 years. This result shows that many of these farmers have been farming from childhood, contributing to family labour in their parent's farms. The result on monthly income show that 50% of the farmers earn up to ₦20, 000 as their monthly income. It is expected that these farm families spend some part of their income to purchase various sources of cooking energy.

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Table 1: Frequency Distribution of the Farmers by Socio-Economic Characteristics

Socio-economic characteristic	Frequency	Percentage
Age		
31-40	10	13.89
41-50	27	37.50
51-60	22	30.56
61-70	13	18.05
Gender		
Male	19	26.38
Female	53	73.62
Marital Status		
Married	70	97.23
Single	2	2.78
Household Size		
1 – 5	25	34.73
6 – 10	38	52.78
11 – 15	9	12.50
Education		
No Formal Education	1	2.28
Primary Education	31	43.05
Secondary Education	33	45.83
Tertiary Education	7	9.72
Farming Experience		
1 - 10	5	6.95
10-20	24	33.34
21 – 60	43	59.72
Monthly Income		
Less than ₦10, 000	25	34.72
₦10, 000 – ₦20, 000	11	15.37
₦21, 000 – ₦60, 000	36	50.00

Source: Field survey, 2015.

Preference of Farming Households for Cooking Energy Materials

Figure 1 indicates the preference for various cooking energy materials by the farming households in the study area. It shows that the dominating cooking energy source used by the households in the study area is fuel wood (70.83%) and 23.61% use kerosene, while Liquefied Petroleum Gas is used by 5.56% of the households. The preference of these farming households may be relative. This is because, the dominant use of fuel wood 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. More so, from the responses elicited, though the farming households indicated the cooking energy source that gave them the most utility, they still use a combination of cooking energy sources depending on availability and the size of cooking to be done.

The predominant use of fuel wood as a cooking energy material poses health risk especially for the women who are responsible for cooking in the households. Furthermore, valuable time and effort devoted to fuel collection could have been spent instead on education or

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income generation. Environmental damage can also result, such as land degradation, deforestation as well as air pollution from the CO2 emitted from burning the fuel wood.

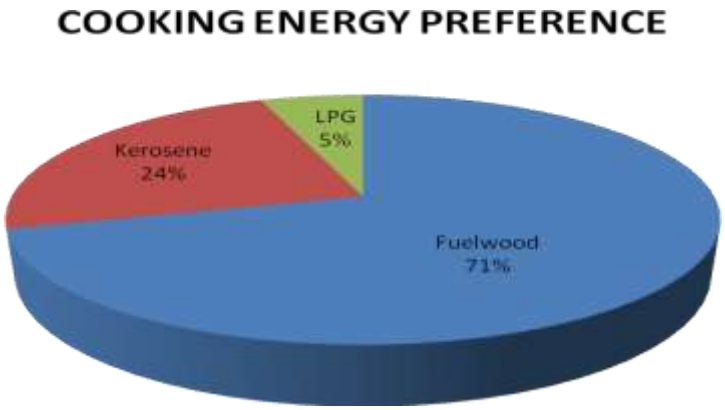

Figure 1: Distribution of Farming Households' by Preference for Various Cooking Energy Source

Quantity of various cooking energy materials used by the households.

From table 2, the farming households consume an average of 21.2 bundles of fuel wood, 18 litres of kerosene and 6.25kg of Liquefied Petroleum Gas respectively monthly. It is observed that these farm families consume more fuel wood than the other modern sources of cooking energy. The reason may be the lower price of this cooking source compared to the other sources. More so, some of this farm families get fuel wood (e.g. firewood) from their farms and do not have to pay any amount of money for it. It goes to show that fuel wood sources are more readily available and cheaper. However, the felling of trees for fuel wood has dire implications on the environment. It causes erosion, deforestation and loss of soil cover. The consequences far outweigh the benefits, and hence the need to sensitize these farm families on the need to use cleaner and more environmental friendly sources.

Table 2: Average consumption of various cooking energy materials

Average Consumption	Fuel Wood (Bundles)	Kerosene (Litres)	Liquefied Petroleum Gas (Kg)
Weekly	5.3	4.5	1.56
Monthly	21.2	18	6.26

Source: Field survey, 2015.

Socio-Economic Factors Influencing the Use of Various Cooking Energy Sources

In order to determine the factors affecting the choice of different energy sources, an ordered probit model analysis was carried out and presented in table 3. The marginal effect after the ordered probit analysis result show that the likelihood ratio chi-square is 25.10 and it is statistically significant ($P<0.01$). This indicates that the model has a good fit to the data.

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The table shows that having a woman as a household head increases the usage likelihood of kerosene by 27.47% and increases the usage likelihood of liquefied petroleum gas by 13.67%. Females are 27.47% and 13.67% points more likely to use kerosene and liquefied petroleum gas respectively. These are significant at 1% level. This result is in line with the fact that women are the main expected users of these sources of cooking energy, because in most cases they take the decision on which energy source to use as well as do the cooking. The positive sign of the variable 'gender' suggests that the conditional probability of use of kerosene and liquefied petroleum gas declines if the household head is male.

Income had a positive and significant effect on the use of kerosene and liquefied petroleum gas by farming households. Each naira of income increases the chance of using kerosene by 0.000478 percent. This effect is significant at the 5% level. An income increase of ₦1.00 increases the usage likelihood of liquefied petroleum gas by 0.000302 percent. This effect is significant at the 1% level interval. This result suggests that richer households are more likely to bear the cost of using kerosene and liquefied petroleum gas.

Table 3: Marginal Effect of Ordered Probit Model Analysis for Determinants of Choice of Cooking Energy Sources.

	Kerosene				**Liquefied Petroleum Gas**			
Variable	dy/dx	Std Err.	Z	P>/z/	dy/dx	Std Err.	Z	P>/z/
Age	-.004084	.00539	-0.76	0.448	-.0025811	.00336	-0.770	0.443
Marital Status	-.097476	.07509	-1.30	0.194	-.2206947	.27057	-0.82	0.415
Educational level	.0170526	.01235	1.38	0.167	.0107772	.00757	1.42	0.154
House hold size	.0022995	.01586	0.14	0.885	.0014533	.01001	0.15	0.885
Sex	.2747027	.10501	2.62***	0.009	.136619	.05284	2.59***	0.010
Income	4.78e-06	.00000	2.31**	0.021	3.02e-06	.00000	2.57***	0.010
Number of observation = 72 Logistic regression chi (6) = 25.10^{xxx} Pseudo R^2 = 0.1703								

Source: Field survey, 2015

xxx = significant at 1 per cent
xx = significant at 5 per cent

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CONCLUSION

Many households use various cooking energy sources and a higher proportion use fuel wood, in spite of the consequences on health, environment and development. Government have a decidedly important role to play in increasing access to cleaner, more efficient fuels and technologies.

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