P-ISSN: 2618-0723
E-ISSN: 2618-0731

Extension Journal

www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 5; Issue 2; Jul-Dec 2022; Page No. 49-54

Received: 12-07-2022
Accepted: 15-08-2022

Indexed Journal
Peer Reviewed Journal

Determinant of household biomass energy preference in Oyo state, Nigeria

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DOI: https://doi.org/10.33545/26180723.2022.v5.i2a.155

Abstract

The global energy supply has been increasing over the years, in an effort to meet the global demand many of the world's poor population are being left behind. It has been estimated that approximately 1.4 billion people (20%) of the global population lack access to electricity and 2.7 billion (40%) of the global population, rely on the traditional use of biomass for cooking. This study reveals that firewood is the main type of cooking energy used or demanded for by the respondents. Among the various reasons accounted for such preferences of firewood to charcoal and kerosene are availability, ability of firewood to burn well and fast, perception on efficiency. Energy price (a significant variable in QUAIDS) indicated negative impact on demand for biomass fuel as well educational level of head of household while age, size of the households positively determines demand for biomass fuel.

Keywords: Household, biomass, energy, energy preference

1. Introduction

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 (Akpan *et al*., 2007) [1]. Biomass fuels play a key role in household cooking fuels. According to World Bank (2003) [8], many rural households use biomass fuels for cooking in Nigeria. Biomass fuel is largely free and relatively available to most communities.

The pattern of energy consumption in Nigeria can be divided into industrial, transport commercial, agricultural, and household sectors. The major energy consuming activities in Nigeria's households are cooking, lighting, and use of electrical appliances with cooking accounting for 70% of household energy consumption, lighting uses up to 3%, hot water boiling takes about 25% and the remaining 2% can be attributed to the use of basic electrical appliances such as television and pressing iron (ECN, 2012)

In Nigeria, the rural and urban populace depends on traditional and modern fuel for household needs which includes cooking such as wood, animal, charcoal, kerosene, cooking gas, electricity etc. Over 68% of her population depends on fuel wood for cooking and other domestic uses especially in the rural areas. Nigeria consumes over 50million metric tons of fuel wood for domestic and commercial uses is a major cause of desertification in the arid-zone states and erosion in the southern part of the country (Sambo, 2009) [6].

Energy is one of the essential inputs for improved well-being of individuals and socioeconomic development of nations. In spite of the importance of energy, most households in Oyo State are still faced with the over-consumption of low grade traditional energy sources (National Bureau of Statistics, 2009) [3]. Large amounts of human energy are spent gathering fuel wood in many parts of the state, and the burden tends to fall more heavily on women and children. In many communities today, it is not uncommon to see women and children trek several kilometres in search of fuel wood in rural areas of Oyo State.

Cooking energy represents the bulk of energy demand in Nigeria, which is dominated by different sources of cooking although there is the use of unclean energy sources in form of fuel wood which raises several environmental concerns because of its inefficiency and contributions to indoor air pollution.

Hence the importance of this study identify types of energy used by the households for cooking, energy appliances used by the households, reasons for main energy preferences by the Households and examine the factors influencing the preferences of the households' Energy Preference.

2. Materials and Methods

The study employed a primary data collection method whereby a questionnaire was designed and distribution in Oluyole and Ibadan South West LGAs. The major predominant activity (occupation of the respondents), random sampling technique was employed to select the study participants. The collected primary data for this study were gathered through the three hundred and four (304) respondents from whom the administered questions were retrieved. Various analytical approaches were used including descriptive method for profiling demographic and socio-economic characteristics of the respondents in this study. Logit model based on QUAIDS framework was used to determine the factors that influence the choice of a given energy for cooking by households.

3. Results and Discussion

The demographic and socio-economic characteristics of the surveyed households for this study are presented in this section these are location, gender, age range, marital status, occupation, household size, educational status, and their monthly income ranges among others.

Table 1: Sex Distribution of the Households

SEX		Frequency	Percent
Valid	Male	72	23.7
	Female	232	76.3
	Total	304	100.0

Source: Author's computation from field survey, 2017

Evidence from Table 1 is that the number of female respondents (households) that were randomly selected for the study was 232 (76.3%) while male households were only 72 (23.7%). One of the possible explanations for this wide variance in gender of the sampled household could be attributed to the fact that female, by gender roles in Nigerian society like most African society are more responsible and deeply involve in various household chores including fetching of biomass for domestic energy used. This could be account for high rate of energy poverty and low gender productivity of most households in Nigerian rural areas.

Table 2: Age Distribution of Respondents

Age Bracket		Frequency	Percent
Valid	20-30 Years	45	14.8
	31-40 Years	111	36.5
	41-60 Years	91	29.9
	60 Years and Above	51	16.8
	Total	298	98.0
Missing	System	6	2.0
Total		304	100.0

***Source*:** Author's computation from field survey, 2017

Table 2 shows the rural households within age distribution of 31-40 years dominated the sampled respondents. This is shown in the table as 111 (36.5%). This is followed by 91 households (29.9%) that are within age range of 41-60 years. 14.8% of the households are between the ages of 20-30 years

Table 3: Marital Status distribution of Households

Marital Status		Frequency	Percent
Valid	Single	21	6.9
	Married	197	64.8
	Divorced/Separated	8	2.6
	Widowed	78	25.7
	Total	304	100.0

Source: Author's computation from field survey, 2017

The survey result in table 3 shows the numbers of married households are more than respondents from other categories. 64.8% of the respondents are married, the widows are (25.7%), single respondents amounted to 21 (6.9%), while 2.6% are either divorced or separated from their husband.

Table 4: Occupational Distribution of the Households

Occupation		Frequency	Percent
Valid	Employed	14	4.6
	Self-Employed	46	15.1
	Unemployed	39	12.8
	Trading	75	24.7
	ARTISAN	51	16.8
	FARMING	79	26.0
	Total	304	100.0

***Source*:** Author's computation from field survey, 2017

Table 4 shows the distribution of the households based on occupation, it revealed that 26% of the respondents which represents 79 households were farmers. 75 respondents (24.7%) were into trading. (16.8%) of the respondents were artisans, while the unemployed respondents totaled 39 (12.8%). It is glaring from this distribution that employed respondents among these rural households are few, they amounted to 14 (4.6%) and so occupational distribution of the households in the selected study areas is biased or skewed toward self-directed businesses and all forms of activities that could aid survival in the rural areas. This occupational profile of the selected households would likely contribute to the choice of the type of energy used.

Table 5: Distribution of the Respondents by Household Size

Household Size (Number of Male dependent)		Frequency	Percent
Valid	1	46	15.1
	2	81	26.6
	3	43	14.1
	4	29	9.5
	5	12	3.9
	8	5	1.6
	Total	216	71.1
Missing	System	88	28.9
Total		304	100.0

***Source*:** Author's computation from field survey, 2017

It is a reality that dependency ratio is a demographic factor that can determine the level of household welfare. The table 5 reveals the number of male dependents in each of the surveyed households. From the table, 81 households (26.6%) had 2 male dependents in their families. Also, 46 households (15.1%) had 1 male dependent in their families, while the least were 5 families (1.6%) with 8 male dependents in their families. Households with large number of dependents would likely have a reduced household welfare, especially where income is low.

Table 6: Distribution of the Respondents by Household Size

Household Size (number of Female dependent)		Frequency	Percent
Valid	1	56	18.4
	2	64	21.1
	3	33	10.9
	4	40	13.2
	5	3	1.0
	7	2	.7
	Total	198	65.1
Missing	System	106	34.9
Total		304	100.0

***Source*:** Author's computation from field survey, 2017

Table 6 shows the dependency ratio of female in the selected households is however lower than that of the male. The table shows the number of female dependents in each of the surveyed households. From the table, 64 households (21.1%) had 2 female dependents in their families. Also, 56 households (18.4%) had 1 female dependent in their families, while the least were 2 families (0.7%) with 7 female dependents in their families. As explained above, large number of dependents would likely have a reduced household welfare, especially where income is low.

Table 7: Distribution of the Respondents by Educational Qualification

Educational Qualification		Frequency	Percent
Valid	No Formal Education	164	53.9
	SSCE	55	18.1
	OND	5	1.6
	HND	5	1.6
	Primary School	72	23.7
	Others	3	1.0
	Total	304	100.0

***Source*:** Author's computation from field survey, 2017

It can be seen from the table 7 that 164 households (53.9%) has no formal educational qualification. Also, 72 respondents (23.7%) expressed that they has primary school certificate examination. Those with senior school certificate among the surveyed rural households were 55 (18.1%), while the least are those that has other types of educational qualification like vocational education or community-based adult education. It is therefore glaring that majority of the surveyed households were illiterate and this can determine the level of the stream of income flows to them and the choice of energy use.

Table 8: Household head educational distribution of respondents

Family Head Level of Education		Frequency	Percent
Valid	No Formal Education	174	57.2
	SSCE	47	15.5
	OND	16	5.3
	Primary School	56	18.4
	Others	3	1.0
	Total	296	97.4
Missing	System	8	2.6
Total		304	100.0

***Source*:** Author's computation from field survey, 2017

It can be observed from table 8 that 174 household heads (57.2%) has no formal educational qualification. Also, 56 household heads (18.4%) has primary education, 47 (15.5%) has SSCE, 16 (5.3%) has OND, while those with other types of educational qualification among the surveyed household heads were 3 (1%). Overall, majority of the surveyed head of households does not have formal school.

Table 9: Distribution of Households by types of Dwelling Places

Type of Dwelling Place		Frequency	Percent
Valid	Single Room	46	15.1
	Self-Contain	79	26.0
	Room and parlour	168	55.3
	2- & 3-Bedroom Flat	11	3.6
	Total	304	100.0

***Source*:** Author's computation from field survey, 2017

The indication from the table 9 is that majority of the selected households live in a Room and Parlour apartment. This accounted for 168 households (55.3%). Those that live in self-contain apartments were 79 (26%), 15.1% represents 46 households who were living in single rooms as at the time of the survey, while only 11 households (3.6%) were dwelling in 2 or 3 bedroom flats (usually a whole buildings).

Table 10: Distribution of Households by Monthly Income

Monthly Income Range		Frequency	Percent
Valid	Below #10,000.00	126	41.4
	#10,000.00 - #20,000.00	127	41.8
	#20,000.00 - #30,000.00	41	13.5
	#30,000.00 - #40,000.00	10	3.3
	Total	304	100.0

***Source*:** Author's computation from field survey, 2017

The table 10 above shows that 127 households (41.8%) and 126 households (41.4%) are earning between 10-20 thousand naira and below 10 thousand naira monthly respectively from their different lines of occupations. It is only 10 respondents (3.2%) that earn between 30 and 40 thousand. Income range of these households is generally low and this affects their demand for biomass.

4. Types of energy used by the Households and the determinants of their preference

This section identifies the types of energy commonly used by the surveyed households via frequency distribution tables. Secondly, it empirically determined the factors that influence household preference for their main energy sources via a multinomial logistic regression.

Table 11: Distribution of Households by Main Source of Energy used for Cooking

What is your main source of energy for cooking		Frequency	Percent
Valid	Firewood	249	81.9
	Charcoal	34	11.2
	Kerosene Stove	16	5.3
	Total	299	98.4
Missing	System	5	1.6
Total		304	100.0

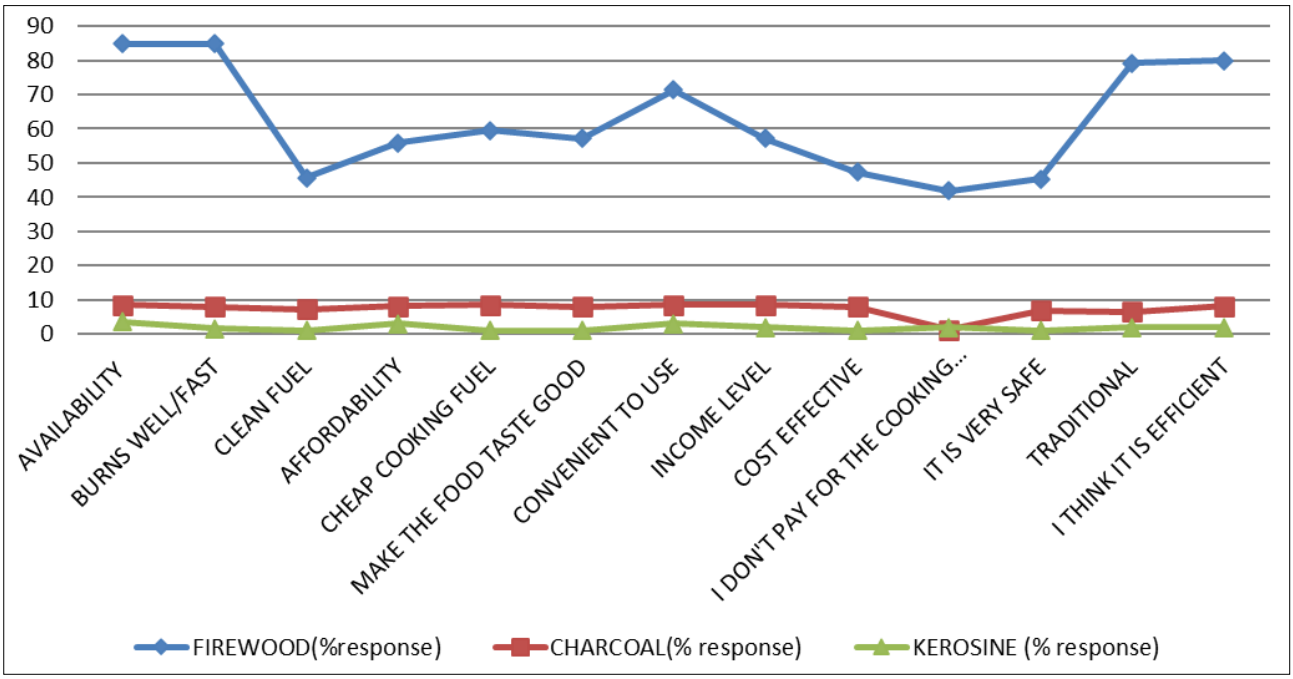
***Source*:** Author's computation from field survey, 2017

The distribution above (table 11) is in order of magnitude. Here, firewood is the dominant energy source used by the rural households for cooking. Approximately 82% of the

respondents, which represents 249 households, used firewood mainly for their household energy need (mostly cooking and heating). This was followed by 34 households (11.2%) who usually use charcoal, while 16 of the surveyed households (5.3%) used kerosene. Thus, Firewood and Charcoal are examples of biomass, and evidence from the responses showed that the firewood is the predominant energy source used. Thus, further analysis is done to show determinants of household preference for their energy choice. Various reasons have been adduced by the respondents as the precursor for their choice of these dominants energy types for domestic use. A tabular and graphical projection of the various reasons for the chosen energy types by the respondents are shown in Table 12.

Table 12: Reasons for main energy preferences by the Households

Why do you choose this?	Firewood		Charcoal		Kerosene		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Availability	258	84.9	26	8.6	11	3.6	295	97
Burns well/fast	258	84.9	24	7.9	5	1.6	287	94.4
Clean fuel	139	45.7	22	7.2	3	1	164	53.9
Affordability (with little money you can get it)	170	55.9	25	8.2	9	3	207	68.1
Cheap cooking fuel	181	59.5	26	8.6	3	1	210	69.1
Make the food taste good	174	57.2	24	7.9	3	1	201	66.1
Convenient to use	217	71.4	26	8.6	9	3	252	82.9
Income level	174	57.2	26	8.6	6	2	206	67.8
Cost effective	144	47.4	24	7.9	3	1	171	56.3
I don't pay for the cooking fuel	127	41.8	4	1.3	6	2	137	45.1
It is very safe	138	45.4	21	6.9	3	1	162	53.3
Traditional (this is what we have been using since i know how to cook)	241	79.3	20	6.6	6	2	267	87.8
I think it is efficient	243	79.9	25	8.2	6	2	274	90.1



***Source*:** Author's computation from field survey, 2017

Fig 1: Line graph of responses on the reasons for various energy choices

It can be revealed from the table and the line graph, that the demand for biomass (firewood and charcoal) outpaced kerosene. For firewood, availability, ability to burn well and fast, traditional inclination and efficiency perception of the households overwhelmingly account for its preference to others. On the part of charcoal, the perception that it is available, cheap, convenient to use, and the income level were the leading factors that informed it preference to others. on the part of kerosene however, availability, affordability, convenience, and income appear to be the major reasons. It can however be seen that charcoal is the alternative energy source to firewood as kerosene is the alternative to charcoal. In fact, responses on the various reasons for choosing charcoals and kerosene were less than 10% from all the respondents. Therefore, firewood is the most prevalent fuelwood demanded for by the selected respondents (households), thus, the specified model for energy demand is only estimated for firewood in this study as the main biomass (energy) used for cooking and other domestic use.

5. Empirical Determinants of Households' Energy Preference

It can be understood from this descriptive analysis that

firewood is the major biomass demanded or chosen by the households for their cooking. Therefore, the main factors that drive or determined the preferences of firewood by the surveyed rural households are empirically estimated in this section. The results were obtained from a binary logistic model under the quadratic almost ideal demand system (QUAIDS) framework. Since the main energy use for cooking are categorized as (firewood, charcoal, and kerosene), and having discovered that firewood is the dominant type, the variables were re-coded using binary value of 1 for firewood and 0 if otherwise. Thus, the estimation is done for firewood.

Model 1: Logit, using observations 3-304 (n = 203) Missing or incomplete observations dropped: 99 Dependent variable: ED (Firewood) Standard errors based on Hessian.

Table 13: Result for determinants of Households' energy preference

	Coefficient	Std. Error	z	p-value
Const	9.49917	22.0596	0.4306	0.66675
LogQ2	-3.60549	1.26259	-2.8556	0.00430***
LogQ3	2.30906	1.29813	1.7788	0.07528*
LogQ4	3.99098	31.5327	0.1266	0.89928
LogQ5	-0.521182	0.620552	-0.8399	0.40098
LogQ6	1.96805	0.675082	2.9153	0.00355***
LogQ7	0.16943	0.736005	0.2302	0.81793
LogQ8	-1.96878	0.826052	-2.3834	0.01716**
LogQ9	0.787827	0.873384	0.9020	0.36704
LogQ10	-3.65899	1.02279	-3.5774	0.00035***
LogQ18	0.404716	0.68193	0.5935	0.55286
LogQ29	-2.09514	0.912345	-2.2964	0.02165**
Mean dependent var	0.802956		S.D. dependent var	0.398749
McFadden R-squared	0.539116		Adjusted R-squared	0.420002
Log-likelihood	-46.43148		Akaike criterion	116.8630
Schwarz criterion	156.6214		Hannan-Quinn	132.9476

***Source*:** Author's computation from field survey, 2017

Number of cases 'correctly predicted' = 175 (86.2%)

f(beta'x) at mean of independent vars = 0.399

Likelihood ratio test: Chi-square (11) = 108.626 [0.0000]*

Note: *, ** and *** denote that the variables are respectively significant at 1%, 5% and 10% level of statistical significance. The logarithmic values of the independent variables are:Q2(sex), Q3(age), Q4(marital status), Q5(occupation), Q6(household size), Q7(educational qualification of households), Q8(level of education of family head), Q9(types of dwelling place), Q10(monthly income), Q18(years of experience in using energy appliances), and Q29(energy price).

The results from the table above indicate that the model has a very high goodness of fit based on the maximum likelihood ratio test of chi-square distribution value of 108.626 with a probability value that is significant at 1% level of significance. Similarly, the McFadden R-squared, which is the coefficient of the determination of the model and its corresponding, adjusted R-squared accounted for 53.9% and 42% variation in the demand for the main cooking energy. This variation implies that aside the included explanatory variables in the models, other random factors can still account or determine the the main cooking energy preference by the rural households. With respect to each of the explanatory variables however, the results above show that at 10% level of significance, the gender or sex of the households is statistically significant as a factor that determine household energy preference. The coefficient signed negatively, which potentially implied that a 1% increase in the perception of gender difference among the rural households will likely lead to 3.61% reduction in subsequent demand for this biomass (firewood). This seem to be related to societal gender roles in which females are more likely to do domestic chores including cooking and sourcing for available firewood to cook.

Thus, at 1% level of statistical significance, the result also shows that age of the respondents is a significant factor influencing energy preference among the surveyed rural households. In this case, a 1% increase in household age would lead to 2.3% increase in demand for firewood among rural households in Ibadan. This corresponds with the findings of Shittu *et al*. (2004) [7] who found that age of household heads in Ogun State of Nigeria is an important factor that determine energy preference for biomass fuel. It is also found from the table above that the size of the households positively determines energy preference. Here, at 10% level of statistical significance, a 1% increase in the number of people in a given household would lead to 1.9% increase in demand for biomass fuel among the selected households.

Similarly, at 5% level of statistical significance, the level of education of household heads proved to be a negative determinant for biomass fuel. The implication is that a 1% increase in educational advancement or status of head of households would approximately lead to 2% decrease in demand for biomass fuel. This verifies the fact that more educated household head would likely go for modern or clean energy rather than the biomass fuel.

Lastly, energy price showed negative impact on demand for biomass fuel. The result showed that at 5% level of significance, an increase in the price of energy of about 1% would cause demand for biomass cooking fuel to decrease by 2.1%. The implication is that there is inverse relationship between demand for biomass and energy price.

6. Conclusion

The study has shown that firewood, kerosene and charcoal are majorly the biomass energy preference of rural households in Oyo state due to their affordability and accessibility. The study revealed that marital status, occupation of households, educational qualification of households, types of dwelling place, and years of experience in using the main energy appliances for the preferred cooking energy were not statistically significant as determinants or factors that influence household preference for main energy sources this study recommends that sensitization of the public by government agencies or private agencies on the health implications of their prefence for biomass energy is important

7. References

1. Akpan M, Wakili A, Akosim C. Fuel Wood Consumption Pattern in Bauchi State: A Guide for Energy Planners in Nigeria. An International Journal of Agricultural Science, Environment and Technology. 2007;7(1);126-150. Retrieved from ASSET On 20th July 2012.
2. Energy Commission of Nigeria. Assessment of Energy options and Strategies for Nigeria: Energy Demand, Supply and Environmental Analysis for Sustainable Energy Development (2000-2030); c2008.
3. National Bureau of Statistics. Nigeria Abstract of Statistics 2009. Federal Republic of Nigeria; c2009.
4. International Energy Agency (IEA)). Energy poverty - how to make modern energy access universal' World Energy Outlook, 2010. Paris, France; c2010.
5. Onyekuru N, Eboh E. Determinants of Cooking Energy Demand in the Rural Households of Enugu State, Nigeria: An Application of the Bivariate Probit Model. ASIAN journal exp. biological science. 2011;2(2):332.
6. Sambo AS. Matching Electricity Supply with Demand in Nigeria. International Association for Energy Economics. Retrieved from Sheilah M & Alison B (2002), Significance of energy for poor urban livelihoods: Its contribution to poverty reduction. DPU news; c2009. p. 44.
7. Shittu A, Idowu A, Otunaiya A, Ismail A. The demand for energy among households in Ijebu division, Ogun state, Nigeria. Journal of the Agricultural Science. Agrekon. 2004;43(1):38-51.
8. World Bank. Household Biomass Cookstoves, Environment, Health, and climate Change: A New Look at an Old Problem. The Environment Department (Climate Change). The World Bank, Washington, District of Columbia; c2003.