Determinants of Household Energy Demand in Babura Local Government Area, Jigawa State

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ABSTRACT

This study examines the Determinant of Household Energy Demand in Babura Local Government Area, Jigawa State. The study was guide with six research questions and adopted the descriptive survey research design. A sample size of 385 households was drawn from the target population (366200), using the cluster sampling technique. The instrument for data collection was a structured checklist and likert scale. The data collection was done after administration and retrieval of the instrument. Out of the 385 administered, 323 were retrieved and 321 were found useful for analysis. The inferential statistics was used to analysis the data with the aid of IBM SPSS version 30.0. Analysis was done using multinomial logistic regression. The results revealed that a one-level increase in the education code was associated with a lower relative risk of choosing agricultural residues rather than firewood (B = -0.898, p = .024). Each additional year of age was associated with approximately 5.8% lower relative risk of choosing LPG rather than firewood (B = -0.060, p=.038). Also a ₦100,000 increase in income was associated with approximately 2.25 times the relative risk of choosing LPG rather than firewood (B = 0.813, p = .009). In conclusion, the study established that firewood was the predominant primary household energy source among the surveyed households, but it does not provide sufficient evidence to conclude that the selected explanatory variables jointly determine energy-source choice in Babura LGA. The study concluded that the government should prioritize affordable access to cleaner energy, sustainable use of existing biomass sources and better local evidence on household energy needs.

Keywords: Household, Energy Demand, Households Major Energy Sources, Babura LGA

INTRODUCTION

Energy is a fundamental element of household welfare and socio-economic development. At the household level, energy is needed for cooking, refrigeration, lighting and the operation of electrical and domestic appliances. The availability, reliability, affordability and types of energy used by households thus have significant implications for standard of living quality of life. The demand for household energy is influenced by several socio-economic and structural factors. According to Barnes (2019), as household income increases and job opportunities improve, households are more likely to shift from traditional biomass sources to cleaner and modern energy. Sovacool as cited in Daniel (2025) posited that the affordability of energy also shapes demand, as households' ability to purchase for alternative energy or energy technologies influence their choice of energy. Further International Energy Agency [IEA] (2020), energy available and accessibility are important and that limited access to electricity, liquefied petroleum gas (LPG) or other modern sources strengthen the reliance on biomass, especially in the rural or semi-urban areas. Also, the prices of energy and reliability can affect household choices, leading in the substitution of different sources of energy.

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The problem with household energy demand is especially significant in developing counties this is because energy consumption is closely connected with household socio-economic situations. Households with higher incomes may be better place to obtain electricity connections, LPG, solar system as well as modern appliances; while households with lower incomes may rely heavily on relatively freely available biomass. Likewise, larger households may need greater quantities of energy for cooking and other domestic activities. Therefore, understanding the situation of energy in the study area is particularly significant as household energy choice have implications beyond immediate domestic consumption.

This study is hinged on Theory of Consumer Behaviour. This theory is also known as the Theory of Household Behaviour and the theory was developed gradually through contributors from multiple economists and theorists (such as Jeremy Bentham, William Stanley Jevons, Vilfredo Pareto, Paul Samuelson, John Howard and Jagdish Sheth, etc.) overtime the theory described how households allocate their limited resources among alternative goods and services to get maximum satisfaction. Liberto (2026), consumer theory investigates how individuals allocate their limited resources to maximize satisfaction or utility when making decisions on purchasing goods and services. Meanwhile, the consumers are assumed to make their choices based on factors like income, preferences, prices, quality, availability etc. however with respect to household energy, the households have several alternatives like electricity, liquefied petroleum gas (LPG), natural gas, biogas and solar energy. Knowing that household resources are limited, the household must decide which source of energy best satisfies their needs for cooking, lighting, heating, refrigeration and other domestic activities. For instance, a low income household may prefer charcoal or firewood because they are accessible and as well affordable; while a household with high income may prefer liquefied petroleum gas (LPG), electricity or solar energy because of convenience, cleanliness and efficacy. Also, household may choose firewood because it is locally available in spite of the environmental and health disadvantages. Therefore, this theory gives reason for why various households in the study area may use different types of energy source. Diagrammatically, the theory conceptual framework is as follows:

Empirically, Daniel et al. (2025) studied “An Analysis of the Determinants of Household Biomass Energy Demand and Willingness to Pay for Improved Energy Source in Michika Local Government Area LGA”. Their main objective was to examine the determinants of household biomass energy demand and willingness to pay for improved energy sources in Michika LGA in Adamawa State of Nigeria. The cross—sectional survey design was adopted and a sample size of 400 households was selected across 13 wards. Data collection was done after administration of questionnaires and analysed using simple percentage, multinomial logit (MNL) and binary logit model. The results revealed that household income and type of dwelling unit significantly influence energy accessibility, indicating that wealthier households in better housing structures are more likely to use modern energy sources. In contrast, reliance on traditional fuels negatively affected access to improved energy. The logistic regression model further confirmed that the type of energy source significantly influenced the likelihood of having reliable energy access. The model demonstrated good fit and predictive accuracy, validating its suitability for analyzing household energy behavior. The study concludes that enhancing access to modern and cleaner energy sources is vital for reducing dependence on biomass fuels and promoting sustainable energy use in rural communities.

Gaya et al, (2023) investigated the “Determinants of Fuel Wood Consumption in Rural and Urban Farming Households of Kano State, Nigeria”. Their main objective was to examine the determinants of fuel wood consumption in rural and urban farming households of Kano State. The cross sectional survey design was adopted and a sample size of 258 households was selected from the target population using the multi-stage sampling technique. Data collection was through the primary source using a structured questionnaire and analysed using descriptive statistics of simple percentage and inferential statistics of multiple regression. The results revealed that urban dwellers were more educated (50.5%), obtained more income ((₦64,426), spent more on non-food expenditures ((₦63,000) and stacked fuelwood, unlike rural households who had less tertiary education (7.3%), lower income ((₦52,666) and spent less (₦16,000) while using fuelwood only as their source of domestic energy. Multiple regression analysis of the factors affecting rural household consumption of fuelwood had a R^2 adjusted value of 0.642. Education, price of kerosene, household size, nature of cooking, accessibility and gender of household heads were the significant variables affecting fuel wood consumption. On the other hand, the urban households had an R^2 adjusted value of 0.515 for fuelwood consumption; with age and

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household size being the most significant variables that determined the quantity of fuelwood consumed. Therefore, both rural and urban households need to create more income generating activities to be able to afford clean and superior fuels.

Akin-Olagunju and Yusuf (2022) investigated "Household energy choice relationships and determinants in Nigeria". Their objective was examine the relationship among fuel options and assessed the determinants. They adopted the correlational research design and a sample size of 180 respondents was drawn from the target population using the multi-stage sampling technique. Data collection for the study was a structured questionnaire that had been subjected to validity and reliability before administered to the respondents. The analysis of data was done using bivariate probit and logit regression models. Firewood and charcoal were found to be in use as substitute cooking fuels to LPG while electricity was used as its complement. Improved economic state of households was associated with the use of clean energy sources. Households with large number of members had to settle for less clean fuel types because of low per capita resource availability while education assisted in making better fuel choices for cooking.

MATERIALS AND METHODS

The study area is Babura Local Government Area (LGA) of Jigawa State, the LGA shares boundary with Baure LGA of Katsina Sate from North, Kazaure from West, Sule Tankarkar from East and Danbatta LGA of Kano State from the South. Its temperature ranges from 15 °C (59 °F) to 39 °C (102 °F) year-round and is oppressively hot, cloudy and windy during the dry season. Babura LGA holds eleven wards: Babura, Batali, Dorawa, Garu, Gasakoli, Insharuwa, Jigawa, Kanya, Kuzunzumi, Kyambo and Takwasa. The headquarters of the LGA is situated in the town of Babura and it incorporated several towns and villages including Bai-Ali, Bebur, Burukum, Dorawa, Gaskoli, Inshanuwa and Kafin-Rabo. The LGA is predominantly agrarian with its inhabitants engaged in cultivating crops like millets, beans, rice and sorghum. Cattles rearing and hunting also form key aspect of the local economy. Babura LGA has an area of 992 km^2, a population of 208,101 and population density of 272.3/ km^2 according to the 2006 census, which was projected to raise to 366,200 by 2022; resulting a population density of 358.0 people per km^2 (City-Facts, 2026).

The study adopted the survey research design. A sample size of 384 was first determined using Cochran's formula, which is being commonly used in the computation of sample size in research. The formula is expressed or shown below;

$$n = \frac{Z^2 Pq}{d^2}$$

Where:

n = sample size with finite population correction

Z = standard normal deviate corresponding to a 5% level of significance (1.96)

P = the prevalence or proportion of the attribute interest that is present in the population

q = 1-p (48%), complementary probability of health records.

d = Is the desired level of precision (i.e. the margin of error) that is absolute error or precision limit (proportion of acceptable sample error or margin error) which is usually 5% (0.05)

Substituting the various values into the Cochran's formula as presented below:

$$n = \frac{Z^2 Pq}{d^2}$$

We have that;

$$n = \frac{(1.96)^2(0.5)(0.5)}{(0.05)^2}$$

$$n = \frac{(3.8416)(0.25)}{0.0025}$$

$$n = \frac{0.9604}{0.0025}$$

$$n = 384.16 \text{ or } 384$$

According to Singh and Masuku (2014), when the sample size of a finite population is greater than ten thousand (> 10,000); the sample size can be estimated further with the formula expressed below:

$$n = \frac{n}{1 + \frac{n-1}{N}}$$

Where:

n = 384 (computed samples size from Cochran's formula)

N = 366,200 [study population (projected population of Babura LGA)]

Substituting the values of the Cochran's formula when the desired sample size is greater than ten thousand (> 10,000) as presented below:

$$n = \frac{384}{1 + \frac{384-1}{366,200}}$$

$$n = \frac{384}{1 + \frac{383}{366,200}}$$

$$n = \frac{384}{1 + 0.00105}$$

$$n = \frac{384}{1.00105}$$

$$n = 383.60 \text{ or } 384$$

A non-proportionate sampling technique was adopted to randomly select the households based on the calculated sample size of 384 using cluster sampling technique. In other to make the division to have a whole number for each of the 11 Wards, 1 was add to the calculated sample size of 384 to make the sample size 385. Therefore, in each cluster (Ward) 35 households were randomly selected from the 11 Wards that made up Babura LGA. The instrument for the study was a self-constructed structured checklist titled "Determinant of Household Energy Demand Questionnaire (DHEDQ)", the demographic variable was dichotomously coded into 0 and 1, while the household energy sources were coded 1 to 9. The data collection was done after administration and retrieval of the questionnaire with the help of trained research assistants. Out of the 385 administered, 323 were retrieved and 321 were found useful for analysis.

Model Specification

In this model (multinomial logistic regression model), the dependent variable is households' energy source and is categorized into Firewood, Charcoal, Agricultural Residues, Kerosene, Liquefied Petroleum Gas (LPG), Electricity (National Grid), Electricity Captive (Generator), Solar Energy and Others. The model is specified as:

$$1n = \left(\frac{Pij}{Pi1}\right) = \beta_{0j} + \sum_{k=0}^{n} \beta kj \, X_{ik}$$

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Where:

P_{ij} = probability that household *i* chooses energy source *j*

P_{i1} = probability that household i chooses firewood

β_{0j} = intercept for energy-source category *j*

β_{kj} = regression coefficient for explanatory variable *k* and category *j*

X_{ik} = explanatory variable *k* for households *i*

j = 2,3,4…., 9 represents Firewood, Charcoal, Agricultural Residues, Kerosene, Liquefied Petroleum Gas (LPG), Electricity (National Grid), Electricity Captive (Generator), Solar Energy and Others

k = number of explanatory variables

For this study, the model is written as:

$$1n = \left(\frac{Pij}{Pi1}\right) = \beta_{0j} + \beta_{1j}AGE_i + \beta_{2j}GEN_i + + \beta_{3j}OCC_i + \beta_{4j} + \beta_{5j}INC_i + \beta_{6j}EDU_i + u_{ij}$$

Where:

AGE = Age of Household Head

GEN = Gender of Household Head

OCC = Occupation of Household Head

INC = Income of Household Head

EDU = Education of Household Head

u = Stochastic error term

β_0 = intercept

$\beta_1 - \beta_6$ = Coefficient of the independent variables

The analysis of data was done using descriptive and inferential statistics. The inferential statistics of multinomial logistic regression was used for hypotheses testing with the aid of IBM Statistical Package for Social Science (SPSS) version 30.0; with a decision rule that if $p < 0.05$, indicates statistical significance.

ANALYSIS/RESULTS AND DISCUSSIONS

3.1 Analysis/Results

Table 3.1.1 Overall Model Fitting

Statistics	Results
Number of Households	321
Final Model Log-Likelihood	-487.921
Intercept-only Log-Likelihood	-509.155
Likelihood-Ratio Chi-Square	42.468
Degrees of Freedom	36

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Significance	.212
McFadden Pseudo-R^2	

Interpretation: The overall likelihood-ratio test was not statistically significant, χ^2 (36) = 42.47, p =.212). At the 5% significance level, there is insufficient evidence that the full set of predictors, considered jointly, improves the model over the intercept-only model. McFadden's pseudo-R^2 was .042, indicating a modest improvement in log-likelihood relative to the intercept-only model. This is not equivalent to saying that the predictors explain exactly 4.2% of the variance.

Table 3.1.2 Likelihood-Ratio Tests for Individual Predictors

Predictors	**Chi–Square**	**df**	**p–value**
Age of Household Head	6.044	6	.418
Gender of Household Head	14.050	6	.029
Occupation of Household Head	5.049	6	.538
Income of Household Head	5.674	6	.461
Education of Household Head	11.204	6	.082
Households Size	5.382	6	.496

The predictor-specific likelihood-ratio tests showed that household income made a statistically significant contribution to distinguishing among energy-source categories (χ^2 (6) =14.050, p =.029). The tests for age, gender, occupation, education and household size were not statistically significant at the 5% level. The exploratory parameter estimates also suggested that income and age were associated with the relative likelihood of choosing LPG rather than firewood, while education was associated with the relative likelihood of choosing agricultural residues rather than firewood. These individual associations should be interpreted cautiously because the overall model was not statistically significant and some energy-source categories contained few observations.

Table 3.1.3 Parameter Estimates: Significant Comparisons

Comparison with firewood	**Predictors**	**B**	**p–value**	**Exp(B)**
Agricultural Residues	Education Codes	−0.898	.024	0.407
LPG	Age (years)	−0.060	.038	0.942
LPG	Income (per ₦100,000)	0.813	.009	2.254

A one-level increase in the education code was associated with a lower relative risk of choosing agricultural residues rather than firewood (B = -0.898, p = .024). The estimated relative risk ratio was 0.407, or approximately 59.3% lower relative risk. This interpretation assumes that the education codes represent increasing educational levels and that a one-level increase has a linear effect on the log-relative odds. Each additional year of age was associated with approximately 5.8% lower relative risk of choosing LPG rather than firewood (B = -0.060, p=.038), holding the other variables constant. A ₦100,000 increase in income was associated with approximately 2.25 times the relative risk of choosing LPG rather than firewood (B = 0.813, p = .009), holding the other variables constant.

DISCUSSIONS

The results indicated that traditional biomass remains important in the observed household energy source, while the demographic factors require further investigation. However, the indication that traditional biomass remains important in the observed household energy source. The significance of firewood, charcoal and agricultural residues may be connected with their relative availability and affordability, especially in rural areas where agricultural activities constitute a significant part of household livelihoods. While the agricultural residues like shells, stalks and other crop by products can be readily obtained after farming activities and farming activities and consequently serve as accessible sources of household fuel. However, firewood may be particularly attractive to low income households as it can be collected at small or no monetary cost or can be purchase at relatively low prices. This result is consistence with the finding of Akin-Olagunju and Yusuf (2022) Akin-

Olagunju and Yusuf (2022) investigated "Household energy choice relationships and determinants in Nigeria". Their objective was examine the relationship among fuel options and assessed the determinants. Firewood and charcoal were found to be in use as substitute cooking fuels to LPG while electricity was used as its complement. Improved economic state of households was associated with the use of clean energy sources. Households with large number of members had to settle for less clean fuel types because of low per capita resource availability while education assisted in making better fuel choices for cooking.

CONCLUSIONS/RECOMMENDATIONS

The study investigated the determinant of household energy demand in Babura Local Government Area, Jigawa State. The results revealed that firewood was the most commonly reported primary household energy source, accounting for most of the households surveyed. In conclusion, the study establishes that firewood was the predominant primary household energy source among the surveyed households, but it does not provide sufficient evidence to conclude that the selected explanatory variables jointly determine energy-source choice in Babura LGA. The results also highlight the need for a more robust model specification, adequate representation of less common energy sources, and further examination of factors such as fuel affordability, availability, accessibility and household cooking requirements. These factors may help explain the persistence of traditional energy use and the potential barriers to adopting alternative household energy sources. The study concluded that the government should prioritize affordable access to cleaner energy, sustainable use of existing biomass sources and better local evidence on household energy needs.

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