



DETERMINANTS OF HOUSEHOLD FIREWOOD EXPENDITURE FOR COOKING IN RURAL AND URBAN AREAS OF KANO STATE, NIGERIA

Hadiza Nasir Iro¹, Nura Sani Yahaya², Nadira Madaki Iliyasu³, Shuibu Jafar⁴

^{1,2}Kano State College of Education and Preliminary Studies, Nigeria

³Federal University Dutse, Jigawa State, Nigeria

⁴RMK College of Advanced and Remedial Studies Tudun Wada, Kano State, Nigeria

*Corresponding email : irohadiza@gmail.com

(Received: 30 April 2025; Accepted: 10 May, 2025; Published on-line: 7 November, 2025)

Abstract

This study investigates the determinants of household firewood expenditure for cooking in rural and urban zones of Kano State. The research used survey to gather data for this study, and questionnaires were administered to households in Tarauni, Makoda, and Karaye local government areas of Kano State, each of which represents a different senatorial zone. For the study, a multi-stage cluster sampling approach was applied. A regression analysis was employed to assess the various factors that affect firewood expenditure. The outcome of the analysis shows a positive relationship between location, firewood expenditure, age of the head of household, household size, and income. Household heads that live in rented houses and single detached houses spend less on firewood. More so, living in an apartment has a significant positive relationship with firewood expenditure. The interaction variable income and location show a negative relationship. Therefore, in line with the study's findings, it was recommended that a by-law be passed at the village level to ensure that all households using firewood use stoves. The state government should also create suitable circumstances for the populace, such as adequate electricity, resilient infrastructure, and credit facilities.

Keywords: Energy consumption, firewood expenditure, Regression, Kano

© AUN Journals

1. Introduction

The capacity of every nation to fight poverty, grow economically, and maintain its security greatly relies on its access to energy. The long-term supply of energy from accessible, inexpensive, and environmentally friendly sources is essential for future economic growth (Oyedepo, 2012). In Nigeria, the household cooking sector utilizes more than 80% of all energy, 90% of which is generated by biomass, primarily firewood (International Energy Agency, 2015). Animal dung, plant waste, fuel wood, kerosene, gas, and electricity are among the many energy sources used for cooking in the majority of developing nations (Julius, 2013). Despite the availability of basic energy supplies in Nigeria, the majority of households still use firewood (Anthony and Angela, 2012). In terms of meeting people's needs, Nigeria's energy sector ranks among the least effective. The markets for power and petroleum products, in particular kerosene and premium motor spirit (PMS), remain unstable (Danlami, 2017a; Iwayemi, 2008). Both urban and rural inhabitants grapple with finding suitable and dependable sources of energy for their homes due to a high level of poverty and other socioeconomic issues. Nigeria's over-reliance on biomass for cooking fuels causes it to account for 10% of all smoking-related illnesses that cause yearly global mortality

(Nwofe, 2013; Newsom, 2012). The use of firewood as a cooking fuel has a devastating impact on the environment due to excessive felling of trees and causes desertification.

Additionally, households in Kano State, Nigeria, and other developing nations struggle to adopt modern cooking fuels due to inconsistent power supplies, voltage fluctuation, family size, income, and home design. Additionally, the risk of electric shock that comes with using electricity (electric stoves) for cooking, even in urban areas, is another deterrent. These factors have increased the proportion of households using alternate fuel sources for cooking (Taru et al., 2011; Oyekale, 2012; Nnaji, Ukwueze & Chukwu, 2012; Ojo & Chuffor, 2013). When examining the diverse household heads, particularly in urban and rural areas of Kano, there are few empirical studies on energy use for cooking, therefore necessitating the need to assess household energy use in rural and urban areas of Kano. Also, the study aligned with the UN Sustainable Goal 7 to ensure access to affordable, reliable, and sustainable energy for all by 2030. Therefore, the study examined the determinants of household firewood use for cooking in urban and rural areas of Kano State.

2. Literature Review

The decision to use one or more energy sources by a household is influenced by a wide range of variables, including socioeconomic issues, household demographics, meteorological conditions, housing, product, or vehicle features, attitudinal variables, and environmental factors (Danlami & Islam, 2020). Gaya et al. (2023) found that factors, like family size, gender, level of education, and kerosene price, are positive and significant in determining fuel wood use. According to Wuyuan et al. (2022), residents with higher levels of education use less biomass and more commercial fuel because the opportunity cost of collecting biomass is rising. Cooking, accessibility, and the gender of household heads essentially influenced the use of fuel wood. A negative correlation between distance and fuel wood use was discovered. The outcome of the study reveals that households view distance as a separate expense from the cost of market fuel (Taj & Far, 2020). In this regard, a greater distance means that families must bear a greater portion of the transportation expense, which discourages households from using such fuels. Therefore, based on the review, no previous studies analyzed the household firewood expenditure for cooking in rural and urban zones, particularly in Kano State, and no study has captured the impact of income and location on household firewood expenditure for cooking. This study intends to fill the gaps identified (Danlami *et al.*, 2025; Abc & Def, 2022; Lim & Yuan, 2021).

3. Research Methodology

This part explains the data and methods use in analyzing the study model.

3.1 Data Source

Kano State serves as the study area. It is Nigeria's main commercial hub, the second most-

industrialized state, the northern region's economic hub, and the area with the most politically engaged and educated citizens (K-SEEDS, 2000). Additionally, three local government areas—Tarauni, Makoda, and Karaye, each of which represents a distinct senatorial zone, were used for the study. The study population comprised every household in Kano State. NBS (2024) estimates that Kano State has 1,603,335 households, including high-, low-, and middle-income families.

3.2 Sample Size and Sampling Technique

The study employed Dillman's (2011) sample size technique to calculate appropriate sample sizes. Hence, a sample size of 384 was calculated. The sample size was doubled to account for sampling problems and the non-response rate issue (Hair et al., 2008). Thus, a total of 768 households made up the sample for the study. The multi-stage cluster sampling technique was also used. This sampling technique was applied due to the nature and categories involved in both rural and urban areas of Kano State. Semi-structured questionnaires were personally administered to accommodate both qualitative and quantitative data. When a researcher or other member of the research team personally administered the questionnaire, they swiftly collected all the completed responses and answered any queries that respondents may have. For Tarauni, Makoda, and Karaye local government areas (LGAs), a total of 768 questionnaires were delivered to reach the targeted heads of household or their spouses. Studies that used questionnaires include Bashir and Danlami (2022), Kofarmata and Danlami (2021), Tsauni and Danlami (2016), Kadiri and Alabi (2014), and Ampitan and Oyerinde (2015).

4.3 Method of Data Analysis

The multiple regression approach was employed to identify the variables that determine the usage of firewood in Kano state. In order to identify the variables impacting the use of firewood in selected local government areas of Taraba State, Maurice, Umar, & Zubairu (2015) employed multiple regression analysis.

Therefore, Maurice, Umar and Zubairu (2015) model is adopted and modified in this study as:

$$Lgfwexp = \beta_0 + \beta_1 loc_i + \beta_2 gender_i + \beta_3 age_i + \beta_4 mstatus_i + \beta_5 educ2_i + \beta_6 hhsz_i + \beta_7 employer_i + \beta_8 income_i + \beta_9 hownshp_i + \beta_{10} hmnature_i + \beta_{11} ic_loc_i + \varepsilon_i$$

Where;

Lgfwexp = log of firewood expenditure

loc = household location

gender = gender of the respondent

age = age of the respondent

mstatus= marital status of the respondent
educ2 = educational level of the respondent
hhsz = household size of the respondent
employer= employment sector of the respondent
income= income earned by the respondent
hownshp = home ownership
hmnature = home nature
ic_loc = interaction of income and respondents' location

4. Results and Discussion

In order to investigate the determinants of household expenditure on firewood in Kano state; the multiple regression method was applied. Table 5 shows multiple regression estimation of firewood expenditure.

Table 5. 1: Regression Estimation for Firewood Consumption

Variables	Coefficient	T ratio	P Values
Location	.4067551*** (.1384)	2.94	0.003
Gender	-.1775339 (.1141)	-1.56	0.120
Age	.005538* (.0034)	1.65	0.100
Marital status	.0185567 (.1068)	0.17	0.862
educ2	.0084306 (.0060)	1.41	0.161
Home size	.0347822*** (.0078)	4.46	0.000
Employer			
Private company	-.095085 (.1561)	-0.61	0.543
Local Government	.0029297 (.1142)	0.03	0.980
State Government	.0979305 (.0989)	0.99	0.323
Federal Government	-.1357502 (.2343)	-0.58	0.563
Others	-.3074231***	-2.80	0.005

	(.1098)		
Income	8.22e-06*** (2.36e-06)	3.49	0.001
Home ownership			
Rented	-.1515251 (.0878)	-1.73	0.085
Dwelling provided by employer	-.1449779 (.2214)	-0.65	0.513
Free Dwelling	.0359287 (.1074)	0.33	0.738
Others	-.1036001 (.2116)	-0.49	0.625
Home nature			
Single Detached	-.1395282 (.0770)	-1.81	0.071
Semi Detached	-.1168573 (.0886)	-1.32	0.188
Row House	-.0043386 (.0892)	-0.05	0.961
Flat in Duplex	.0620242 (.1451)	0.43	0.669
Apartment in Building	.4768794*** (.1759)	2.71	0.007
Others	.160736 (.5016)	0.32	0.749
Income _Location	-7.42e-06** (3.00e-06)	-2.48	0.014
Cons	7.27536 (.2243)	32.44	0.000
R ² = 0.13			

Source: Author's computation using Stata /Note: Standard error in parenthesis. * ** *** illustrates the significance level at 10% 5% and 1%.

From Table 5.1, the results of the multiple regression model show approximately 13% variations in the DV are accounted for by the independent variables. More so, the overall model is significant at 1 percent with P value of 0.0000.

The important determinants of firewood expenditure are

4.1.1 Location of the Household

The household's home location impacts energy consumption for cooking. The variable is

significant at the 1% level. The study outcome shows a positive relationship between location and firewood expenditure. Every 1% rise in the number of households living in rural zones compared to urban zones results in a 41 % increase in firewood expenditure, holding other variables constant. Households located in urban zones used cleaner energy compared to those in rural zones. This is due to the availability of clean cooking fuel in urban centers. This finding aligns with previous studies, such as Eakins (2013), Ozcan et al. (2013), and Mensah & Audu (2013).

4.1.2 Age of Household Head

The age of the head of household exerts a positive effect on firewood consumption. An additional year of the household head increases firewood expenditure by 5.5 %. The outcome is in line with past studies (Abebaw, 2007; Nnaji et al., 2012; Ganchimeg & Havrland, 2011; Onoja, 2012).

4.1.3 Household Size

Household size positively influences expenditure on firewood. An increase in the size of household by 1 individual results in an increase in firewood expenditure by 3.5 % of cooking fuel. This finding meets a priori expectations and supports results from past studies on household energy (Jingchao & Kotani, 2011; Laureti & Secondi, 2012; Mensah & Adu, 2013; Ozcan et al., 2013; Danlami et al., 2017).

4.1.4 Income of Household Head

A ₦1000 increase in the income of household heads increases firewood expenditure by 0.82 percent. The positive coefficients of the income may indicate that firewood may not be abandoned for a long period until household income reaches a considerably high level. This assertion aligns with a priori expectations and parallels past studies (Lee, 2013; Nlom & Karimov, 2014; Oyekale & Olugbire, 2012).

4.1.5 Employer

This outcome shows that a 1% rise in the number of household heads that work in other types of employment sectors, such as voluntary organizations, decreases firewood expenditure by 31%. This is in line with this study's expectation. Voluntary workers are flexible, can do more work, and earn more income. Therefore, they can adopt clean energy.

4.1.6 Home Ownership

The study outcome shows a negative relationship between rented houses and firewood expenditure. A 1% increase in the number of household heads who live in rented houses decreases firewood expenditure by 15%. This conforms to a priori expectations.

4.1.7 Home Nature

The estimated result shows a negative relationship between single detached house and firewood expenditure. A 1% increase in the number of household heads who live in single detached house decrease firewood expenditure by 14 %.

4.1.8 Income Location

A rise in income of household heads in rural area decreases firewood expenditure by 0.74%. This finding is similar to the works by Link et al., 2011; Heltberg, 2003; Danlami *et al.*, 2017.

4.2 Diagnostic Test for Regression Model

4.2.1 Heteroskedasticity

In this study, robust estimates were obtained; the data have accounted for heteroskedasticity.

4.2.2 Specification Error Test

The table below shows the specification error test.

Table 5.2 Specification Error Test

Lgfwdexp	Coef	T	P> t
_hat	.4295 (5.9197)	0.07	0.942
_hatsq	.0351 (.3639)	0.10	0.923
_cons	2.3179 (24.0646)	0.10	0.923

The outcome reveals that the P-value of hatsq is not significant; therefore, it can be concluded that the model is correctly specified and free from specification bias.

4.2.3 Multicollinearity

In this case, the VIF test was conducted to examine the extent of the association among the independent variables. The table below shows “VIF” and “1/VIF” results.

Table 5.3 Multicollinearity Test

VARIABLE	VIF	1/VIF
Location	6.92	0.145
Gender	1.94	0.516
Age	1.92	0.521

Marital status	1.91	0.524
educ2	2.01	0.499
Household size	1.53	0.653
Employer		
Private company	1.18	0.849
Local Government	1.68	0.594
State Government	1.80	0.555
Federal Government	1.14	0.873
Others	1.11	0.902
Income	4.73	0.211
Home ownership		
Rented	1.25	0.799
Dwelling By Employer	1.03	0.974
Free Dwelling	1.06	0.947
Others	1.10	0.910
Home nature		
Single Detached House	1.99	0.502
Semi Detached House	1.72	0.581
Row House	1.65	0.605
Flat in Duplex	1.25	0.801
Apartment	1.06	0.947
Others	1.05	0.950
Income Location	7.66	0.131
Mean VIF	2.12	

The result shows the coefficients are not inflated, and all variables are retained for further analysis.

5. Conclusion and Recommendation

This study examines household energy use for cooking in urban and rural zones of Kano State. The results of the study revealed that different factors significantly affect household expenditure on firewood. These include location, age, family size, employer, income, home

ownership, home nature, interaction variable, income, and location. The results of the regression model show a positive relationship between location and firewood expenditure, age of the head of household, and firewood expenditure. The findings also reveal that household size and income positively influence expenditure on firewood. Household heads that live in rented houses and single-detached houses spend less on firewood. Additionally, living in an apartment has a positive significant relationship with firewood expenditure. The interaction between variable income and location shows a negative relationship. An upsurge in the income of household heads that live in rural areas decreases firewood expenditure. Therefore, in accordance with the study's findings, it was recommended that a by-law be enacted at the village level to ensure that all families using wood fuel use stoves. Since most people will not be able to afford them, the upgraded fuel wood stove will need state and local government subsidies. This intervention will help individuals who are in need, especially in rural areas. Additionally, strong controls should be implemented to reduce the possibility of corruption. Through campaigns and workshops, the state, local governments, and non-governmental organizations should educate the public about the negative effects of using firewood. The state government should also create favorable conditions for the populace, such as sufficient electricity, adequate infrastructure, and credit facilities. Thus, less dirty energy will be used.

Moreover, this study has added to the current literature on household energy consumption through an analysis of household firewood expenditure. To the knowledge of the researcher, no empirical investigation has been conducted on the factors underlying household cooking energy use in both urban and rural areas of Kano State. The study provided a more comprehensive understanding of current household cooking energy usage across regions in Kano State, Nigeria. Previous studies have not utilized interaction variables to examine their effects on household energy consumption. Therefore, this study incorporates interaction variables in the regression model. Specifically, the interaction between income and location (Inc_loc) was found to be negative and significant.

References

- Barnes, D. F., & Floor, W. M. (1996). Rural energy in developing countries: A challenge for economic development. *Annual Review of Energy and the Environment*, 21, 497–530.
- Bashir, R., & Danlami, A.H. (2022). Gender and loan accessibility among entrepreneurs: empirical evidence from women entrepreneurs in Kano Metropolis. *European Journal of Government and Economics*, 11(1), 97 -112.
- Danlami, A. H. (2019). Assessment of factors influencing firewood consumption in Bauchi State, Nigeria. *Journal of Sustainability Science and Management*, 14(1), 99 – 109.
- Danlami, A. H. (2017a). An intensity of household kerosene use in Bauchi State, Nigeria: a Tobit analysis. *Nigerian Journal of Management Technology and Development*, 8(2), 1 – 13.
- Danlami, A. H. (2017b). An Analysis of Household Energy Choice and Consumption in Bauchi State, Nigeria. An unpublished Ph.D. Thesis submitted to School of Economics, Finance and Banking, Universiti Utara Malaysia.
- Danlami, A.H., & Applanaidu, S.D. (2021). Sustaining a cleaner environment by curbing down biomass energy consumption. A chapter published by Springer in W. Leal Filho et al. (eds.) “African Hand Book of Climate Change Adaptation” 1423 – 1439.
- Danlami, A. H., & Islam, R. (2020). Explorative analysis of household energy consumption in Bauchi State, Nigeria. In J. Manuel & G. Alfonso (Eds.), *Energy efficiency and sustainable lighting – a bet for the future* (pp. 97-113). IntechOpen.
- Danlami, A. H., Applanaidu, S. D., & Islam, R. (2019). Movement towards the adoption of non-traditional household lighting fuel energy in developing areas, *Biofuels*, 10(5), 623 – 633.
- Danlami, A.H., Applanaidu, S.D., & Islam, R. (2018a). Axiom of the relative income hypothesis and household energy choice and consumption in developing areas: Empirical evidence using Verme model. *Kasessart Journal of Social Sciences*, 39; 422 - 431.
- Danlami, A. H., Applanaidu, S. D. & Islam, R. (2018b). An analysis of household cooking fuel choice: a case of Bauchi State, Nigeria. *International Journal of Energy Sector Management*, 12(2), 265 – 283. <https://doi.org/10.1108/IJESM-05-2016-0007>
- Danlami, A.H., Applanaidu, S.D. & Islam, R. (2017). From biomass cooking fuel source to modern alternative for Bauchi State households: a preliminary analysis. *Biofuels*, 3(8), 323-331. <http://dx.doi.org/10.1080/17597269.2016.1226724>
- Desalu, O., Ariyibi, E. T., Kolawole, A., & Ogunleye, A. (2012). A community survey of the pattern and determinants of household sources of energy for cooking in rural and urban south western Nigeria. *The Pan African Medical Journal*, 12(1), Article 2.
- Desalu, O., Ariyibi, E. T., Kolawole, A., & Ogunleye, A. (2012). A community survey of the pattern and determinants of household sources of energy for cooking in rural and urban south western Nigeria. *The Pan African Medical Journal*, 12(1), Article 2. <https://www.panafrican-med-journal.com/content/article/12/2/full>
- Dillman, D. A. (2011). *Mail and Internet surveys: The tailored design method--2007 update*

with new Internet, visual, and mixed-mode guide. John Wiley & Sons.

- International Energy Agency. (2015). *World energy outlook 2015*. OECD. <https://www.iea.org/reports/world-energy-outlook-2015>
- Kwakwa, P., Wiafe, E. D., & Alhassan, H. (2013). Households energy choice in Ghana. *Journal of Empirical Economics*, 1(3), 96–103.
- Masera, O., Saatkamp, B., & Kamonen, D. (2000). From linear fuel switching to multiple cooking strategies: A critique and alternative to the energy ladder model. *World Development*, 28(12), 2083–2103. [https://doi.org/10.1016/S0305-750X\(00\)00076-0](https://doi.org/10.1016/S0305-750X(00)00076-0)