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EFFECTS OF SOCIO-ECONOMIC CHARACTERISTICS OF HOUSEHOLDS ON COOKING ENERGY CONSUMPTION IN KARU LGA, NASSARAWA STATE.

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ABSTRACTS

This study examined the effects of household socio-economic characteristics on cooking energy consumption in Karu Local Government. The objectives were to profile household socio-economic characteristics, identify the primary cooking energy sources used by rural and urban households and quantify the relationship between these characteristics and household cooking energy consumption. Primary data were collected using structured questionnaires administered to households using stratified, systematic and simple random sampling. Data were analyzed using descriptive statistics and Pearson product-moment correlation. Findings revealed that the major sources of cooking energy among rural households were firewood, charcoal, and crop residues, and while in urban areas, the dominant sources were Gas/LPG, charcoal, and electricity. The study further established strong correlations between cooking energy consumption and selected socio-economic characteristics. In rural households, significant determinants included age (r^2 = 76.6%), income level (r^2 = 78.1%), household size (r^2 = 73.1%), and occupation (r^2 = 88.9%). In urban households, key influencing factors were age (r^2 = 76.2%), type of house (r^2 = 81.4%), and location of kitchen (r^2 = 87%). The study recommends increasing access to cleaner and more efficient cooking energy sources, such as Gas/LPG and electricity, particularly in rural communities. Targeted subsidization and equitable distribution programs are crucial for promoting energy transition and enhancing household welfare.

Keywords: *Cooking Energy, Consumption, Rural and Urban Households, Socio-economic Characteristics*

Specifically, it seeks to profile household socio-economic and demographic characteristics, to identify the main sources of cooking energy used by rural and urban households, and analyze the relationship between household socio-economic factors and cooking energy consumption.

1. INTRODUCTION

Access to affordable, reliable, sustainable, and modern energy remains a central pillar of the United Nations (UN) 2030 Agenda for Sustainable Development, particularly under Sustainable Development Goal (SDG) 7, which emphasize universal access to clean and modern energy services (UN, 2018; Alagbe & Danjuma, 2025). A critical indicator of this goal is SDG 7.1.2, which focuses on access to clean fuels and technologies for cooking, given that the use of clean cook stoves can significantly reduce exposure to indoor air pollutants, one of the leading causes of premature deaths in low-income households (United Nations, 2018; World Health Organisation, 2021).

Energy is fundamental to human existence and national development. It drives economic productivity, enhances social welfare, and underpins poverty reduction and sustainable growth (Rahut, Ali, & Mottaleb, 2020; Karmaker, Hossain, Rahman & Ahmed, 2022). However, access to modern cooking energy remains a persistent challenge in many developing countries. Globally, approximately 2.7 to 3 billion people still depend on solid fuels such as firewood, charcoal, and agricultural residues for cooking, a dependence that poses serious health, environmental, and socio-economic consequences (Aziz, Barua, & Chowdhury, 2022; Pangaribowo & Iskandar, 2022).

In Nigeria, this challenge is particularly pronounced. The household sector constitutes the largest share of national energy consumption, about 64 percent, with cooking accounting for more than 70 percent of this share and roughly 90 percent of the cooking energy supplied by biomass (Energy Commission of Nigeria [ECN], 2012; International Energy Agency [IEA], 2014). This overwhelming dependence on traditional biomass fuels precipitates a cascade of health and environmental crises. The inefficient combustion of solid fuels releases harmful pollutants, including carbon monoxide and particulate matter, which contribute to respiratory diseases and premature deaths. The World Health Organization (WHO) estimates that household air pollution from solid fuel use causes over 95,000 premature deaths annually in Nigeria (Ozoh, et al., 2020). Moreover, the unsustainable harvesting of firewood drives deforestation, biodiversity loss, and greenhouse gas emissions, thereby intensifying the impacts of climate change.

The transition to modern cooking energy is complex and uneven, often reflecting socio-economic and spatial disparities. Rural households tend to rely heavily on freely available biomass due to income constraints and limited access to modern energy infrastructure. In contrast, urban households, though relatively better positioned, frequently adopt “fuel stacking” strategies, using multiple fuels such as Liquefied Petroleum Gas (LPG) alongside charcoal to cope with the high cost and erratic supply of cleaner energy sources (Maina, Hyseni, Yaro, & Mahmoud, 2021; Edomah, 2022). These variations in energy consumption patterns reveal underlying socio-economic inequalities and pose challenges for achieving equitable energy transitions.

In Nasarawa State, particularly in Karu Local Government Area (LGA), these disparities are evident due to rapid urbanization, income differentials, and variations in household socio-economic characteristics. Despite the critical importance of energy access for household welfare and environmental sustainability, there is limited empirical research on the determinants of

cooking energy choices and consumption patterns within this region. Therefore, this study investigates the effects of household socio-economic characteristics on cooking energy consumption in Karu LGA, Nasarawa State, Nigeria. Specifically, it seeks to profile household socio-economic and demographic characteristics, to identify the main sources of cooking energy used by rural and urban households, and analyze the relationship between household socio-economic factors and cooking energy consumption.

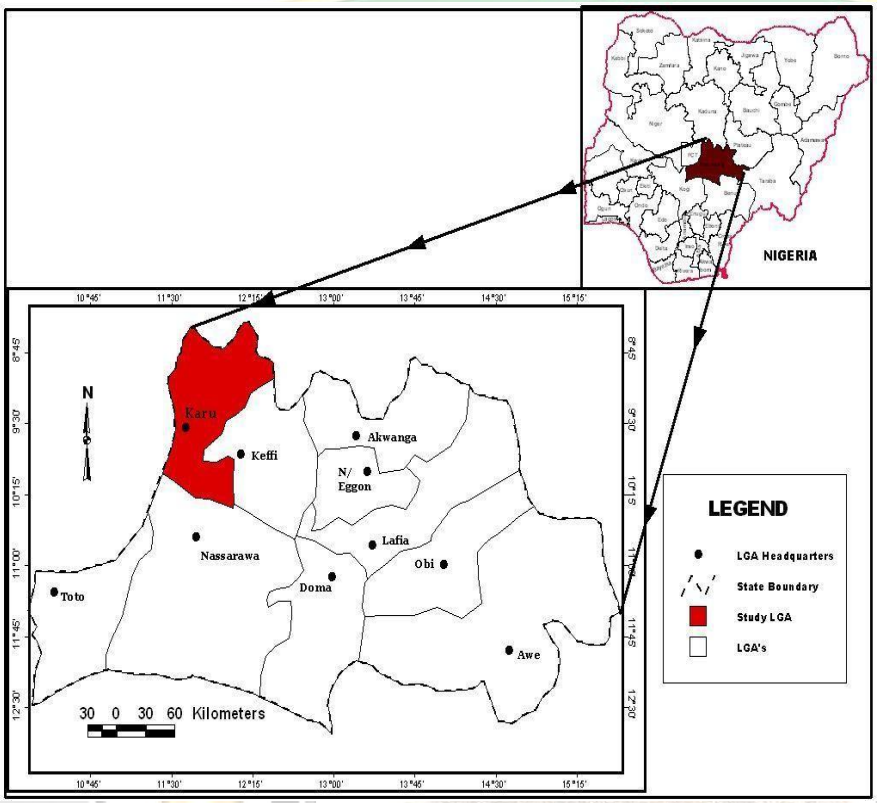

Figure 1: Nasarawa State showing Karu LGA
Source: Monitoring Environmental Sanitation in Greater Karu Urban Area (2023)

2. MATERIALS AND METHODS

Karu Local Government Area (LGA) is located in the north-central region of Nigeria, within Nasarawa State. Geographically, the area lies between latitude 8°59'46"N and longitude 7°34'32"E Figure 1. It experiences two distinct seasons: the wet season, which spans from April to October, and the dry season, which occurs between November and March. The dry season is often influenced by the Harmattan wind, a dry and dusty wind blowing from the Sahara Desert. The vegetation of the area is predominantly Guinea Savannah, characterized by scattered trees and grasses (Aboki, Mailafiya, & Osaba, 2007).

The study utilised both primary and secondary sources of data.
Primary data were obtained through field surveys using a structured questionnaire administered to selected households across rural and urban communities in Karu LGA.
Secondary data were drawn from published and unpublished materials such as journals, theses, dissertations, bulletins, seminar and conference papers, and official government publications,

including data from the National Bureau of Statistics (NBS, 2014) and the National Population Commission (NPC). Population data from the NBS (2014) were used to estimate the number of persons residing in Karu LGA, while NPC data were used to project the population of the selected communities, as shown in Table 1. The population cuts across diverse occupational groups irrespective of income level, social status, or educational background Figure 1.

The study employed a descriptive survey design to assess household cooking energy consumption among urban and rural dwellers in Karu LGA. A total of 400 households were selected proportionally from eight communities across four districts: Karu, Karshi, Panda, and Bagaji. The sampling was based on population projections and household representation. The sampling distribution is presented in Table 1.

Table 1: Sample distribution

S/N	District	Communities Selected	2014 Population	2024 Projected Population	Number of Households Selected
1.	Karu	Mararaba-Guruku	15,342	125,112	136
		Masaka	10,422	84,989	92
2.	Karshi	Karshi	4,784	39,013	42
		Piyanku	5,116	41,720	46
3.	Panda	Akwag	1,312	10,699	12
		Oyork	1,025	8,359	9
4	Bagaji	Gunduma	4,274	34,854	38
		Bagaji	2,723	22,206	25
	Total		**44,998**	**366,952**	**400**

Source: National Population Commission (NPC) and Researchers' Computation (2025)

Data were analyzed using quantitative and descriptive statistical techniques. Descriptive statistics such as frequency, percentage, mean, and standard deviation were employed to summarise the socio-economic and demographic characteristics of respondents, as well as patterns of cooking energy consumption. Furthermore, the Pearson Product-Moment Correlation was used to examine the relationship between socio-economic factors and the type and amount of cooking energy consumed. All analyses were conducted using Statistical Package for the Social Sciences (SPSS) version 20.0.

3. RESULTS AND DISCUSSION

Table 2: Socio-economic and Demographic characteristics of respondents

Variables		Frequency	Percentage (%)
Sex	Male	257	64.25
	Female	143	35.75
	Total	**400**	**100**
Age (years)	≤ 30	48	12.00
	31 – 40	93	23.25
	41 – 50	162	40.50
	51 – 60	67	16.75
	≥ 61	30	7.50
	Total	**400**	**100**
Marital status	Single	86	21.50
	Married	178	44.50
	Separated	59	14.75
	Widowed	42	10.50
	Divorced	35	8.75
	Total	**400**	**100**
Educational status	No formal education	79	19.75
	Primary education	34	8.50
	Secondary education	67	16.75
	Tertiary education	220	55.00
	Total	**400**	**100**
Household size	1 – 4	178	44.50
	5 – 8	125	31.25
	9 – 12	67	16.75
	≥ 13	30	7.50
	Total	**400**	**100**
Occupation	Civil servant	216	54.00
	Private sector	88	22.00
	Self employed	64	16.00
	Others	32	8.00
	Total	**400**	**100**
Monthly income (#)	< 39,999	38	9.50
	40,000 – 69,999	70	17.50
	70,000 – 99,999	83	20.75
	100,000 – 129,999	109	26.75
	130,000 – 159,999	68	17.00
	160,000 – 189,999	19	4.75
	> 190,000	15	3.75
	Total	**400**	**100**

Table 2 presents the socio-economic and demographic characteristics of respondents in Karu LGA. The results show that most household heads were male (64.25%), reflecting cultural norms where men are considered family heads, except in cases of widowhood or divorce. The dominant age group (41–50 years, 40.5%) represents the economically active population, suggesting stable income levels that influence cooking energy choices. A majority (44.5%) of respondents were married, underscoring higher domestic energy needs for family cooking activities. Educational attainment was relatively high, with 55% having tertiary education. This level of awareness

increases the likelihood of adopting cleaner energy options. This findings is consistent with findings by Abubakar, Alola, & Onifade, (2024) Table 2.

Regarding household size, 44.5% of respondents had between 1–4 members Table 2, indicating smaller households typical of semi-urban settings. Occupation data indicate that 54% of the population were civil servants, reflecting the area's proximity to Abuja and its semi-urban character. Monthly income distribution revealed that most households (26.75%) earned ₦100,000–₦129,999, implying moderate income capacity that could support a gradual shift toward modern fuels. Overall, the socio-economic profile indicates that income, education, and occupation remain key determinants of household energy choice in Karu LGA, corroborating previous findings by Alagbe & Danjuma (2025) and Heltberg (2005), which suggest that households with higher socio-economic status are more likely to transition to cleaner cooking fuels.

Table 3: Main Sources of Cooking Energy in Rural and Urban Households in the Study Area

Sources of Cooking Energy	Rural		Urban	
	Frequency	Percentage	Frequency	Percentage
Firewood	40	48.2	15	4.8
Charcoal	20	24.1	85	27.1
Electricity	3	3.6	27	8.6
Gas/LPG	1	1.2	156	49.7
Kerosene	2	2.4	20	6.4
Crop Residue	14	16.9	2	0.6
Sawdust	3	3.6	9	2.9
Total	**83**	**100.0**	**314**	**100.0**

Table 3 presents the main cooking energy sources used by rural and urban households in Karu Local Government Area. Among rural households, nearly half (48.2%) rely on firewood as their primary cooking energy source, followed by charcoal (24.1%) and crop residues (16.9%). Only a small proportion of households reported using electricity (3.6%), gas/LPG (1.2%), or kerosene (2.4%). This dominance of traditional biomass fuels underscores persistent dependence on unsustainable energy sources, which may contribute to deforestation and health risks from indoor air pollution. Similar patterns were observed in Gombe Metropolis by Ahmed, Isma'il, Hassan, Bello, Saidu, & Umar (2023) and in Ogun State by Obayelu, Lawal, & Omotulyole (2017), where rural communities exhibited limited access to cleaner cooking fuels.

In contrast, urban households in Karu LGA showed a different trend, with almost half (49.7%) using gas/LPG as their primary fuel, followed by charcoal (27.1%) and electricity (8.6%). Kerosene (6.4%), firewood (4.8%), and other biomass sources such as sawdust (2.9%) and crop residues (0.6%) accounted for smaller shares. This indicates that urban households are transitioning toward modern energy sources due to better access to infrastructure and higher income levels. Nevertheless, the continued use of charcoal and kerosene suggests that affordability and reliability challenges still influence energy choices. These findings align with Abubakar, Alola, & Onifade (2024), who identified income, education, and energy cost as significant determinants of household energy choice in Nigeria. Overall, the data reveal a clear rural–urban divide in cooking energy consumption patterns, emphasizing the need for targeted policies to promote clean energy adoption, particularly among low-income and rural households.

Table 4a: Relationship between Socioeconomic Characteristic of Rural Households and Cooking Energy Consumption in the Study Area

	Cooking Energy Consumption	Sex	Age	Marital Status	Level of Education	Income Level	Household Size	Type of House	Location of Kitchen	Occupation
Cooking energy consumption	1									
Sex	.557** .000 82	1								
Age	.875** .000 82	.567	1							
Marital status	.684** .000 82	.770	.775	1						
Level of education	.908** .000 82	.547	.940	.804	1					
Income level	.884** .000 82	.320	.778	.624	.849					
Household size	.855** .000 82	.637	.924	.868	.918	.805	1			
Type of house	.520** .000 82	.399	.646	.441	.526	.437	.628	1		
Location of kitchen	.731** .000 82	.745	.802	.955	.826	.708	919	.495	1	
Occupation	.943** .000 82	.399	.884	.763	.900	.884	.888	.632	.584	1

****: significant at 0.05 at 2-tailed**

Table 4b: Relationship between Socioeconomic Characteristics of Urban Households and Cooking Energy Consumption in the Study Area.

	Cooking Energy Consumption	Sex	Age	Marital Status	Level of Education	Occupation	Income Level	Household Size	Type of House	Location of Kitchen
Cooking energy consumption	1 314									
Sex	.567** .000 314	1								
Age	.873** .000 314	.598	1							
Marital status	.551** .000 314	.874	.636							
Level of education	.480 .000 314	.745	.604	.908	1					
occupation	.708** .000 314	.824	.811	.914	.833	1				
Income level	.661** .000 314	.879	.747	.932	.871	.961	1			
Household size	.761** .000 314	.760	.827	.872	.788	.867	.833	1		
Type of house	.902** .000 314	.638	.812	.607	.475	.758	.723	.792	1	
Location of kitchen	.933** .000 314	.525	.845	.499	.391	.664	.596	.804	.917	1

****: Significant at 0.05 at 2-tailed**

Tables 4a and 4b present the Pearson correlation results showing the relationship between socioeconomic characteristics and cooking energy consumption among rural and urban households in Karu Local Government Area. The results indicate that, in rural areas, significant relationships exist between cooking energy consumption and variables such as age ($r = 0.875$; $r^2 = 76.6\%$), level of education ($r = 0.908$; $r^2 = 82.4\%$), income level ($r = 0.884$; $r^2 = 78.1\%$), household size ($r = 0.855$; $r^2 = 73.1\%$), and occupation ($r = 0.943$; $r^2 = 88.9\%$). These high coefficients of determination suggest that these socioeconomic factors are major predictors of cooking energy choice in rural households. In contrast, sex ($r = 0.557$; $r^2 = 31\%$), marital status ($r = 0.684$; $r^2 = 46.8\%$), type of house ($r = 0.520$; $r^2 = 27\%$), and kitchen location ($r = 0.731$; $r^2 = 53.4\%$) show moderate relationships, implying that other unobserved variables may influence energy selection in these communities.

For urban households, the results reveal significant correlations between cooking energy consumption and several socioeconomic variables, with type of house ($r = 0.902$; $r^2 = 81.4\%$) and location of kitchen ($r = 0.933$; $r^2 = 87\%$) showing the highest coefficients of determination. Age ($r = 0.873$; $r^2 = 76.2\%$) also exhibited a strong relationship, while income level ($r = 0.661$; $r^2 = 44\%$), household size ($r = 0.761$; $r^2 = 46.4\%$), and occupation ($r = 0.708$; $r^2 = 50.1\%$) had moderate relationships. Meanwhile, sex, marital status, and level of education showed weaker relationships with cooking energy use. These findings indicate that in urban settings, housing characteristics and spatial factors (such as kitchen location) play a stronger role in determining energy choice compared to demographic factors.

Overall, the results suggest that socioeconomic variables significantly shape household energy behavior in both rural and urban areas, though the degree of influence varies. In rural settings, economic and educational factors are more critical, while in urban areas, physical and infrastructural conditions dominate. This pattern aligns with the findings of Oke, Olugbire, Bolaji-Olutunji, Kolade, & Adisa (2023), who reported that household income, size, and occupation strongly influenced cooking fuel choice in Oyo State. Similarly, Emagbetere, Odia, and Oreko (2016) found that income, educational attainment, and dwelling type were significant predictors of cooking energy use in Lagos State. The observed rural–urban contrast further supports the argument by Abubakar, Alola, & Onifade (2024) that energy transition in Nigeria is heavily mediated by socioeconomic capacity and access to infrastructure. Hence, policies promoting clean and efficient cooking fuels must consider these demographic and contextual disparities to enhance equitable energy access and environmental sustainability.

4. CONCLUSION

This study investigated how household socio-economic characteristics influence cooking energy consumption in Karu Local Government Area, Nasarawa State. Findings revealed a distinct rural–urban disparity in energy use: rural households largely depend on traditional biomass fuels such as firewood, charcoal, and crop residues, whereas urban households increasingly adopt modern fuels like liquefied petroleum gas (LPG) and electricity. In rural areas, factors such as income, education, household size, and occupation significantly shaped energy choice, while in urban areas, housing type and kitchen location were stronger determinants. These results emphasise that socio-economic status, infrastructural access, and awareness collectively constrain the transition toward clean cooking energy in the study area.

5. RECOMMENDATIONS

There is a need to increase access to cleaner and more efficient cooking energy sources like Gas/LPG and electricity in rural communities; targeted subsidization and distribution programs should be implemented. This will reduce reliance on less efficient and more harmful cooking energy like firewood and crop residue.

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