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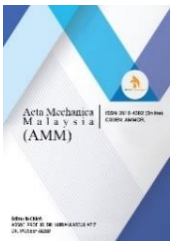

RESEARCH ARTICLE

HOUSEHOLDS FUEL CONSUMPTION PREFERENCES: EMPIRICAL EVIDENCE FROM JOS-NORTH, NIGERIA

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ABSTRACT

In developing countries, more than 2.5 billion people depend on fossil and biomass fuels as their main source of household fuel for cooking, heating, and lighting. This study therefore evaluates factors affecting fuel consumption preferences among rural households in Jos-North, Plateau State, Nigeria. *The research utilized various sampling methods. Information was gathered from 113 participants and analyzed using descriptive statistics and Weighted Average Index (WAI). The results revealed that* the most common fuel variants in the area were charcoal (92%), fuel wood (82%) and *kerosene (71%). Also, mean monthly income and fuel consumption expenditure per household was* ₦36,850 and *₦7,150, respectively.* Further, the factors affecting households' fuel consumption preferences are significant and as such affected consumption preferences among respondents in the area; as indicated by factors including fuel cost (2.46), fuel efficiency (2.33), fuel availability (2.31), fuel safety (2.27) and fuel emission (2.19). This study therefore recommends adoption of policies that regulates and subsidizes prices of fuel variants; development of efficient and environmentally compatible fuel alternatives or substitutes; that maximizes households' needs, mitigates environmental degradation and high carbon emissions. In addition, policies that will ensure adequate supply and availability of fuel variants, mitigate consumption constraints, as well as facilitate equity in income redistribution among low-income households are also suggested.

KEYWORDS

consumption preferences, fuel expenditure, fuel variants, households' income, weighted average index

1. INTRODUCTION

Household fuel consumption is the amount of energy resources used by households for various purposes such as cooking, lighting, and heating (Emagbetere et al., 2016). These energy resources include fossil and biomass fuels like farm or household residues, kerosene, LPG fuels, PMS fuels, charcoal, and fuel wood (IEA, 2014). Energy resources are essential for modern life convenience. All sectors, from households to businesses, rely heavily on various energy sources to operate. The use of household fuels varies significantly from country to country due to differences in climate, policies, economic development, and other factors (Bhattacharyya, 2011). The household sector is considered one of the most important energy consumption sectors (Musago, 2014; Wang et al., 2011). About 30% of the world's total energy consumption comes from the household sector (Tsue et al., 2016). Energy plays a vital role in the social, economic, and industrial development of nations (Chukwu et al., 2014; Oyedepo, 2012). Solid fuels are used for household cooking by almost half of the world's population (Bonjour et al., 2013). Access to modern, affordable, and reliable energy sources is a major challenge in Africa, particularly in Nigeria (Baiyegunhi and Hassan, 2014). Household cooking fuels make up a significant portion of the total energy consumed in Nigeria (Oyedepo, 2012). Fuel consumption in households is greater in less developed countries (Daioglou et al., 2012). Cooking fuel makes up 65% of total energy consumption in countries that are less industrialized (Adeyemi and Adereleye, 2016). Households require fuel for a variety of purposes, with cooking being the most significant and accounting for the highest proportion of total household fuel consumption (Oyedepo, 2012). Different economic variables have therefore led to either a switch in the fuel consumption preferences and combinations among households (Lam et al., 2012; Bello and Roslan, 2010). One crucial element needed to transition to different household fuels in countries such as Nigeria is the presence of other available options. Therefore, biomass fuels appear to be more widely used in these regions (Kadiri and Alabi, 2014; Daioglou et al., 2012).

Despite the abundance of renewable, environmentally friendly energy sources (e.g. solar and hydro energy), approximately more than 2.5 billion individuals in developing nations depend on fossil and biomass fuels for cooking, heating, and lighting in their homes (Hossain, 2012; Kowasari and Zerriffi, 2011). Fuel wood and charcoal are commonly used household fuels in these regions, despite the pollution they cause, leading to health risks (Bisu et al., 2016). Traditional biomass fuels are prevalent in both urban and rural areas of developing countries due to their abundance (Dogo et al., 2019 and Umar et al., 2016). The use of these fuels contributes to various environmental issues such as air pollution, deforestation, and soil erosion (Toole, 2015). The World Health Organization estimates that over a million people die prematurely each year due to the use of these household fuels (WHO, 2015). Indoor air pollution from biomass fuels is ranked as the eighth largest health risk worldwide (WHO, 2015). Efforts have been made to reduce biomass consumption in order to improve the well-being of vulnerable households, as recommended by the Millennium Development Goals and the United Nations Millennium Project (Sa'ad and Bugaje, 2016; Suliman, 2010). In Africa, biomass fuels meet about 50% of the continent's energy needs (IEA, 2011). Other household fuel options include kerosene, PMS fuels, LPG fuels, and farm or household residues. Various studies have been conducted to analyze the use of household fuel

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in Nigeria. A study in 2016 focused on the cooking energy choices of urban households in Bauchi metropolis (Bisu et al., 2016). Another study investigated the cooking energy consumption patterns of households in Ikeja, Lagos state (Emagbetere et al., 2016). Researchers studied the factors influencing the sources of energy used for cooking in rural and urban areas of southwestern Nigeria (Olufemi et al., 2012).

The concept of the energy ladder has been utilized by many researchers to understand the dynamics of household fuel consumption in developing nations (Otte, 2014; Kowasari and Zerriffi, 2011; Arthur et al., 2010). These studies however focused on the various types of household's fuel and its utilization, with little or no information on the factors affecting household's fuel consumption preferences and expenditures. The significance of income in influencing household energy consumption and fuel choices is not given enough attention (Alem et al., 2015). It is crucial to understand how households use fuel in order to develop policies and interventions that promote the use of cleaner and more efficient fuels (Van der Kroon et al., 2013). The amount and type of energy used in a country's economy are important indicators of its economic development level (Maina et al., 2019). Thus, provision of modern and efficient energy sources is critical for economic development ecosystem management (IEA, 2014). This study will identify the variants of fuel available for households use and evaluate if the existing fuel consumption trends are eco-friendly and beneficial. This will be used as a foundation for creating long-lasting policies regarding the fuel consumption of households. The study will also provide insight into households' energy needs that facilitates partnerships with energy regulatory institutions and agencies. Also, it will provide empirical data for further research on household's fuel consumption preferences. This research aims to address the knowledge gaps mentioned above by providing in-depth empirical evidence. The goal is to aid in the development of policies and interventions that encourage the use of cleaner and more efficient fuels, ultimately enhancing the quality of life for households in developing countries, specifically Nigeria. This study therefore evaluates factors affecting fuel consumption preferences among rural households; and specifically aims to:

i. identify the variants of fuel consumed by rural households;
ii. assess the level of monthly household income;
iii. ascertain the monthly expenditure on fuel consumption among rural households; and
iv. evaluate the factors affecting fuel consumption preferences among households in the area.

2. Methodology

2.1 Study Area

The research was conducted in the Jos North Local Government Area (LGA) of Plateau State, Nigeria. This LGA is situated between longitude 8°40'N and 9°50'E, as well as latitude 9°40'N and 10°45'E (NBS, 2010). The area experiences an average temperature ranging from 18°C to 30°C, with an elevation of 1,500 meters above sea level and an annual rainfall of 1,300mm to 1,500mm (NBS, 2010). Jos North LGA is characterized by hilly terrain, mountains, forests, rivers, settlements, and farmland. Furthermore, it spans a total of 291km^2 (NBS, 2010). The urban nature of the region offers benefits like access to infrastructure and amenities such as roads, water and electricity supply, as well as various social and cultural activities.

2.2 Sampling Procedure

A multi-stage sampling method was utilized for the research. Initially, Gwong district was chosen as the sole district in the LGA. Following that, six out of the fourteen communities in Gwong district were selected in the second stage, which included Jenta-Adamu, Apata, Jos-Jarawa, Naraguta A, Naraguta B, and Tudun-Wada (Kabong) due to the high number of households in these areas. Subsequently, a sample frame for each of the chosen communities was created by local enumerators from the Program Coordinating Unit (P.C.U) at the LGA secretariat in the third stage. In the final stage, households were randomly selected from each community using a constant proportionality rule of 10% (0.1). This resulted in a sample size of 113 respondents, which was verified with raosoft sample size calculator at a 95% confidence level and 5% margin of error. The details of the sample frame and size distribution can be found in Table 1.

Table 1: Sample Frame and Size Distribution

s/n	Community	Sample frame	Sample Size
1	Jenta-Adamu	213	21
2	Apata	167	16
3	Jos-Jarawa	131	13
4	Naraguta A	124	12
5	Naraguta B	195	19
6	Tudun-Wada (Kabong)	322	32
	Total	1,152	113

Source: Jos-North LGA, Program Coordinating Unit (P.C.U), Plateau State

2.3 Method of Data Collection

Structured questionnaires were used to gather primary data for the study, aligning with its objectives.

2.4 Analytical Techniques

Descriptive and inferential statistics was used to analyze data collected. Descriptive statistics (frequency distribution, mean and percentages) was used to analyze objectives i, ii, and iii, while the Weighted Average Index (WAI) was used to analyze objective iv.

2.5 Weighted Average Index

Weighted average index (WAI) analysis is an index ranking method that was used to evaluate the factors affecting household's fuel consumption preferences. To determine the weight of each scale, each item was calculated by multiplying the frequency of each response pattern by its appropriate nominal value and dividing the sum by the number of respondents to the items. Responses for the components are rated by using a three-point scale with the scoring order. Given that; 1= Indifferent (I), 2 = Agree (A) and 3 = Strongly Agree (S.A). A weighted average index (WAI) analysis was then estimated and presented in equations 1 and 2. It was adapted from (Onuwa and Folorunsho, 2022):

$$\sum f_i w_i \div N \quad (1)$$

$$WI \div N \quad (2)$$

Where:

$\sum$=Summation; F_i= frequency of 'i' occurrence; W_i= weight of each scale; WI = weighted index; and

N = number of respondents

The advantages were ranked based on their average weight. This was calculated using equation (3):

$$\text{Average weight (WA)} = \Sigma s / r \quad (3)$$

Where: Σs = Summation of scoring order; and r = scale rating (3-point scale)

$\sum s = 1+2+3=6$; $=6 \div 3=2$. Thus, weighted average index ≥2 was considered to be critical.

3. Results and Discussion

3.1 Fuel Variants Consumed

Table 1 shows that the majority of participants (92%) used charcoal, followed by fuel wood (82%), kerosene (71%), LPG fuel (36%), PMS fuel (6%), and Farm/Household residues (3%). This suggests that the use of charcoal was widespread in the area surveyed. Additionally, the research uncovered that there was a significant shortage and high prices of kerosene, LPG fuel, and PMS fuel in the area, due to the absence of gas stations and as such most households depend on retailers and other parallel markets for their supply at exorbitant rates. *According to researchers, charcoal and fuel wood are commonly used as household fuels because they are easily accessible through free collection from the forest or direct purchase (Massawe et al., 2015).*

Table 1: Distribution based on Fuel Variants Consumed		
Sources of energy	***Frequency****	***%***
Charcoal	*104*	*92*
Fuel wood	93	*82*
Kerosene	*80*	*71*
LPG fuel	41	*36*
PMS fuel	6	*5*
Farm/Household residues	*3*	*3*

(Field survey, 2022); *Multiple choice responses

3.2 Level of Income

Table 2 revealed that the mean household monthly income was ₦36,850; also, *most (68%) of the respondents earn monthly income of ≤₦39,000, 24% earn between ₦40000-₦69000 and 8% earned ≥₦80,000.* The findings show that the majority of households fell within the low-income category.

The higher the income the more options households would have regarding fuel consumption preferences. According to Vihi *et al.* (2022) the dependence of lower income households on fuel wood as source of energy is due to lack of purchasing power for other alternatives. Also, fuel wood harvesting had a negative effect on the environment as it results to the depletion of forest cover.

Table 2: Distribution of Participants According to their Monthly Income Level		
Income (₦)	**Frequency**	**%**
≤39,000	77	68
40,000 - 69,000	27	24
≥ 70,000 Mean: 36,850	9	8

Source: Field survey (2022)

3.3 Fuel Consumption Expenditure

Table 3 revealed that the mean monthly expenditure per household on fuel consumed was ₦7,150; also, 50% of the respondents have monthly fuel expenditure of ₦7,000 - ₦13,999, ≤₦66,999 comprised *47% and 3% spent* ≥₦14,000 monthly on household fuels consumed. *This implies that expenses on fuel consumption are a major component of households' consumption expenditure in the area.* This conforms to a study in 2017, that stated the price and expenditure on fuel variants is one factor that affects consumption preferences (Obayelu et al, 2017).

Table 3: Distribution based on Households Monthly Fuel Consumption Expenditure		
Monthly Expenditure (₦)	**Frequency**	**%**
≤6,999	54	47
7,000 - 13,999	56	50
≥ 14,000	3	3
Mean: 7,150		

Source: (Field survey, 2022)

3.4 Factors Affecting Households Fuel Consumption Preferences

From the result in Table 4, the factors evaluated significantly affected households' fuel consumption preferences in the area. This was indicated by the critical value of the weighted average index of factors such as fuel cost (2.46), fuel efficiency (2.33), fuel availability (2.31), fuel safety (2.27) and fuel emission (2.19) as reflected. This outcome aligns with the findings of previous studies, which reported similar results in their research on the factors that influence households' preferences for fuel consumption (Buba et al., 2017; Obayelu et al., 2017).

Table 4: Factors Affecting Households Fuel Consumption Preferences						
Variables	**SA**	**A**	**I**	**$\sum f_i w_i$**	**WI**	**Rank**
Fuel Cost	69	27	17	278	2.46	1st
Fuel efficiency	60	30	23	263	2.33	2nd
Fuel availability	58	33	22	262	2.31	3rd
Fuel safety	50	43	20	256	2.27	4th
Fuel emission	44	56	13	247	2.19	5th

Source: (Field survey, 2022); SA= strongly agree, A= agree, I= indifferent

4. Conclusion and Recommendations

The study revealed that several factors influenced households' fuel consumption preferences in the study area. Also, several fuel variants were identified in the area, while the most prevalent fuel variants were charcoal and fuel wood. Further, most of the households were in the low income bracket. Also, *expenses on fuel consumption are a major component of households' consumption expenditure in the area. Additionally,* the significant factors that affect households' fuel consumption preferences in the area include fuel cost, fuel efficiency, fuel availability, fuel safety and fuel emission. The results of this research suggest the following recommendations:

i. Policy formulation that regulates price volatility and commodity cost.

ii. Adoption of price control measures for and subsidization of selected fuel variants to minimize household expenditure on fuel consumption.

iii. Development of efficient, low-cost and environmentally compatible household fuel alternatives.

iv. Development and adoption of fuel variants that maximizes households' needs.

v. Policy formulation that ensures adequate supply and availability of household fuels.

vi. Policy formulation to regulate utilization of fuel variants that result to environmental degradation and high carbon emission.

vii. Policy modifications that improves income redistribution among low-income households.

References

Adeyemi, P.A and Adereleye, A., 2016. Determinants of Household Choice of Cooking Energy in Ondo State, Nigeria. Journal of Economics and Sustainable Development, 7(9), Pp. 131-142.

Alem, Y., Beyene, A.D., Kohlin, G., Mekonnen, A., 2015. Modelling household cooking fuel choice: A panel multinomial logit approach. Working papers in Economics No 632. University of Gothenburg.

Arthur, M.S.R., Zahran, S., Bucini, G., 2010. On the adoption of electricity as

a domestic Source by Mozambican households. Energy Pol., 38 (11), Pp. 7235-7249.

Baiyegunhi L.J.S. and Hassan M.B., 2014. Rural household fuel energy transition: Evidence from Giwa LGA Kaduna State, Nigeria. Energy Sustainable Development, 20 (1), Pp. 30-35

Bonjour, S., Adair-Rohani, H., Wolf, J., Bruce, N. G., Mehta, S., Prüss-Ustün, A., and Smith, K. R., 2013. Solid fuel use for household cooking: country and regional estimates for 1980–2010. Environmental Health Perspectives, 121 (7), Pp. 784-796

Bello, M.A., and Roslan, A.H., 2010. Has Poverty Reduced in Nigeria 20 Years After? European Journal of Social Sclence. 15 (2), Pp. 7-19.

Bhattacharyya, S.C., 2011. Energy Economics Concepts, Issues, Markets and Governance. SpringerVerlag Limited, London.

Bisu D. Y., Kuhe, A., and AondoverIortyer, H., 2016. Urban household cooking energy choice: an example of Bauchi metropolis, Nigeria. Energy, Sustainability and Society, 6 (2), Pp. 15-29.

Buba, A., Musa, A., Idi, A., Yusuf, U.J., 2017. Socio-Economic Determinants of Households Fuel Consumption in Nigeria: International Journal of Research Granthaalayah, 5 (10), Pp. 348-360.

Bukola, O.B., 2012. Effects of Unsustainable Use of Biomass for Cooking and Strategies for Their Reduction in Developing Countries. Developing Country Studies, 2(3), Pp. 19-25. www.iiste.org.

Chukwu P.U., Ibrahim I.U., Ojosu J.O., and Iortyer H.A., 2014. Sustainable energy future for Nigeria: The role of engineers. Journal of Sustainable Development Studies, 6 (2), Pp. 242-259

Daioglou, V., Van Ruijven, B.J., and Van Vuuren, D.P., 2012. Model projections for household energy use in developing countries. Energy, 37 (1), Pp. 601-615

Dogo Simeon, B., Wendock, N., Friday, B., and Madaka, M., 2019. Fuel wood Exploitation and its impacts on Residents of Kakau Daji Village, Chikun Local Government Area, Kaduna State, Nigeria. E-Newsletter.

Emagbetere E., Odia J. and Oreko B.U. (2016). Assessment of household energy utilized for cooking in Ikeja, Lagos State, Nigeria. *Nigerian Journal of Technology*, 35 (4), 796-804

Eakins, J., 2013. An Analysis of the Determinants of Household Energy Expenditures: Empirical Evidence from the Irish Household Budget Survey. PhD Thesis, University of Surrey, UK.

Hossain K.A. (2012). Global energy consumption pattern and GDP. Int. Journal of Renewable Energy Technol. Resources, 1 (1), Pp. 23-29

International Energy Agency (IEA) (2014). Energy Poverty. Available at: http://www.iea.org/topics/energypoverty/ [Accessed 28-4-2014].

International Energy Agency (IEA), 2011. Energy for cooking in developing countries. World Energy Outlook 2011 (3rd ed.): Paris, France. IEA publications

Kowasari,R., Zerriffi, H., 2011. Three-dimensional energy profiles: A conceptual framework for assessing household energy use. Energy Policy 39, Pp. 7505–7517

Kadiri, K.O., Alabi, O.A., 2014. Household energy consumption pattern in Offa City, Kwara State, Nigeria. J. Sci. Research & Report, 3(11), Pp. 1499-1506.

Lam, N.L., Kirk, R.S., Alison, G., Michael, N.B., 2012. Kerosene: A review of household uses and their hazards in low-and middle-income countries. Journal Toxicol. & Environ. Health, Part B 15 (6), Pp. 396-432.

Maina, Y.B., Kyari, B.G., and Maina, M.B., 2019. Socio-Economic Determinants of Household Dirty-Energy use in Nigeria. Journal of Agricultural Economics, Environmental and Social Sciences 5(1&2), Pp. 64 – 71.

Massawe, F.A., Bengesi, K.M.K., and Kweka, A.E., 2015. Pattern of household cooking energy and associated factors: Experience from Kilimanjaro Region, Tanzania. The Stanford Journal of Science Technology and Society. 8(3), Pp. 1 – 25.

Musago, J., 2014. Household electricity access and consumption behavior in an urban environment: The case of Gauteng in South Africa. Energy for Sustainable Development, 23, Pp. 305 – 316.

National Bureau of Statistics (NBS). 2010. Statistical Survey report 2010. NBS Bulletin.

Obayelu, A.E., Lawal, I.B., and Omotulyole, I.A., 2017. Comparative analysis of access, and preferences of rural and urban household for cooking energy and determinants in Nigeria: A case of Ogun State. Agricultural Tropica et Subtropica, 50 (1), Pp. 45 – 53.

Olufemi, O., Desalu, O., Ololade, O., Ebenezer, K., Tolutope, F., and Ayodele, I., 2012. A community survey of the pattern and determinants of household sources of energy for cooking in rural and urban Southwest, Nigeria. The Pan African Medical Journal, 12 (2), Pp. 25-39. doi:10.11604/pamj.2012.12.2.1436

Onuwa, G., and Folorunsho, S., 2022. Determinants of Tomato Farmers Participation in Agricultural Services and Training Centre (ASTC) Activities, Turkish Journal of Agriculture-Food Science and Technology (TURJAF), 10(8), Pp. 1369-1376, DOI: https://doi.org/10.24925/turjaf.v10i8.1369-1376.4905

Otte, P.P., 2014. Warming to solar cooking a comparative study on motivations and the adoption of institution solar cookers in developing countries. Energy Procedia, 57 (1), Pp. 1632-1641. Doi.org.10.1015/j.egypro.2013.10.154

Oyedepo S.O. (2012). Energy and sustainable development in Nigeria: The way forward. Energy, Sustainability and. Society, 15 (2), Pp. 1-17

Suliman, M.K. (2010). Factors Affecting the Choice of Households' Primary Cooking Fuel in Sudan. Research report presented to the Economic Research Forum, Cairo, Egypt.

Sa'ad, S., and Bugaje, I.M., 2016. Biomass consumption in Nigeria: Trends and policy issues. J. Agricul. and Sustain. 9(2), Pp. 127-157

Toole, R., 2015. The energy ladder: A valid model for household fuel transition in Sub Saharan Africa? MSc thesis submitted to the Department of Urban and Environmental planning and Economics. Tufts University, USA.

Tsue, P.T., Gidado, E.H., and Abah, D., 2016. Cooking Energy Demand among Rural Farmers in Gboko Local Government Area, Benue State, Nigeria. Journal of Agricultural Economics, Extension & Science (JAEES), 2(1), Pp. 71-80.

Umar, O.U., Nura, S., Dahiru, M.M., and Isa, M.A., 2016. Effect of fuel wood exploitation on the environment. A case study of Nassarawa Local Government Area, Nassarawa State, Nigeria. Journal of Pure and Applied Science, 2(1), Pp. 159 – 201.

Van der Kroon, B., Brouwer, R., Van Beukering, J.H., 2013. The energy ladder: Theoretical myth or empirical truth? Results from a meta-analysis. Renew. & Sustain. Energy Reviews, 20 (2), Pp. 504-513.

Vihi S. K, Momoh, Y. O Markwinm f.M, Chomini, E.A., Onuwa, G.C Seizing, P.M., and Ochelle B. (2022). Analysis of Household Fuel wood Consumption as Cooking Energy and Implication on Environment: A case study deikya Local Government Area of Benue State, Nigeria. UMYU Scientica, 1(1), Pp. 241 – 253. http://doi/org/10.56919/usci.1122.031.

Wang, Z., Zhang, B., Yin, J., and Zhang, Y., 2011. Determinants and policy implication of household electricity saving behaviour: Evidence from Beijing China. Energy Policy, 39, Pp. 3550-3557.

World Health Organization (WHO), 2015. Reducing the Risks, Promoting Healthy Life. The World health report; 2015. Geneva