

Assessing Clean Cooking Energy Utilization Among Households in North-Western States of Nigeria: Evidence from NDHS 2018 Data

Sani, J.¹, Ahmed, A.², Hassan, A. W.², Usman, J.³, Wali, I. G.¹, Iyonom, B. I.⁴, Ahmad, B. B.⁵ and Khalid, U. S.⁶

¹Department of Demography & Social Statistics, Federal University Birnin Kebbi

²Department of Geography & Environmental Management, Ahmadu Bello University, Zaria

³Department of Geography, Gombe State University, Gombe

⁴Department of Social and Environmental Forestry, Joseph Sarwuan Tarka University, Makurdi

⁵Department of Science Education, Physics Education Unit, Ahmadu Bello University, Zaria

⁶Department of Geography, Federal College of Education (Technical) Bichi, Kano State

Corresponding Author's email: jamilu.sani@fubk.edu.ng

Received on: October, 2024 Revised and Accepted on: November, 2024

Published on: December, 2024

ABSTRACT

The use of clean cooking fuels is crucial for enhancing public health and environmental sustainability. However, in many low-income regions, including North-Western Nigeria, the reliance on unclean fuels remains high, contributing to adverse health outcomes and environmental degradation. This study assesses the utilization of clean energy and identifies household factors influencing the adoption of clean cooking fuels among households in North-Western Nigeria, while analysing disparities across states. Data from the 2018 Nigeria Demographic and Health Survey (NDHS) were analyzed, focusing on the household recode (HR) file, resulting in a sample of 9,509 households across Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa, and Kaduna state. Descriptive statistics and bivariate analysis were employed to assess the proportion of households using clean versus unclean cooking fuels and to identify sociodemographic factors associated with clean fuel usage. The analysis revealed that approximately 95% of households relied on unclean fuels, such as wood, kerosene, and charcoal, while only 5% used clean fuels, including electricity and liquefied petroleum gas (LPG). Significant variations were observed among the states, with Kano having the highest proportion of clean fuel usage at 8.87%, while Sokoto had the lowest at 0.42%. Wealth, educational attainment, and urban residence were strong predictors of clean fuel use. These findings underscore the urgent need for targeted interventions to promote the adoption of clean cooking fuels in North-Western Nigeria, addressing barriers to usage and improving access to clean energy sources to enhance public health and environmental sustainability.

Keywords: Clean cooking fuels, Household energy, Public health, Energy poverty, NDHS

1.0 INTRODUCTION

The use of clean cooking fuels is critical to achieving several global health and environmental goals, including reducing household air pollution, improving respiratory health, and mitigating climate change. According to the World Health Organization (WHO), over 3 billion people worldwide rely on solid fuels, such as wood, charcoal, and dung, for cooking, leading to significant health risks, including respiratory infections, cardiovascular diseases, and cancer (Frostad, Nguyen, Baumann, Blacker, Marczak, Deshpande...Abbasi-Kangevari (2022); WHO, 2021). In sub-Saharan Africa, where the reliance on unclean cooking fuels is particularly high, household air pollution contributes to approximately 400,000 deaths annually (Fisher et al., 2021).

Nigeria, Africa's most populous country, exemplifies the challenges associated with transitioning to clean cooking fuels. Despite being a major oil-producing nation, the adoption of clean cooking technologies, such as liquefied petroleum gas (LPG), remains limited, particularly in rural and low-income regions (Shari et al., 2022). In North-Western Nigeria, the

reliance on traditional biomass fuels is especially pronounced, exacerbated by factors such as poverty, low educational attainment, and limited infrastructure (Eleri, 2021).

The health implications of using unclean cooking fuels are severe. The combustion of biomass fuels releases harmful pollutants, including particulate matter (PM_{2.5}), carbon monoxide (CO), and polycyclic aromatic hydrocarbons (PAHs), which are linked to various respiratory and cardiovascular diseases (WHO, 2021). Women and children, who spend more time near cooking areas, are disproportionately affected by these pollutants, leading to a higher incidence of health problems among these groups (Fakunle et al., 2017).

Several studies have highlighted the sociodemographic factors influencing the adoption of clean cooking fuels. Wealth is a significant determinant, with richer households more likely to afford clean energy sources, such as LPG or electricity (Dongzagla & Adams, 2022). Educational attainment is another critical factor, as it enhances awareness of the health risks associated with unclean fuels and the benefits of cleaner

alternatives (Rahut et al., 2019). Additionally, urban residence often correlates with higher rates of clean fuel adoption due to better access to energy infrastructure and greater availability of clean fuels (Rahut et al., 2019).

Despite the known benefits of clean cooking fuels, their adoption in Nigeria remains low, particularly in rural and low-income areas. This study seeks to explore the sociodemographic characteristics of households that influence clean cooking fuel adoption in North-Western Nigeria, where the use of traditional biomass fuels is prevalent. By examining the disparities in clean fuel use across different states and identifying the key factors associated with their adoption, this research aims to provide insights that can inform targeted interventions to promote the transition to clean cooking technologies in this region.

2.0 METHODS

2.1 Study Setting

The research was conducted across the seven North-western (NW) states of Nigeria, which are characterized by high rural populations and a prevalent reliance on traditional cooking fuels. The states involved in the study include Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa, and Kaduna. These are particularly vulnerable to household air pollution.

2.2 Data Source and Study Sample

Data for this study was sourced from the 2018 Nigeria Demographic and Health Survey (NDHS), specifically utilizing the household recode (HR) file. The NDHS is a comprehensive nationwide survey that gathers information on various aspects of households, including demographics, socioeconomic status, and health indicators. Only households with data on the type of cooking fuel were included in the analysis, resulting in a final sample of 9,509 households.

2.3 Study Variables

Dependent variable:

The study categorized households in North-western Nigeria based on their primary cooking fuel type. "Clean" fuels included electricity, liquefied petroleum gas (LPG), natural gas, and biogas, while "unclean" fuels included kerosene, coal, charcoal, wood, straw/shrubs/grass, agricultural crop residues, and animal dung. This classification aligns with World Health Organization (WHO) guidelines on clean cooking fuels and technologies. The outcome variable was encoded as a binary variable: "0" for unclean fuel type and "1" for clean fuel type. This coding scheme allowed for a direct comparison of the prevalence and factors associated with clean and unclean cooking fuel use in the region.

Independent variables:

The independent variables of the study focused mainly on the sociodemographic characteristics of households. They include: number of household members, age of head of household, sex of head of household, wealth index, education level of head of household, residence and state.

2.4 Data Analysis

Descriptive statistics were used to examine the frequency and distribution of different fuel types, comparing the original DHS categories to our newly defined clean and unclean fuel classifications. Pie chart, bar chart, and map were employed to visualize these distributions and disparities in cooking fuel utilization across the North-western states of Nigeria. Chi-square tests were conducted to identify factors associated with clean cooking fuel utilization. The analysis was performed using STATA 17, with sample weights applied to account for the complex sampling design of the DHS surveys.

3.0 RESULTS

3.1 Sociodemographic Characteristics of Households

The study analysed 9,509 households across the North-Western states of Nigeria. A significant proportion of households had 4-6 members (36.4%), while the majority of household heads were aged between 35-49 years (36.7%). The data revealed a predominantly male-headed household structure, with 92.3% of households being led by males. In terms of wealth distribution, the poorest households accounted for 32.7% of the sample, whereas only 8.8% were categorized as the richest. Educational attainment was notably low, with 52.7% of household heads having no formal education. Additionally, a substantial majority of households (71.1%) were located in rural areas.

Table 1: Sociodemographic Characteristics of Households (N = 9,509)

Variable	Weighted Freq.	Percent
Household members		
1-3	2,472	25.9%
4-6	3,465	36.4%
7-9	2,038	21.4%
10+	1,534	16.1%
Age of household head		
14-24	418	4.4%
25-34	2,338	24.6%
35-49	3,486	36.7%
50-64	2,125	22.3%
65+	1,142	12.0%

IJSGS FUGUSAU VOL10 (4)

WEBSITE: <https://fugus-ijsgs.com.ng>

Sex of household head		
Male	8,777	92.3%
Female	733	7.7%
Wealth index		
Poorest	3,112	32.7%
Poorer	2,814	29.6%
Middle	1,716	18.0%
Richer	1,034	10.9%
Richest	834	8.8%
Highest education		
No education, preschool	5,011	52.7%
Primary	1,640	17.3%
Secondary	1,722	18.1%
Higher	1,136	11.9%
Place of residence		
Urban	2,748	28.9%
Rural	6,761	71.1%
State		
Sokoto	833	8.8%
Zamfara	1,021	10.7%
Katsina	1,721	18.1%
Jigawa	1,088	11.4%
Kano	2,049	21.5%
Kaduna	1,887	19.9%
Kebbi	910	9.6%

Source: NDHS, 2018

3.2 Cooking Fuel Types and Proportion of Clean and Unclean Energy

The analysis of cooking fuel types revealed a stark contrast in the use of clean versus unclean fuels. The majority of households (94.6%) relied on unclean cooking fuels such as wood, charcoal, and animal dung. Clean fuels, including electricity, liquefied petroleum gas (LPG), and natural gas, were used by only 5.4% of households. This significant disparity underscores the reliance on traditional fuels in the region, which poses health risks due to household air pollution and exacerbate environmental degradation.

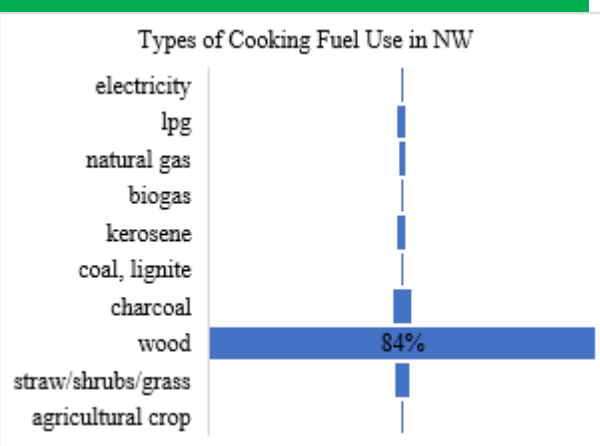


Figure 1: Proportion of types of cooking fuel use by households in Northwest
Source: NDHS, 2018

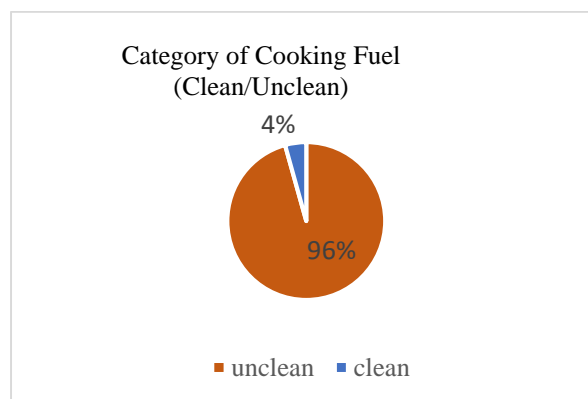


Figure 2: Category of cooking fuel utilised by Households – clean vs. unclean
Source: NDHS, 2018

3.3 Disparities in Cooking Fuel Utilization Across States

There were notable disparities in the utilization of clean cooking fuels across the North-Western states (Figure 3, 4). The highest proportion of clean fuel usage was observed in Kano (8.87%) and Kaduna (8.53%), while states like Sokoto (0.42%) and Kebbi (0.32%) had the lowest rates of clean fuel adoption. The stark differences in fuel usage across states highlight the regional inequalities in access to clean cooking energy, with certain states lagging significantly behind others.

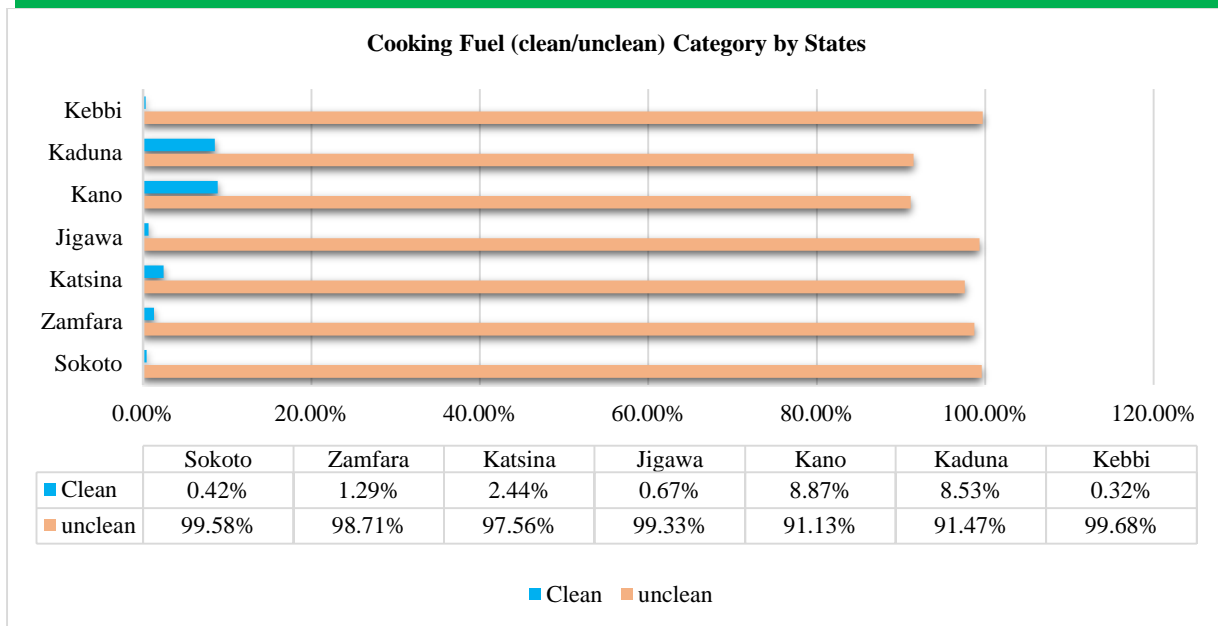


Figure 3: Categories of cooking fuel utilisation by states
Source: NDHS, 2018

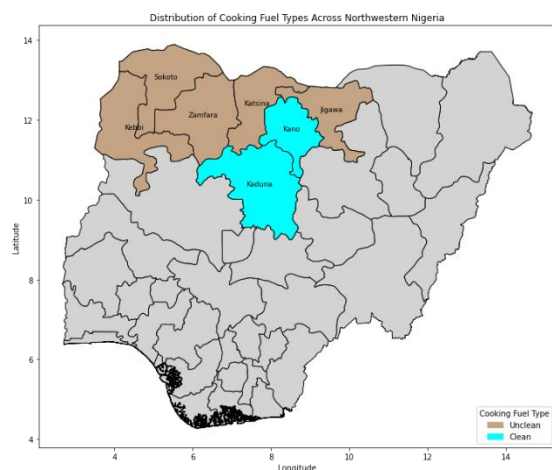


Figure 4: Map of Nigeria
Source: Adapted from Administrative Map of Nigeria

3.4 Household Factors Associated with Clean Cooking Fuel

The bivariate analysis revealed several household factors associated with the utilization of clean cooking fuels. Households with fewer members (1-3) were more likely to use clean fuels (5.79%) compared to larger households (10+ members) where only 2.88% used clean fuels ($p < 0.001$). The age of the household head was also a significant factor; households headed by individuals aged 50-64 years were more likely to use clean fuels (5.71%) compared to those aged 14-24 years (1.45%) ($p < 0.001$). Female-headed households had a higher likelihood of using clean fuels (8.13%) compared to male-headed households (4.01%) ($p < 0.001$). Wealth was a particularly strong determinant; 43.95% of the wealthiest households used clean fuels, in contrast to 0% of the poorest households ($p < 0.001$). Educational attainment was similarly influential; households headed by individuals with higher education had a significantly higher proportion of clean fuel use (24.63%) compared to those with no formal education (0.51%) ($p < 0.001$). Urban residence also strongly correlated with clean fuel use (13.98%) compared to rural areas (0.40%) ($p < 0.001$).

Table 2: Household characteristics associated with clean cooking fuel

Variable	Cooking Fuel Category		X ²	p-value
	Unclean	Clean		
household members				
1-3	2,329 (94.21%)	143 (5.79%)	16.16	0.00
4-6	3,302 (95.30%)	163 (4.70%)		
7-9	1,977 (97.00%)	61 (3.00%)		
10+	1,490 (97.12%)	44 (2.88%)		
Age of household head				

IJS GS FUGUSAU VOL10 (4)		WEBSITE: https://fugus-ijsgs.com.ng		
14-24	412 (98.55%)	6 (1.45%)		
25-34	2,259 (96.62%)	79 (3.38%)		
35-49	3,315 (95.08%)	171 (4.92%)	26.00	0.00
50-64	2,004 (94.29%)	121 (5.71%)		
65+	1,109 (97.08%)	33 (2.92%)		
Sex of household head				
Male	8,425 (95.99%)	352 (4.01%)	13.68	0.00
Female	673 (91.87%)	60 (8.13%)		
Wealth index				
Poorest	3,112 (100.00%)	0 (0.00%)		
Poorer	2,810 (99.85%)	4 (0.15%)		
Middle	1,705 (99.38%)	11 (0.62%)	2700.00	0.00
Richer	1,004 (97.08%)	30 (2.92%)		
Richest	467 (56.05%)	367 (43.95%)		
Highest education				
No formal education	4,985 (99.49%)	26 (0.51%)		
Primary	1,609 (98.08%)	31 (1.92%)	1000.00	0.00
Secondary	1,647 (95.66%)	75 (4.34%)		
Higher	856 (75.37%)	280 (24.63%)		
Place of residence				
Urban	2,364 (86.02%)	384 (13.98%)	619.59	0.00
Rural	6,734 (99.60%)	27 (0.40%)		
State				
Sokoto	829 (99.58%)	4 (0.42%)		
Zamfara	1,008 (98.71%)	13 (1.29%)		
Katsina	1,679 (97.56%)	42 (2.44%)		
Jigawa	1,081 (99.33%)	7 (0.67%)	303.31	0.00
Kano	1,867 (91.13%)	182 (8.87%)		
Kaduna	1,726 (91.47%)	161 (8.53%)		
Kebbi	908 (99.68%)	3 (0.32%)		

Source: NDHS, 2018

4.0 DISCUSSION

The findings from this study highlight significant sociodemographic and regional disparities in the adoption of clean cooking fuels across North-Western Nigeria, reflecting broader trends observed in sub-Saharan Africa. The extremely low overall adoption rate of clean cooking fuels (5.4%) in the region underscores the pervasive reliance on traditional biomass fuels such as wood and charcoal. This reliance on unclean fuels is consistent with other studies that have identified similar patterns of energy use in low-income regions, where economic, educational, and infrastructural barriers limit access to cleaner alternatives (Abubakar et al., 2024).

Wealth emerged as a powerful determinant of clean cooking fuel adoption. Households in the wealthiest

quintile were 43.95% more likely to use clean fuels, while none of the poorest households reported using clean cooking fuels. This stark contrast highlights the economic barriers that lower-income households face, including the higher upfront costs of acquiring clean fuel technologies like liquefied petroleum gas (LPG) stoves and the recurring expense of purchasing LPG or electricity (Nicolai & Fiona, 2008; Puzzolo et al., 2016). The economic constraints were further exacerbated in rural areas, where infrastructure to support the distribution and maintenance of clean fuels is often underdeveloped (Fakunle et al., 2017). These findings suggest that economic interventions, such as subsidies or microfinance programs, could play a crucial role in making clean cooking fuels more accessible to poorer households (Popoola & Ibrahim, 2023).

Educational attainment was also a significant predictor of clean cooking fuel adoption. Households headed by individuals with higher education were substantially more likely to use clean fuels (24.63%) compared to those with no formal education (0.51%). This strong association between education and clean fuel use aligns with existing research, which suggests that education increases awareness of the health risks associated with unclean cooking fuels and the benefits of cleaner alternatives (Puzzolo et al., 2016, 2016). Education also enhances individuals' ability to understand and navigate energy markets, making it easier for them to adopt new technologies (Gould & Urpelainen, 2020). These findings underscore the importance of educational interventions that not only raise awareness about the dangers of biomass fuels but also promote the adoption of clean cooking technologies. Such interventions could be particularly effective if targeted at women, who are typically the primary users of cooking fuels and are most affected by the health risks associated with unclean fuels (Campbell et al., 2021).

Urbanization significantly influenced the adoption of clean cooking fuels, with urban households being much more likely to use clean fuels (13.98%) compared to their rural counterparts (0.40%). The higher adoption rates in urban areas can be attributed to better infrastructure, which makes clean fuels more accessible and affordable (Bisu et al., 2016; Dongzagla & Adams, 2022). Urban households also tend to have better access to markets where clean fuels like LPG are sold, as well as to information about the health benefits of using clean fuels (Dongzagla & Adams, 2022). However, this study also found considerable disparities within urban areas, particularly between different states. For example, Kano (8.87%) and Kaduna (8.53%) had the highest rates of clean fuel use, while states like Sokoto (0.42%) and Kebbi (0.32%) lagged significantly behind. These disparities suggest that even within urban settings, access to clean cooking fuels is not uniform and is likely influenced by state-specific factors such as local policies, market dynamics, and infrastructure development (Bisu et al., 2016). The economic stability and level of education are higher in the urban centers than rural areas.

5.0 CONCLUSION AND RECOMMENDATIONS

This study highlights significant sociodemographic and regional disparities in the adoption of clean cooking fuels in North-Western Nigeria. Key determinants of clean fuel use include wealth, education, and urbanization. Households with higher wealth and education levels, as well as those residing in urban areas, were more likely to use clean cooking fuels. These findings align with previous studies that have identified economic and educational barriers to clean fuel adoption in low-income settings.

The stark regional disparities observed across the seven North-Western states underscore the need for targeted interventions to promote clean cooking fuel usage. States with the lowest rates of clean fuel adoption, such as Sokoto, Jigawa, and Kebbi, require focused efforts to improve access and affordability. Conversely, states like Kano and Kaduna, which have relatively higher clean fuel usage, can serve as models for successful interventions and provide insights into effective strategies.

To enhance clean cooking fuel adoption in North-Western Nigeria, targeted interventions focusing on economic empowerment, education, and infrastructure development are essential. Improving household wealth through income-generating activities and social safety nets can increase the affordability of clean fuels. Educational campaigns and awareness programs can also play a crucial role in informing households about the health and environmental benefits of clean cooking. Additionally, investing in infrastructure, such as LPG distribution networks and electricity grids, can facilitate access to clean fuels in underserved areas.

REFERENCES

- Abubakar, I. R., Alola, A. A., Bekun, F. V., & Onifade, S. T. (2024). Investigating the determinants of household energy consumption in Nigeria: Insights and implications. *Energy, Sustainability and Society*, 14(1), 29. <https://doi.org/10.1186/s13705-024-00451-6>
- Bisu, D. Y., Kuhe, A., & Iortyer, H. A. (2016). Urban household cooking energy choice: An example of Bauchi metropolis, Nigeria. *Energy, Sustainability and Society*, 6(1), 15. <https://doi.org/10.1186/s13705-016-0080-1>
- Campbell, C. A., Bartington, S. E., Woolley, K. E., Pope, F. D., Thomas, G. N., Singh, A., Avis, W. R., Tumwizere, P. R., Uwanyirigira, C., & Abimana, P. (2021). Investigating cooking activity patterns and perceptions of air quality interventions among women in urban Rwanda. *International Journal of Environmental Research and Public Health*, 18(11), 5984.
- Dongzagla, A., & Adams, A.-M. (2022). Determinants of urban household choice of cooking fuel in Ghana: Do socioeconomic and demographic factors matter? *Energy*, 256, 124613.
- Eleri, A. I. (2021). Expanding demand for clean-cooking in Nigeria. In *International Centre for Energy, Environment and Development Report 2021*. https://ng.boell.org/sites/default/files/2021-05/Expanding%20Demand%20EDITED_Draft%201.pdf
- Fakunle, A. G., Ogundare, J. O., Adelekan, A. L., & Bello, T. A. (2017). Household cooking practices as risk factor for acute respiratory infections among

- hospitalized under-5 children in Ibadan, Nigeria. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, 11(01), 60–65.
- Fisher, S., Bellinger, D. C., Cropper, M. L., Kumar, P., Binagwaho, A., Koudenoukpo, J. B., Park, Y., Taghian, G., & Landrigan, P. J. (2021). Air pollution and development in Africa: Impacts on health, the economy, and human capital. *The Lancet Planetary Health*, 5(10), e681–e688.
- Frostad, J. J., Nguyen, Q. P., Baumann, M. M., Blacker, B. F., Marczak, L. B., Deshpande, A., Wiens, K. E., LeGrand, K. E., Johnson, K. B., & Abbasi-Kangevari, M. (2022). Mapping development and health effects of cooking with solid fuels in low-income and middle-income countries, 2000–18: A geospatial modelling study. *The Lancet Global Health*, 10(10), e1395–e1411.
- Gould, C. F., & Urpelainen, J. (2020). The Role of Education and Attitudes in Cooking Fuel Choice: Evidence from two states in India. *Energy for Sustainable Development: The Journal of the International Energy Initiative*, 54, 36–50. <https://doi.org/10.1016/j.esd.2019.09.003>
- World Health Organization (2021). Household air pollution. (n.d.). Retrieved July 29, 2024, from <https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health>
- Nicolai, S., & Fiona, Z. (2008). Market barriers to clean cooking fuels in Sub-Saharan Africa. Stockholm Environment Institute.
- Popoola, T. O., & Ibrahim, S. (2023). Determinants of households' primary cooking fuel in Nigeria: Evidence from country-wide study. *Ilorin Journal of Economic Policy*, 10(2), 1–15.
- Puzzolo, E., Pope, D., Stanistreet, D., Rehfuess, E. A., & Bruce, N. G. (2016). Clean fuels for resource-poor settings: A systematic review of barriers and enablers to adoption and sustained use. *Environmental Research*, 146, 218–234.
- Rahut, D. B., Ali, A., Mottaleb, K. A., & Aryal, J. P. (2019). Wealth, education and cooking-fuel choices among rural households in Pakistan. *Energy Strategy Reviews*, 24, 236–243. <https://doi.org/10.1016/j.esr.2019.03.005>
- Shari, B. E., Dioha, M. O., Abraham-Dukuma, M. C., Sobanke, V. O., & Emodi, N. V. (2022). Clean cooking energy transition in Nigeria: Policy implications for developing countries. *Journal of Policy Modeling*, 44(2), 319–343.