

FACTORS ASSOCIATED WITH THE CHOICE OF COOKING FUEL AMONG HOUSEHOLDS IN UGANDA

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ABSTRACT. The majority of households in Uganda rely on traditional cooking fuels the use of which is associated with many dangers. This study sought to identify the factors related to the choice of cooking fuel among households in Uganda. The study used secondary data from the 2018–19 Uganda Malaria Indicator Survey (UMIS). The analysis was performed using Pearson’s chi-square test and the complementary log-log regression model. Most respondents used unclean cooking fuels (98.96%). The use of clean cooking fuels was more likely among households in the richest wealth index category, those from the Pentecostal/born-again/evangelical or other religions, and households that had electricity. An increase in household members was found to reduce the likelihood of using clean cooking fuels. There is a need for the government to reduce the initial connection fees to the power grid and the tariff per unit of electricity consumed by households in Uganda.

Keywords: complementary log-log regression; cooking fuel; Uganda.

INTRODUCTION

An estimated 2.4 billion of the world’s population lacks access to clean cooking fuel yet in developing countries, cooking contributes to approximately 90 per cent of the household energy consumption (Choudhury *et al.*, 2023). One of the targets under Goal 7 of the United Nations Sustainable Development Goals (SDGs) is ensuring universal access to affordable, reliable, and modern energy services by 2030. To achieve this, a renewed effort is needed to accelerate access to clean energy solutions beyond current efforts. If not revised, with the current trend, by 2030 an estimated 60 per cent of people lacking access to clean



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cooking fuel will be from sub-Saharan Africa (World Bank, 2024).

Consistent exposure to smoke from unclean cooking fuels has been linked to numerous health problems, including cataracts, childhood pneumonia, lung cancer, high blood pressure, under-five mortality, and obstetric complications, among others, due to household air pollution (Rasel *et al.*, 2024; Simkovich *et al.*, 2019). Traditional or unclean cooking fuels have also contributed to environmental degradation, greenhouse gas emissions, etc. (Timilsina *et al.*, 2016).

If this trend is not addressed, this will have serious implications for the attainment of other SDGs, such as Goals 1–3 aimed, respectively, at ending all forms of poverty; ending hunger and achieving food security; and ensuring healthy lives due to the overall environmental, social, economic, health, and financial implications of cooking fuel choices.

Sub-Saharan Africa (SSA) which is predominantly rural, is characterized by heavy reliance on cooking fuels such as crop residue, cow dung, wood fuel, charcoal, and kerosene, with few – mostly urban-based – households using modern cooking fuels such as solar, liquefied petroleum gas (LPG), and electricity. The choice of cooking fuel is mainly driven by affordability or costs (Ali *et al.*, 2017; Rahut *et al.*, 2019), with households progressing from traditional methods (unprocessed biomass energy e.g. wood) to transition methods (processed biomass e.g. charcoal, kerosene) and finally to sustainable modern methods (non-solid e.g. electricity) as income or economic status improves (Mainimo *et al.*, 2022). Other

than economic factors (cost, income, access to credit, etc.), studies have found other factors that do influence the adoption and use of modern cooking methods. These can be broadly grouped under demographic (age, gender, education, family size, etc.), technical (risk perception, safety concerns, health impact, etc.), sociocultural (cultural norms, religion, peer influence, etc.), and physical (access, availability, seasonal variations, etc.) (Ibe and Kollur, 2024).

In Uganda, households predominantly cook using firewood (85%) and charcoal (13%), mainly obtained from cutting down forests (NPA, 2020). However, government and development partners have fronted alternative solutions such as improved cooking stoves, LPG gas, and solar cookers, among others. However, the adoption of these has been low due to the high costs of purchasing and maintaining them, limited infrastructure to aid in distribution, limited awareness and negative perceptions of alternative cooking energy solutions, etc.

Some households in urban areas continue to use unclean cooking fuels such as charcoal alongside clean cooking fuels, such as electricity, depending on the available finances and the type of food being prepared, among other factors. According to the National Development Plan 3 (NDP3), the government of Uganda aims to reduce the use of biomass for cooking from 88% to 50% and also to increase the use of clean energy for cooking from 15% to 50% by 2025 (NPA, 2020). This will require identifying the key issues that influence peoples' adoption and continuous use of either unclean or clean cooking fuels to inform policy decisions and other

interventions by the government and other key stakeholders. Some studies have explored the factors that influence the choice of cooking fuel among households in Uganda. However, some of them have focused on specific parts of the country (Elasu *et al.*, 2022; Mainimo *et al.*, 2022) and with relatively small sample sizes, making it impossible to generalize the findings to the entire country. Furthermore, for some studies, key variables have not been included, such as access to electricity (Katutsi *et al.*, 2020), which is the main source of clean energy in the country.

Therefore, this study seeks to identify the factors that influence households to opt to use either modern or traditional cooking fuels using nationwide data and proposes interventions to counter the current negative trend in the country regarding the use of sustainable improved cooking fuels.

MATERIALS AND METHODS

Data source

The study will use secondary data from the 2018–19 Uganda Malaria Indicator Survey (UMIS). The data were collected between 11 December 2018 and 31 January 2019 using a two-stage sampling design.

Firstly, a sample of clusters was selected from sampling frames for both non-refugee and refugee settlements. The sample frame for the non-refugee areas was the 2014 National Population and Housing Census (NPHC) while for the refugee areas, it was the National Refugees' Survey sampling frame (UNHCR, 2020). Using probability proportional to size, 320 clusters (84 in

urban areas and 236 in rural areas) were selected in non-refugee areas and 22 clusters in refugee areas.

At the second stage, households were selected using systematic sampling. In total, 8,878 households were selected. The sample was selected so as to enable the computation of estimates for key indicators at the national level, for rural and urban areas and for the 15 regions of the country (South Buganda, North Buganda, Kampala, Busoga, Bukedi, Bugisu, Teso, Karamoja, Lango, Acholi, West Nile, Bunyoro, Tooro, Kigezi, and Ankole). All women aged 15–49 years who resided permanently or visited and stayed in the selected households the night before the survey were eligible to be interviewed.

Dependent variable

The dependent variable in this study was the choice of cooking fuel. In the UMIS, respondents were asked, "What type of fuel does your household mainly use for cooking?" The responses were grouped into either modern/clean (electricity, LPG/cylinder gas, biogas) or traditional/unclean (kerosene, charcoal, wood, straw/shrubs/grass, agricultural crop residue, animal dung) (Choudhury *et al.*, 2023; Eruitai *et al.*, 2022; Ishengoma and Igangula, 2021). The responses to the question were then grouped under the categories of clean or unclean cooking fuels, based on the literature. Therefore, the dependent variable used for subsequent analysis is a nominal variable with two possible outcomes.

Independent variables

The independent variables considered for this study were: place of residence; region; sex of household head;

age of household head; wealth index; number of household members; religion; highest educational level; household has radio; household has television; and household has electricity.

Data analysis

Data were analysed using STATA version 15 at three stages. Firstly, a descriptive summary of all plausible independent variables and the dependent variable was made using frequency distributions and percentages. Secondly, using Pearson's chi-square test (*Equation 1*), the association between the dependent variable (slept under bed net) and the plausible independent variables were tested and the significant variables ($p \leq 0.05$) at this level were considered for multivariate analysis.

$$\chi^2 = \sum_{i=1}^2 \sum_{j=1}^2 \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \quad (1)$$

where O_{ij} is the number of individuals observed in the i^{th} row and j^{th} column cell, E_{ij} is the number of individuals expected in the i^{th} row, and j^{th} column cell.

Finally, the complementary log-log regression model (*Equation 2*) was used for multivariate analysis due to the binary nature of the dependent variable and its suitability for events whose chance of occurrence is extremely high or extremely low.

In the case of this study, based on the literature for sub-Saharan Africa, it was assumed that few households used clean cooking fuels.

$$-\ln\{-\ln(1 - \pi_i)\} = \beta_0 + \beta_1 X_1 + \dots + \beta_k X_k \quad (2)$$

where β_0 the intercept, $\beta_1 \dots \beta_k$ are the partial slope coefficients, $X_1 \dots X_k$ are the independent variables

RESULTS

Table 1 provides a descriptive summary of the background characteristics of study respondents. The highest percentage of respondents resided in rural areas (68.46%), were from the northern region (32.28%), resided in male-headed households (68.63%), and were mostly aged 35–44 years (29.03%). Moreover, the highest proportion of respondents were in the poorest wealth index category (27.98%), resided in households with 5–6 members (27.17%), were Catholic (40.17%), and had, at most, primary level education (53.59%). The majority of respondents had a radio (53%), had no television (81.74%), did not have electricity (59.15%), and used unclean cooking fuels (98.96%).

The results for Pearson's chi-square test of the association between choice of cooking fuel and the plausible independent variables are presented in *Table 2*.

The respondents' place of residence, region, wealth index, number of household members, religion, highest education level, having a radio, having a television, and having electricity were significantly associated with the type of cooking fuel used. The age and sex of the household head ($p > 0.05$) had no significant association with the type of cooking fuel used.

From *Table 2*, the majority of respondents in both urban (97.71%) and rural (99.29%) areas and all (100%) those in refugee areas used unclean cooking fuels. The Central region (2.13%) had the highest proportion using clean cooking fuels, followed by the western region (1.31%).

Table 1 – Characteristics of respondents

Variables	Frequency	Percent
Choice of cooking fuel		
Unclean	8,553	98.96
Clean	90	1.04
Place of residence		
Urban	2,099	24.29
Rural	5,917	68.46
Refugee	627	7.25
Region		
Central	1,645	19.03
Eastern	1,849	21.39
Northern	2,790	32.28
Western	2,359	27.29
Sex of household head		
Male	5,932	68.63
Female	2,711	31.37
Age of household head		
15-24	629	7.28
25-34	2,184	25.27
35-44	2,509	29.03
45-54	1,928	22.31
55-64	818	9.46
65+	575	6.65
Wealth index		
Poorest	2,418	27.98
Poorer	1,833	21.21
Middle	1,362	15.76
Richer	1,341	15.52
Richest	1,689	19.54
Number of household members		
1-2 members	532	6.16
3-4 members	1,899	21.97
5-6 members	2,348	27.17
7-8 members	1,920	22.21
9+ members	1,944	22.49
Religion		
Anglican	2,876	33.28
Catholic	3,472	40.17
Muslim	825	9.55
Pentecostal/born-again/evangelical	1,201	13.90
Others	269	3.11
Highest educational level		
No education	1,434	16.59
Primary	4,632	53.59
Secondary	2,072	23.97
Higher	505	5.84
Household has radio		
No	4,062	47.00
Yes	4,581	53.00

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Household has television		
No	7,065	81.74
Yes	1,578	18.26
Household has electricity		
No	5,112	59.15
Yes	3,531	40.85

Table 2 – Association between type of cooking fuel and independent variables

Variables	Choice of cooking fuel		Total	p-value
	Unclean	Clean		
Place of residence				
Urban	97.71	2.29	2,099	0.000
Rural	99.29	0.71	5,917	
Refugee	100.00	0.00	627	
Region				
Central	97.87	2.13	1,645	0.000
Eastern	99.03	0.97	1,849	
Northern	99.78	0.22	2,790	
Western	98.69	1.31	2,359	
Sex of household head				
Male	99.09	0.91	5,932	0.076
Female	98.67	1.33	2,711	
Age of household head				
15-24	98.73	1.27	629	0.724
25-34	98.90	1.10	2,184	
35-44	99.08	0.92	2,509	
45-54	98.81	1.19	1,928	
55-64	99.39	0.61	818	
65+	98.78	1.22	575	
Wealth index				
Poorest	99.92	0.08	2,418	0.000
Poorer	99.51	0.49	1,833	
Middle	99.41	0.59	1,362	
Richer	98.58	1.42	1,341	
Richest	96.92	3.08	1,689	
Number of household members				
1-2 members	96.43	3.57	532	0.000
3-4 members	99.00	1.00	1,899	
5-6 members	99.32	0.68	2,348	
7-8 members	98.80	1.20	1,920	
9+ members	99.33	0.67	1,944	
Religion				
Anglican	99.06	0.94	2,876	0.005
Catholic	99.31	0.69	3,472	
Muslim	98.30	1.70	825	
Pentecostal/born-again/evangelical	98.42	1.58	1,201	
Others	97.77	2.23	269	
Highest educational level				
No education	99.51	0.49	1,434	0.000
Primary	99.35	0.65	4,632	
Secondary	98.31	1.69	2,072	

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Higher	96.44	3.56	505	
Household has radio				
No	99.36	0.64	4,062	0.001
Yes	98.60	1.40	4,581	
Household has television				
No	99.32	0.68	7,065	0.000
Yes	97.34	2.66	1,578	
Household has electricity				
No	99.80	0.20	5,112	0.000
Yes	97.73	2.27	3,531	

The highest proportion of respondents using clean cooking fuels was in the richest wealth index category (3.08%), from households with 1–2 members (3.57%), belonging to other religions (2.23%), and with higher education (3.56%). Clean cooking fuel use was also highest among respondents from households with a radio (1.40%), a television (2.66%), and electricity (2.27%). *Table 3* presents the multivariate analysis results based on the complementary log-log regression model. Respondents' place of residence, region, wealth index, highest education level, having a radio, and having a television had no significant effect ($p>0.05$) on the type of cooking fuel used. From *Table 3*, respondents in the richest wealth index category had a 1.92 (95% CI: 0.22, 3.62) increase in the log odds of using clean cooking fuels compared to those in the poorest wealth index category. The respondents in households with 3–4 members had a 1.03 (95% CI: -1.67, -0.38) decrease in the log odds of using clean cooking fuels compared to those with 1–2 members. In addition, respondents in households with 5–6 members, 7–8 members, and 9+ members had a decrease of 1.29 (95% CI: -1.97, -0.61), 0.74 (95% CI: -1.37, -0.11), and 1.35 (95% CI: -2.08, -0.63), respectively, in the log odds of using clean cooking

fuels compared to those with 1-2 members. Those respondents who were Pentecostal/born-again/evangelical, had a 0.63 (95% CI: 0.03, 1.23) increase in the log odds of using clean cooking fuels compared to Anglicans. As for respondents of other religions, the log odds of using clean cooking fuels increased by 1.08 (95% CI: 0.19, 1.98) compared to Anglicans. Finally, for respondents who had electricity, the log odds of using clean cooking fuels increased by 1.52 (95% CI: 0.74, 2.30) compared to those who never had electricity in their households

DISCUSSION

The study sought to identify the factors that influenced households' choice of cooking fuel in Uganda. Wealth index, number of household members, religion, and whether a household had electricity had a significant effect on households' choice of cooking fuel. The type of place of residence was reported not to affect the type of cooking fuel used in a household. This could be attributed to the fact that people in rural areas of Uganda mostly use firewood while most of the people in urban areas use charcoal, which are both forms of unclean cooking fuel (Bamwesigye *et al.*, 2020; Win *et al.*, 2018).

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Table 3 – Determinants of choice of cooking fuel in Uganda

Variables	Coefficient.	z	P>z	[95% CI]	
Place of residence					
Rural (ref.)					
Urban	0.10	0.35	0.72	-0.46	0.66
Region					
Central (ref.)					
Eastern	0.13	0.41	0.68	-0.48	0.73
Northern	-0.61	-1.26	0.21	-1.55	0.33
Western	0.26	0.87	0.38	-0.32	0.83
Wealth index					
Poorest (ref.)					
Poorer	1.02	1.26	0.21	-0.56	2.61
Middle	0.76	0.89	0.37	-0.91	2.44
Richer	1.35	1.61	0.11	-0.29	2.99
Richest	1.92	2.22	0.03	0.22	3.62
Number of household members					
1-2 members (ref.)					
3-4 members	-1.03	-3.13	0.00	-1.67	-0.38
5-6 members	-1.29	-3.71	0.00	-1.97	-0.61
7-8 members	-0.74	-2.32	0.02	-1.37	-0.11
9+ members	-1.35	-3.65	0.00	-2.08	-0.63
Religion					
Anglican (ref.)					
Catholic	0.05	0.16	0.87	-0.51	0.60
Muslim	0.41	1.20	0.23	-0.26	1.09
Pentecostal/born-again/evangelical	0.63	2.06	0.04	0.03	1.23
Others	1.08	2.37	0.02	0.19	1.98
Highest educational level					
No education (ref.)					
Primary	-0.31	-0.72	0.48	-1.15	0.53
Secondary	-0.12	-0.28	0.78	-1.00	0.75
Higher	0.26	0.53	0.59	-0.70	1.22
Household has radio					
No (ref.)					
Yes	0.13	0.54	0.59	-0.35	0.61
Household has television					
No (ref.)					
Yes	-0.26	-0.91	0.36	-0.83	0.30
Household has electricity					
No (ref.)					
Yes	1.52	3.81	0.00	0.74	2.30

(ref.) - reference category

This is true also within the different regions of Uganda, with a small fraction of households using clean cooking fuels and hence the insignificant effect of region on the type of cooking fuel used by

households in Uganda. The significant increase in the use of clean cooking fuels among households in the richest wealth index category is consistent with other studies that reported high usage of clean

cooking fuels among richer households (Ang'u *et al.*, 2023; Ntegwa and Olan'g, 2024) who make up a small fraction of the general population in developing countries and can afford the high costs of acquiring, using, and maintaining clean energy technologies (Nzengya *et al.*, 2021). Poorer households will most likely opt for cheaper but unclean cooking fuels so that their limited finances can be diverted to other pressing needs, such as food, clothing, school fees, etc.

The reduced likelihood of using clean cooking fuels with the increase in the number of household members is consistent with findings by several studies (Ali and Khan, 2022; Ali *et al.*, 2024; Özcan *et al.*, 2013).

This could be attributed to the increase in available labour for collecting firewood with an increase in household size (Pandey and Chaubal, 2011; Rahut *et al.*, 2020) plus the increased household expenditure arising from having additional members, making it expensive to adopt clean cooking fuels. On the contrary, (Ang'u *et al.*, 2023) reported an increase in the adoption of cleaning cooking fuels with an increase in household size.

The significance of the Pentecostal and other religions could be attributed to the notable influence of religion on people's knowledge, values, attitudes, and practices (Dong *et al.*, 2024). Religious beliefs may influence one's ecological mindfulness and subsequently influence energy behaviours, such as the choice of cooking fuel (Li and Li, 2022). A study in India found that Muslims and Christians were more likely to use clean cooking fuels than Hindus (Majumdar *et al.*, 2023).

The significance of having electricity is consistent with studies that have reported that quality access to electricity is a key contributing factor to the choice of fuel in households (Kapsalyamova *et al.*, 2021; Sedai *et al.*, 2021). Therefore, access to affordable and reliable electricity can result in a reduction in the use of unclean cooking fuels since a cleaner energy alternative is available (Kapsalyamova *et al.*, 2021).

CONCLUSIONS

This study sought to identify the factors associated with the choice of cooking fuel among households in Uganda. Use of clean cooking fuel was more likely among households in the richest wealth index category, among those from the Pentecostal/born-again/evangelical or other religions, and households that had electricity. An increase in household members was found to reduce the likelihood of using clean cooking fuels.

The government and other key stakeholders can partner with religious leaders to sensitize their followers about the need to use clean cooking technologies and the available options. There is a need for the government to reduce the initial connection fees to the power grid and tariff per unit of electricity consumed by households in Uganda to encourage more people to connect to the grid and use power for household cooking since it is cleaner, environmentally friendly, and sustainable in the long run. In addition, there is a need for the government and other development partners to develop and implement policies and programmes

aimed at wealth creation that will in turn increase household disposable income, hence raising the likelihood of households being able to afford to purchase and consistently use clean cooking fuels.

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