

Socioeconomic and Cultural Determinants of Clean Cooking Energy Adoption in Rural Ghana: A Structural Equation Modelling Approach

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ABSTRACT

This study used a Structural Equation Modelling approach to examine the socioeconomic and cultural factors influencing the adoption of clean cooking energy in rural Ghana, specifically within the Bunkpurugu-Nakpanduri district. The study bridges a gap in the literature by combining the Diffusion of Innovations Theory and the Technology Acceptance Model, which tends to disregard cultural aspects in SEM analyses. The data was gathered using a mixed-methods approach that included 7 focus groups, interviews with 30 opinion leaders, and surveys with 500 women. SPSS, NVivo, and AMOS were used for Data analysis. Consistent with previous research, the results validate that adoption of clean cooking technology is significantly positively influenced by household income and education. Most importantly, the study finds that cultural norms play a key mediating role, demonstrating that, even when economic and educational limitations are taken into account, deeply rooted customs and social expectations pose a distinct challenge in the Ghanaian context. According to local hospital data, biomass dependence is linked to thousands of respiratory and other illnesses among women and children each year, underscoring the serious health effects of this practice. The study concludes that effective energy transition policies in Ghana's rural areas need to include culturally sensitive interventions in addition to subsidies and awareness campaigns. To achieve sustainable adoption, it is essential that community leaders be involved, that technology be tailored to local culinary customs, that targeted financial support be put in place, and that an integrated strategy be promoted that respects local culture while enhancing affordability and education.

Keywords: Clean Cooking Energy, Structural Equation Modelling, Adoption, Clean Fuel

INTRODUCTION

Globally, about 2.1 billion people rely heavily on traditional biomass fuels for cooking purposes. This is the leading cause of severe household air pollution (HAP) and environmental degradation. HAP contributes significantly to adverse health impacts, including respiratory diseases, particularly among women and children, and it is responsible for 2.3 million premature deaths per year, worldwide (Mawusi et al., 2025). In Sub-Saharan Africa (SSA), biomass health-related risks like indoor air pollution are more severe (Gangiah, 2022). Nearly 700,000 indoor air pollution-related deaths are recorded annually in SSA (Kalisa et al., 2023). The Sustainable Development Goals (SDGs), particularly Goal 3, emphasize the importance of reducing household air pollution (WHO, 2025; Grove et al., 2025), as clean cooking solutions can significantly mitigate the health risks linked to respiratory diseases.” (Mawusi et al., 2025).

The rising energy demand is a critical issue in SSA because traditional biomass fuels remain the primary source of fuel for residential use. Traditional biomass fuels make up over 70% total household energy use for cooking (Derebe et al., 2025). The situation in Ghana reflects the world crisis. About 75 % (26 million) of Ghanaian households, mostly in rural and low-income urban areas, use traditional biomass fuels for cooking,

with 31.1 % and 23.3 % of households using wood and charcoal, respectively.” (Mawusi et al., 2025; Tabiri et al., 2020). Indoor air pollution makes up nearly 18,000 premature deaths per year (Mawusi et al., 2025; Immurana et al., 2023), mostly among mothers and children under 4 years old (Mawusi et al., 2025). Similarly, traditional biomass fuels are responsible for about a 60 % contraction of the natural vegetation in Ghana (Sánchez et al., 2025; Mensah & Yankson, 2025). With one of the highest global yearly deforestation rates (2 %) (Mawusi et al., 2025), the country’s forests could be destroyed by 2050 if this observation is not addressed (Acheampong et al., 2019). However, the government of Ghana has shown effort in addressing clean cooking challenges (Bukari et al., 2021; McAlister et al., 2024). The National Liquefied Petroleum Gas (LPG) Program for Rural Communities (McAlister et al., 2024), and the allocation of 200,000 Gyapa charcoal cookstoves is a significant commitment (Yunusa et al., 2023).

Nonetheless, affordability challenges, lack of coordinated distribution mechanisms, and sociocultural factors are major barriers slowing the rate of adoption (Kyeremeh & Fiagborlo, 2024; Adjei-Mantey, 2024). Only about 25% of Ghanaian families use clean cooking energy, and this is well below the nationwide penetration target of 50% (Dongzagla & Adams, 2022; Bawakyillenuo et al., 2021). The major reason is that clean cooking energy transitions are more of economic and technological interventions, which often overlook social and cultural norms that play a critical role in clean cooking decisions. Research supports this fact, as Carrion et al. (2021) investigated the adoption of liquefied petroleum gas by emphasizing accessibility and cost rather than cultural constraints. Kyeremeh et al. (2024) examined fuel choices by prioritizing income and education over cultural analysis. A holistic understanding of the socioeconomic and cultural factors that can influence the adoption of clean cooking energy in Ghana is crucial for policy interventions. Integrating an analytical approach, particularly one grounded in structural equation modelling (SEM), can enable the simultaneous examination of complex, interrelated factors influencing household energy choices. This study fills in this gap by adopting the SEM method to analyse the socioeconomic and cultural factors in the clean cooking transition in rural Ghana. Specifically, the study identified determinants of clean cooking energy using SEM to unearth the direct and/or indirect impact of cultural norms on the adoption of clean cooking energy in the Ghanaian rural societies.

LITERATURE REVIEW: THEORETICAL FRAMEWORK

This study adopted two related social theories, the Technological Acceptance Model (TAM) and the Diffusion of Innovations Theory (DIT), to create a structurally grounded model for investigating clean cooking energy transition in rural Ghana. These theories are both interconnected and widely used in behavioural science research. While DIT explores the behavioural patterns of how ideas evolve within societies (Wisnuseputro & Dellyana, 2025), TAM illustrates personal-level perceptions of technology (Kim et al., 2025). Both theories are strong on their own and work well together. Recognising intricate energy transitions in socially established settings requires a thorough evaluation of both larger societal impact and individual choices, which is made possible by its incorporation.

The Technological Acceptance Model holds that perceived usefulness and perceived ease of use are the prime catalysts for technology adoption. These core beliefs of TAM were applied in this study. The perceived usefulness mirrored the latent variable “Awareness” with indicators such as knowledge of health benefits, ecological benefits, and time savings with cooking technology. Perceived ease of use represented “accessibility” with indicators such as availability of LPG, vendors, and “affordability” with indicators like easily affordable cooking fuels, low price of cooking technologies, and low initial investment cost in clean cooking energy accessibility.

The Diffusion of Innovation Theory has five important characteristics: relative advantage, compatibility, complexity, trialability, and observability that relate to adoption. These characteristics reflect the Ghanaian society. They manifest in the sociocultural norms and peer pressure. This study applied this model in the structural equation modelling analysis as the latent construct “Culture”. It addressed the following issues: compatibility and cooking practices, social influence, and perceived usefulness.

Why Structural Equation Modelling, the Appropriate Analytical Technique

SEM is well-suited to test this integrated theoretical framework because it can make multiple projections of interrelated correlations at the same time among latent constructs. For instance, how income influences awareness, which also influences adoption, and is moderated by culture. It takes into consideration the error term, which ensures that the measure variable is reliable. Its ability to provide model fit statistics allows for the overall consistency between empirical data and the structural model.

Study Hypothesis

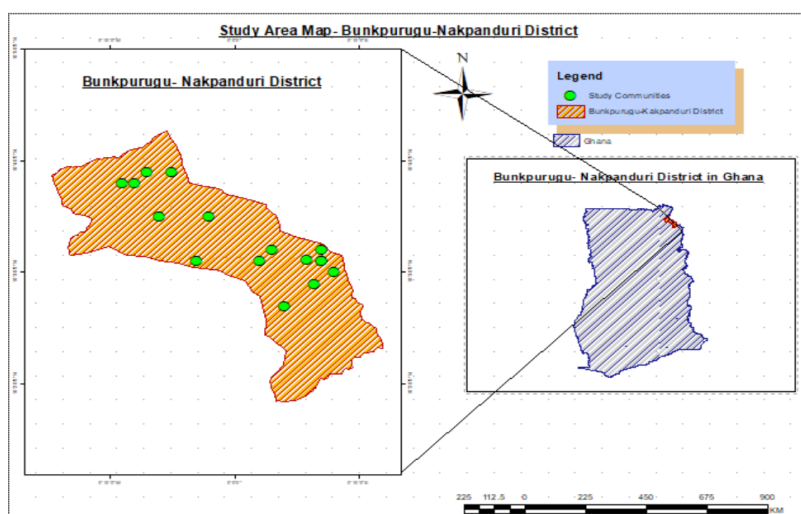
- H1 Higher income increases clean cooking energy adoption. Previous research has linked household fuel choices to income/expenditure and cost/prices (Muller & Yan, 2028). The higher the household income becomes, the more they purchase modern cooking technologies (Kariuki, 2021; Waweru & Mose, 2022).
- H2 Education attainment leads to clean cooking energy adoption. The higher one attains in education; he will be influenced to use clean cooking energy (Baland et al., 2015; Layet al., 2013).
- H3 Cultural norms mediate adoption. Research has linked household energy choice to cultural norms (Guta et al., 2022; Vigolo et al., 2018). From Jiafeng's (2022) perspective, "social norms affect the use of clean cooking fuels in rural societies". As many households embrace LPG as a clean energy source, it becomes a way of life, shaping many rural families to transition to this environmentally friendly fuel source for cooking (Jiafeng, 2020; Price, 2021). Moral condemnation and public opinion pressure resulting from social norms will directly influence individuals to adopt the pro-environmental behaviour of their peers (McCarthy et al., 2025; Xianyu et al., 2024).

METHODOLOGY

Study Area

This study was conducted in the Bunkpurugu-Nakpanduri district of the North-East region of Ghana. The district forms part of the six districts in the region and occupies 533 km² of Ghana's total land area. Solid biomass fuels are the primary energy source for the communities in the district. Approximately 91.1% of all residents rely on wood sourced from the wild (Ghana Statistical Service, 2024). The population of the district is 82,384, with more women (41,980) making up 51.0% of the total population than men (40,404), who make up 49.0%. Rural residents account for 72% and urban residents for 28%. The district's literacy rate is 54.2% for individuals aged 6 and older, with a higher percentage among males (63.2%) compared to females (45.6%) (Ministry of Finance, 2023).

Figure 1: Map of Study Area



The study area is one of the most deprived districts in northern Ghana in terms of access to sustainable energy for cooking. (Ghana Statistical Service, 2024).

Research Design

A case study design was adopted for an in-depth examination of the antecedents of cooking energy options and the challenges and possible solutions that could be recommended to guide the clean cooking energy transition. Quantitative method was used to provide a representative insight into a broader group of women's practices regarding cooking energy and to compare the different groups (age, family size, marital status, occupation, education level, and income) to understand their role in cooking energy decisions. However, the qualitative method enhanced the quantitative data by offering more profound insights into the contextual, cultural, and lived experiences that affect the acceptance of clean cooking fuels.

Population, sampling, and Data

The study's target participants were exclusively women. However, some stakeholders (men) involved in energy decision-making were included. These are community leaders and local government representatives. These women included but were not limited to spouses of households, widows, and young girls aged 18 and above who took on household cooking responsibilities. Their shared opinions and experiences can help shape decisions about clean cooking initiatives. The sample size was estimated by referring to the sample size estimation rule used by international organizations such as the World Bank, UNICEF, and WHO, among others, in social surveys. Additionally, the sample size was estimated by considering the population of the study area and the anticipated response rate. This ensures that it accurately represents a larger community. The rural population of the district, per the 2021 population and housing census, was 59,430 (Ghana Statistical Service, 2021). The estimated sample size used was 500 women. It was obtained using Taro Yamane's (Umar et al., 2021):

$$\text{Sample size } (n) = \frac{N}{1 + N\alpha^2}$$

Where "N" represents the overall population under study, " α " represents the acceptable error margin (5%), and "n" represents the sample size to be determined.

Due to logistical constraints and accessibility, the study used a pragmatic approach where the study area was grouped into 15 zones, and one accessible community in each zone was selected through convenience sampling. Within the selected communities, every third household was approached for the quantitative data collection.

The study analysed primary and secondary data to understand the complexities involved in adopting clean cooking energy. The quantitative data focused on demographic factors that either hinder or encourage clean fuels and technology usage. The qualitative data was a bit nuanced as they focused on knowledge of the significance of usage of modern cooking technologies and fuels, ecological and health concerns, and cultural and social norms. Additionally, both qualitative and quantitative secondary data were employed for the analysis. This data was obtained from two sources (Binde Rural Hospital and Bunkpurugu-Nakpanduri district Assembly). The Binde Rural Hospital provided quantitative data on the reported cases of women and children impacted by domestic air pollution. The Bunkpurugu-Nakpanduri district Assembly provided qualitative data, focusing on policy interventions to promote clean cooking energy adoption.

Method of Data Collection

Household questionnaire administration, interviews, and focus group discussions were used for the data collection. Tools such as questionnaires, interviews, and focus group discussion guides were used. However, 500 questionnaires, 30 interview guides, and 7 discussion group guides were employed. This was done to reach a large number of participants, which provided measurable data useful in this study. The questionnaire was made up of 35 questions, which were grouped into two sections (sections 1 and 2). All these variables

(questions) were evaluated on a 5-point Likert scale (strongly disagree=1, disagree=2, neutral=3, agree=4, and strongly agree=5). The five-point scale was chosen for its medium (neutral) response, which allows respondents who are not certain to avoid making a definite decision that does not fully reflect their opinions. The Likert scale is very easy to understand and has been frequently used in social science research (Tanujaya et al., 2022; Rokeman, 2024). This structured questionnaire was administered to 500 women across fifteen selected rural communities at the household level. These closed-ended questions were multiple-choice options that allowed participants to select from predefined responses. It focused on demography (age, marital status, and educational level) and socioeconomic factors (employment, household income, energy usage patterns, perceived benefits of clean cooking technologies, environmental benefits, and barriers to adoption).

The qualitative data were obtained using interviews, where Semi-structured interviews were conducted with 30 key opinion leaders. These opinion leaders included Queen Mothers, electricity companies, the District Chief Executive, and community leaders. This interview explored the nuanced socio-cultural and personal hindrances to clean cooking technologies adoption. To further validate the findings of the study, five separate group discussions were carried out in five different rural communities within the study area with women, and two group discussions were conducted in two rural communities with men to explore their shared experiences and perspectives on clean cooking energy adoption.

Method of Data Analysis

Excel, structural equation modelling (SEM), and the Statistical Package for Social Sciences (SPSS) version 2, and Python (pandas and NumPy) were used to analyze the quantitative data. This method is ideal for this research because it enables the evaluation of both direct and indirect impacts of predictors on clean cooking energy adoption. The SEM analysis facilitated the identification of crucial elements shaping the decision-making process of rural women in their acceptance of modern cooking solutions, as well as the interconnections among these factors. Broadly, the variables used for this model were categorized into two groups: the independent (input) and dependent (outcome) variables. The independent variables included awareness of cleaner fuels and cooking technologies (socioeconomic benefits), affordability of modern cooking technologies, accessibility of clean fuels and technologies, knowledge of environmental impacts of clean cooking energy, and cultural and social factors affecting their choices of cooking methods. The dependent variable (adoption of clean cooking energy) was analyzed by evaluating the adoption behaviour, which was measured using variables such as the frequency of use of cooking technologies, the satisfaction of use, future use of modern cooking technologies, and improvement in overall well-being associated with the usage of clean cooking fuels and technologies.

The qualitative data were analyzed through thematic analysis by using NVIVO. Interviews and focus group discussions were audio-recorded and later transcribed into the software. These data were then coded for recurring themes related to socio-cultural barriers, decision-making processes, and perception of clean cooking energy. To validate the findings to ensure they are consistent, reliable, and credible, triangulation was employed, where four cross-sectional surveys were organized to validate the measured variables (awareness of cleaner cooking fuel technologies, affordability of clean cooking energy and technologies, and sociocultural issues influencing their choice of cooking methods). Semi-structured interviews were carried out with 10 individuals to evaluate the complexities of socio-cultural and personal challenges obstructing clean cooking technology adoption.

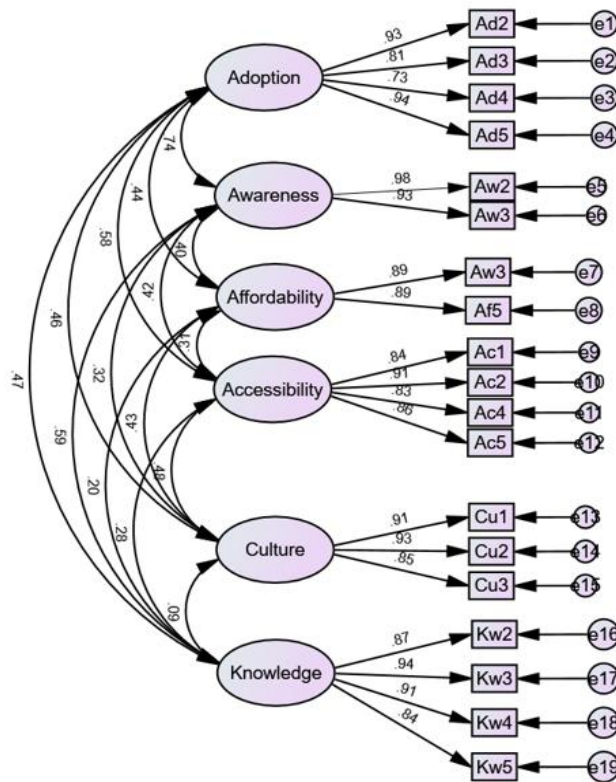
Measurement Model (Confirmatory Factor Analysis)

Confirmatory Factor Analysis (CFA), as a statistical method, assesses the relationship between observed and latent variables (Sureshchandar, 2023). In this study, the CFA was done using Analysis of Moment Structures (AMOS) to identify faulty construct measures. Variables or factors that were considered for the analysis

include: adoption of clean cooking technologies (Adoption), awareness of clean cooking technologies (Awareness), affordability of clean cooking technologies (Affordability), accessibility of clean cooking energy (Accessibility), knowledge of environmental impacts of clean cooking energy (Knowledge), and cultural and social issues that inform their choices for a preferred cooking method (Culture).

However, to obtain unidimensionality in a model measurement, variables having factor loadings less than half (0.5) must be excluded from the model (Cheung et al., 2024). For new variables that are developed, the factor loading should be at least 0.5, whereas established items should have a factor loading of 0.6 or more (Collier, 2020). In this study, variables were removed sequentially, beginning with the variables with the lowest factor loadings. The model was restarted following the removal of an item. This process was repeated until the unidimensionality conditions were met.

Figure 2: Measurement Model



The CFA examines how accurately the measured indicators reflect the underlying concept (latent construct). Model fit indices measure whether the proposed structure matches the data. From the figure above, the measurement model was conducted on six latent variables, namely: adoption, awareness, affordability, accessibility, culture, and knowledge. Each of the latent variables was assessed by its corresponding observed indicators and factor loadings. This indicates the strengths and directions of the correlation between the latent variables and their indicators. As shown in *Figure 2* above, all the factor loadings are within the recommended thresholds of >0.7 , indicating that the observed (measured) variables are strong indicators of their latent variables.

The following indices were obtained from the analysis: Chai-square- χ^2 (χ^2/df) 3.360, which is marginally above the acceptable threshold of 3.0, implying a marginal acceptable fit. Nevertheless, since the χ^2 is influenced by sample size, other indices should be considered.

The Normed Fit Index (NFI) (0.955) is above the >0.90 threshold, implying a strong fit for the model. Relative Fit Index (RFI) (0.942) suggests that model fit is acceptable, and Incremental Fit Index (IFI) (0.968) implies a strong model validity. Tucker Lewis Index (TLI) (0.959), which is above the recommended threshold (>0.90), suggests a good model fit. Comparative Fit Index (CFI) (0.968), which is above the threshold of >0.90 , emphasizes the model's consistency. Root Mean Square Error of Approximation (RMSEA) (0.069) is well within the acceptable range of <0.08 , which indicates an acceptable model approximation. Even though the χ^2/df ratio is marginally above the recommended threshold, the other indices meet the recommended thresholds; hence, the measurement model has a good fit and is reliable, as shown in *Table 1*.

Table 1: Model fit indices measurement

Name of index	Acceptance level	Results
CHISQ/DF	< 3.0	$X^2=394.027, df=137 \ X^2 / df = 3.360$
NFI	> 0.90	0.955
RFI	> 0.90	0.942
IFI	> 0.90	0.968
TLI	> 0.90	0.959
CFI	> 0.90	0.968
RMSEA	< 0.08	0.069

Composite Reliability

Composite reliability assessment in Table 1 assesses the dependability of the measurement model. To achieve composite reliability for a construct, it must have a composite reliability value ($CR > 0.7$) using the factor loadings from a confirmatory factor analysis (Collier, 2020). As shown below, all the components except affordability have a value below 0.7. This could be considered a good reliability.

Table 2: Composite Reliability

Latent Variables	Composite Reliability
<i>Adoption</i>	0.914027
<i>Awareness</i>	0.928114
<i>Affordability</i>	0.285138
<i>Accessibility</i>	0.919504
<i>Knowledge</i>	0.945853
<i>Culture</i>	0.919382

Discriminant Validity

Discriminant validity measures the distinctiveness of a construct from other constructs. These are a group of indicators that quantify one construct different from others. For it to be established, the root square of Average Variance Extracted (AVE) must be greater than its correlation (Collier, 2020). As indicated in the table 2, it can be concluded that the model's validity is established.

Table 3: Discriminant Validity

Latent Variables	Adoption	Awareness	Affordability	Accessibility	Knowledge	Culture
<i>Adoption</i>	0.704404					

<i>Awareness</i>	0.483	0.613046				
<i>Affordability</i>	-0.013	0.026	0.800564			
<i>Accessibility</i>	0.577	0.445	-0.044	0.59269		
<i>Knowledge</i>	0.504	0.627	0.046	0.306	0.777734	
<i>Culture</i>	0.475	0.355	0.117	0.497	0.14	0.741639

Convergent Validity

Convergent validity measures the degree to which two measures that are related actually produce similar results (Panzeri et al., 2024). According to Fornell and Larcker (1981), to compute convergent validity, the average Variance Extracted (AVE) for every construct needs to be determined. By summing the R^2 values of each indicator in a construct and dividing the result by the total number of indicators, an AVE is obtained. In Table 3, the convergent validity test was obtained by calculating the Average Variance Extracted for all the latent variables. For convergence to be effective, the AVE value needs to be 0.5 or more (de Araujo et al., 2025). As shown below, all the latent variables in the model have an AVE of more than 0.5. This implies that the model has good convergent validity.

Table 4: Convergent Validity

Latent Variables	Average Variable Extracted (AVE)
<i>Adoption</i>	0.704404
<i>Awareness</i>	0.613046
<i>Affordability</i>	0.800564
<i>Accessibility</i>	0.59269
<i>Knowledge</i>	0.777734
<i>Culture</i>	0.741639

Methodological Limitation

The sample size used for the study was based on the district population and the margin of error. However, this sample size is relatively small considering the total population of the study area. In light of this, the sample may not accurately reflect the perspectives of the entire rural population on the adoption of clean cooking energy in Ghana, as differences in energy access, cultural norms, and economic conditions exist. Additionally, the selection of one community from each of the zones may be subject to sampling bias. This is because the sampled communities may not entirely represent the zones, and this can impact the study findings, as it may not be a true reflection of the reality on the ground. This could lead to over- or under-representation of some groups, hence impacting the accuracy of the findings.

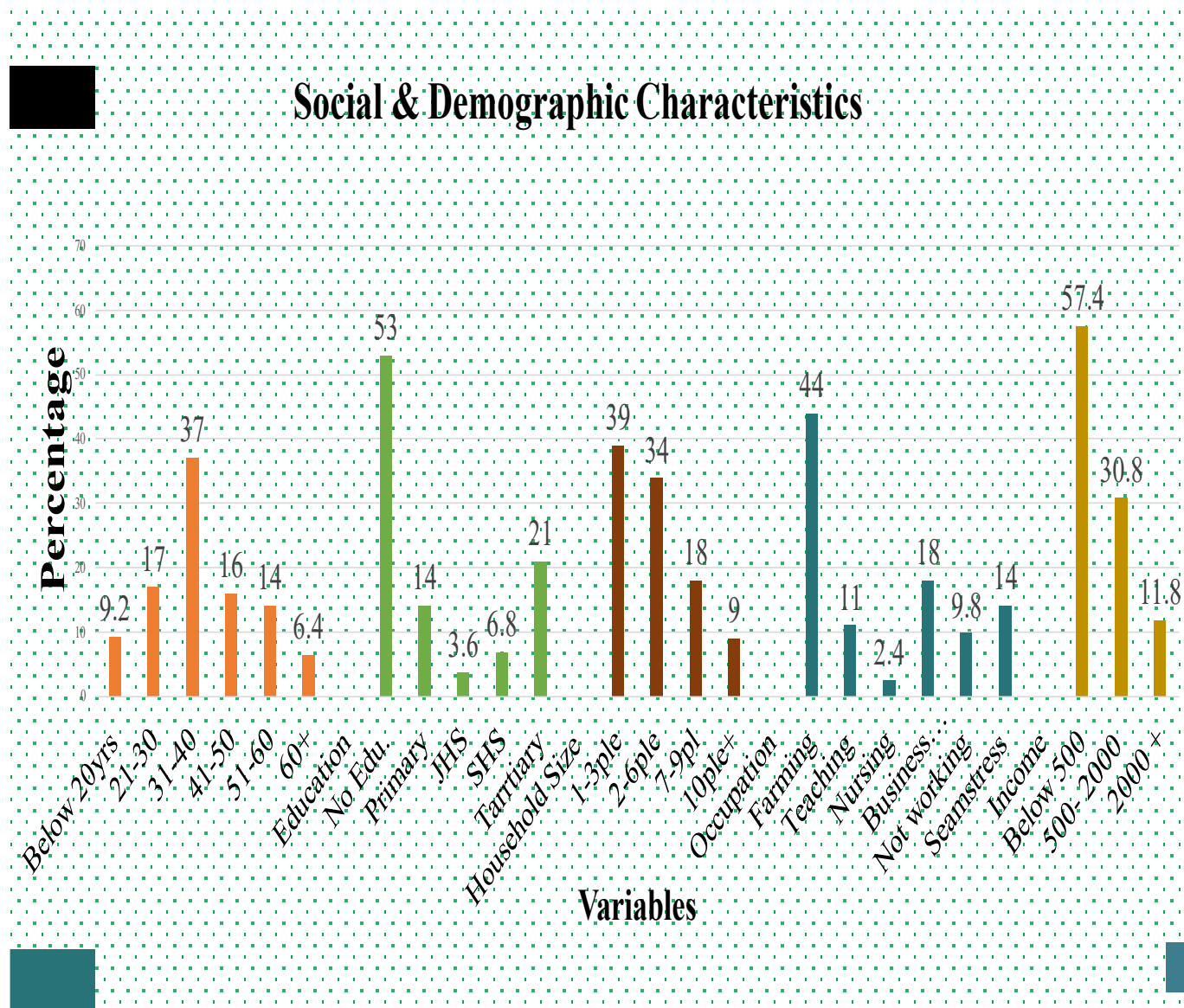
RESULTS AND DISCUSSIONS

Results

Figure 3 below provides the statistics for social, economic, and demographic characteristics for the study population. It addresses the population's age structure, marital status, educational level, household size, occupation, and average monthly household income. The age structure reveals that most women are aged 31-40 (37.2%), followed by those aged 21-30 (17%), and 41-50 (16.4%). Marital status indicates that 57.8% of the women are married, widows comprise 17.2%, singles make up 12.6%, and divorced individuals account for 12.4%. Educational level is generally low across the study population. The statistics show that 53% of the study population has no formal education. Those who attained tertiary education constitute only 21%. Primary, Junior high, and senior school education account for 13.6%, 2.6%, and 6.8%, respectively. The

majority of households between 1-3 and 4-6 members constitute 39.4% and 33.8%, respectively. The larger household sizes (7-9) and 10 members and above account for 17.8% and 9%, respectively. For occupational distribution, farming is the major livelihood occupation among the people. It employs and sustains about 44.8% of the people. Smaller shares for business owners 18.2%, seamstresses (14%), teachers (10.8%), nurses (2.4%), unemployed (9.8%). The income distribution shows that a larger percentage of households (57.4%) make less than GHC 500/USD 41 per month. This is a significant problem because it suggests that most households live on incomes too low to be economically sustainable. Only 30.8% earn between GHC500 (USD 41) and GHC2,000 (USD 165) per month, and just 11.8% earn more than GHC2,000 (USD 165).

Figure 3: Social and Demographic Characteristics



Structural model: Path analysis for hypothesized relationships

Key Paths

The structural model evaluated the mediated relationships between variables. Key findings are that:

1. Higher income (Access) has a positive influence on Adoption. The standardized estimate (0.330), T-value (6.60), and P-value (<0.001) imply that households with higher incomes may adopt clean cooking energy technologies because they can afford it.

2. Education (Awareness) positively influences adoption. With a standardized estimate of 0.481, a T-value of 13.04, and a P-value of <0.001, it suggests that education/ awareness greatly influences the transition of clean cooking technologies. This reaffirms the important role of knowledge in behavioural change.
3. Cultural Norms as a mediator have a standardized estimate of 0.175, T-value (4.38), and P-value (<0.001). This suggests that cultural norms partly mediate adoption behaviour, implying that public or societal expectations are vital in decision-making.

Figure 4: Structural Model

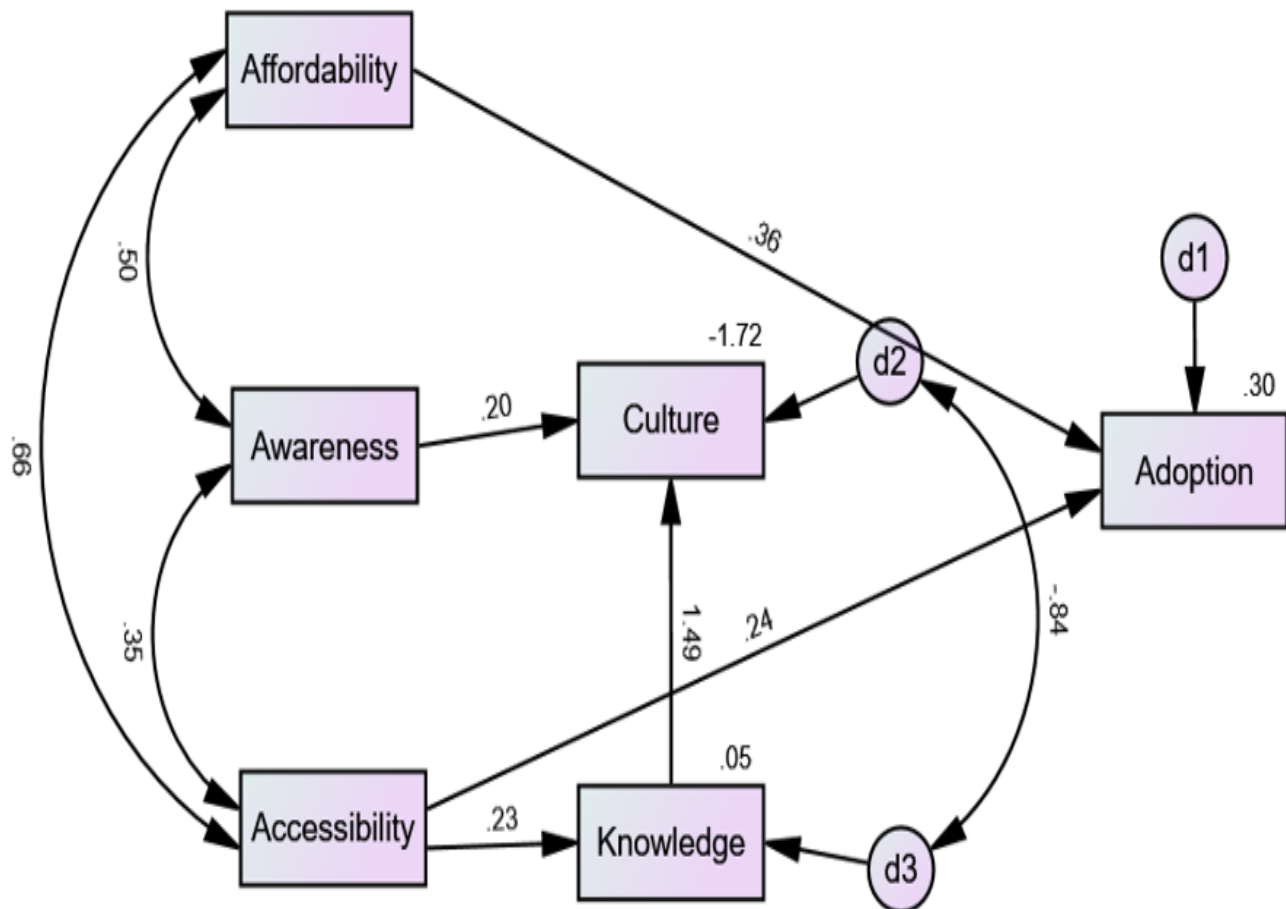


Table 5: Structural Model Statistics

Hypothesized Relationship	Estimates	T-value	P-value	Hypothesis
Higher income (Access) Adoption	0.330	6.60	***	Supports
Education (Awareness) Adoption	0.481	13.04	***	Supports
Cultural Norms Mediate Adoption	0.175	4.38	***	Supports

Impact of exposure to biomass energy for cooking on the lives of women in Northern Ghana (Bunkpurugu-Nakpanduri District)

As shown in Table 2, women suffer more (85.5%) of the health burden associated with the use of traditional biomass fuels. This is because of their primary role as home cooks in the Ghanaian society. They bear more diverse and intense health symptoms largely because of their daily long hours of exposure to biomass fuels during cooking. Children, on the other hand, experience fewer reported cases of exposure to traditional biomass energy. These results support the argument that women and children bear most of the effects of traditional biomass energy and the need for gender-based energy policies to address the technological, social, and cultural issues related to clean cooking energy transition.

Table 6: Reported cases of sickness related to indoor air pollution

Group	Reported Cases	Percentage (%)	Mean Symptom Burden (simulated)	Common Symptoms
Women	4521	85.5	4.29 ± 0.79	<i>Cough, Shortness of breath, Headache, Nausea, Skin rashes</i>
Children	764	14.5	2.57 ± 0.49	<i>Cough, Wheezing Respiratory infection</i>

Community Perspective on Clean Cooking Energy Adoption: Insights from Community Leaders

In many rural communities in the study area, modern cooking technologies are perceived as a mix of curiosity and scepticism. Some perceive it as modern with enormous health benefits. They believe that it can limit household air pollution and promote positive health outcomes. However, a significant share of the population believes that cleaner fuels and cooking technologies are not compatible with the traditional way of life. For their part, foods prepared with modern energy and technology lack the taste compared to traditional cooking methods. Additionally, they believe that clean cooking technologies are expensive and well-designed to suit the rich. They hold the view that traditional cooking methods deeply align with their cultural practices. From this perspective, it is particularly challenging for some communities to embrace what they call “a foreign method of cooking.”

DISCUSSIONS

The findings provide vital information about the population’s demography, socioeconomic structure, and the variables influencing their transition to clean cooking. These findings align with previous studies and, at the same time, provide a new perspective on the significance of cultural norms in Ghanaian society.

The findings suggest that education and income are key factors in clean cooking energy technology adoption. This aligns with earlier studies carried out in similar settings. A positive correlation between adoption and higher income (Access), as indicated in Table 4, is consistent with similar research conducted in Kenya and Tanzania, which found that financial capacity was a key factor in facilitating household acceptance of clean cooking energy initiatives (Amesa, 2019; Berg et al., 2024; Kihedu & Msuya, 2025). This trend highlights the expense of the clean cooking transition, particularly for low-income families. To ensure widespread adoption, financial barriers must be addressed. Given that 57.4% of the study population earns below GHC 500/ USD 41 a month is particularly concerning.

In the same vein, the substantial impact of education (awareness) on adoption, as shown in Table 4, aligns with similar studies, underscoring the vital role of knowledge and awareness in shaping behaviour change. Studies from other African countries demonstrate that increased awareness of the benefits of clean cooking technologies on health and the environment positively correlates with higher educational attainment, which in turn increases adoption rates (Onyinyi et al., 2025; Nduka & Jimoh, 2024; Chishimba, 2024). Given that

half of the population has no formal education, the successful transition to clean cooking will necessitate context-specific interventions to ensure equity in access and real usability.

The study's emphasis on sociocultural norms as a mediator in the adoption process is critical because Ghana's distinct sociocultural dynamics, customs, and social norms are crucial in households' decision-making. Similarly, the findings suggest that cultural resistance is a major barrier to transition in Ghana. This is contrary to the case of Kenya and Tanzania, where financial and infrastructure barriers dominate (Okello, 2023; Rugaimukamu, 2020). Apart from monetary subsidies or awareness campaigns, addressing cultural resistance requires culturally-responsive interventions. Utilizing social media, tailoring technology to local preferences, and engaging local leaders are effective strategies for overcoming cultural resistance. The study sheds light on the challenges to transition in situations where cultural factors play a central role.

The study also reveals a significant health burden on women and children, and this highlights a critical health issue that aligns with a broader issue in sub-Saharan Africa. Thus, women are at the receiving end of policy failure for energy access, particularly in access to clean cooking fuels. This offers empirical support for incorporating clean cooking initiatives into public health for the advancement of SDG 3, SDG5, and SDG 7.

In terms of community perspectives on clean cooking energy technologies, community leaders and stakeholders recognise their benefits; however, they also highlight the key issues related to access, affordability, social, and cultural incompatibilities. They emphasized the importance of community engagement and awareness campaigns to inform and empower women about the value of adopting clean and sustainable cooking practices.

CONCLUSION AND RECOMMENDATIONS

In conclusion, the study confirms, in line with findings from other regions in Africa, the essential role of income and education in the clean cooking transition. It also presents cultural norms as a unique challenge in the Ghanaian setting, providing a new insight into the difficulties of changing behaviour. To achieve sustainable adoption of clean cooking technologies, future efforts should take an integrative approach that respects culture and traditions, promotes cooking education, and addresses financial limitations. These findings contribute to a broader conversation in energy transition by underscoring the importance of context-specific interventions in international clean cooking initiatives.

Similarly, there is a need for a concerted effort from the government of Ghana to educate and encourage the adoption of clean cooking. It requires a comprehensive strategy that is implemented to engage the rural society to create a forward-leaning environment for transition. For instance, introducing subsidy programs targeting cooking innovations such as enhanced cookstoves, LPG, biogas digesters, and gas cylinders. The program could focus on low-income families, especially households in both urban and rural societies, who heavily rely on traditional fuels for cooking. By giving vouchers to these low-income families, they can purchase home cooking technologies at a subsidized rate.

Additionally, the government can reduce the taxes and import duties on these cooking technologies (LPG cylinders and cookstoves). This strategy will reduce the prices of this equipment for both consumers and manufacturers. Finally, supporting and encouraging homegrown production of clean cooking technologies could be a recipe for changing the clean cooking landscape. Encouraging the production of these technologies locally could enhance technology transfer and job creation.

Ethical Considerations

The ethical approval was obtained for this research involving human subjects

Data Availability

The data for this research is available upon request

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