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ENERGY POVERTY, COPING MECHANISMS, AND ITS IMPLICATIONS FOR HUMAN WELL-BEING: A CASE STUDY OF ADAMAWA STATE, NIGERIA

Upev Samuel Kaase[1*], Amurtiya Michael[2], Ocheja Theophilus Attabor[3]
[1,3]American University of Nigeria, Yola, Nigeria
[2]Modibbo Adama University, Yola, Nigeria
Corresponding author: kaase.upev@aun.edu.ng

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Abstract
Energy poverty threatens social and economic development in Nigeria, with Adamawa State facing persistent shortages due to unreliable grid supply and dependence on traditional fuels. This study assessed the prevalence of energy poverty, its impact on households, and the coping mechanisms adopted. A descriptive survey design was employed, and data were collected from 389 respondents using structured questionnaires. Descriptive statistics were used to analyse socio-economic characteristics, energy access, challenges, and coping strategies. Findings revealed that 71.5% of respondents were energy-poor, 57.8% had less than four hours of daily electricity, and 61.2% relied on firewood for cooking. About 73.5% experienced daily power outages, while 41.1% cited the high cost of alternative energy, and 40.4% reported respiratory problems linked to household energy use. Coping strategies included reliance on generators (37.3%), rechargeable lamps (29.1%), solar energy (24.4%), and deliberate reduction of electricity consumption (44 percent). The study concludes that energy poverty undermines health, education, productivity, and household welfare in Adamawa State. It recommends targeted investment in renewable energy, provision of subsidies for clean energy technologies, and improvements in grid infrastructure. Strengthening community-based initiatives alongside government-led interventions would reduce vulnerability, enhance energy access, and align outcomes with Sustainable Development Goal 7.

Keywords: Energy Poverty, Socioeconomic Characteristics, Challenges, Coping Strategies, Adamawa State

1. Introduction

Access to affordable and reliable energy is fundamental to human development and economic growth. Yet, energy poverty persists as one of the most pressing challenges in the Global South. It is commonly defined as reliance on biomass for cooking, irregular electricity supply, and dependence on costly alternatives (Day et al., 2016). Researchers have added accessibility, reliability and security to the concepts of energy poverty (Bouzarovski & Petrova, 2015; Samarakoon, 2019). In sub-Saharan Africa, infrastructural weaknesses and poverty sustain widespread deprivation, leaving households dependent on traditional fuels that harm health and limit productivity (Hihetah et al., 2024; Riahi et al., 2014).

Nigeria illustrates these concerns vividly. Despite its oil and gas resources, over 75% of the

population still experiences energy poverty (Ogwumike & Ozughalu, 2016). The problems of systemic inefficiencies, poor governance and insufficient infrastructure continue to hamper any development with respect to energy access (Agba, 2011). The solutions households use to cover the blackouts, such as generators, kerosene lamps, and firewood, are cost-increasing and health-hazardous (Afaha & Ifarajimi, 2021). They are associated with respiratory infections and eye strains, and poor productivity (Nie et al., 2021; Zhang et al., 2019). Meanwhile, schooling is also affected because students cannot study without light, and women are likely to experience more pressure to collect fuel (Famewo & Uwala, 2022). Such patterns confirm the multidimensional nature of energy poverty and its implications for health, equity, and the environment (Nwozor et al., 2019).

Regional disparities intensify these problems. The North East, with Adamawa state among the most affected, is the most energy poverty prevalent area (Afaha & Ifarajimi, 2021). The sporadic power cuts, meagre grid-tied supply and over-reliance on firewood demonstrate infrastructural failure and abject poverty. On examining the national trend, there is limited empirical research on how households in Adamawa State experience energy poverty and the coping strategies they are taking. This disparity limits the policy formulation process because the actualities on the ground are not captured in policy formulation processes. To eliminate this deficit, it is important to conduct more specific research that would allow for connecting energy deprivation with certain social and economic consequences at the communal level (Hihetah et al., 2024; Li et al., 2023).

This study concentrates on Adamawa State, where households face persistent deprivation of reliable and affordable energy despite national energy reforms. By grounding the analysis in a specific regional context, the study connects local realities to national and global discussions on energy access and human development. It also provides evidence that speaks directly to the challenges of translating policy into outcomes for marginalised communities. As Li et al. (2023) argue, addressing energy poverty is central to advancing human well-being and equitable development. Through empirical findings from Adamawa State, the study generates knowledge that can inform targeted policies and community-driven interventions, strengthening responses to one of the most pressing development issues in Nigeria. Specifically, the study was aimed at describing the socioeconomic characteristics of the respondents, assessing the energy poverty status of the respondents, identifying the challenges posed by energy poverty in the study area, and lastly examining the coping strategies adopted by residents to address energy poverty.

2. Literature Review

Energy Poverty

The inability of households to obtain sufficient resources combined with affordable and reliable, safe and modern energy services stands as a complex problem which impedes decent living standards (Day et al., 2016). Energy poverty can be understood through a capabilities framework according to Day et al. (2016) since affordable and safe, reliable energy services enable higher social participation and better social well-being. It should be noted that without access to basic domestic energy needs, people are unable to meet requirements for lighting and cooking, as well as heating and cooling and acquiring information and communication. The idea differs from simple affordability known as fuel poverty, according to developed nations (which sometimes requires spending more than 10% of household income on fuel), to include complete unavailability of contemporary energy sources, which remains widespread in developing countries due to their biomass fuel use (Riahi et al., 2014; Mckague et al., 2016; Aderemi et al., 2023).

From a capabilities perspective, energy poverty can be understood as the inability to achieve essential capabilities as a result of insufficient access to affordable, reliable, and safe energy services, considering available alternatives (Famewo & Uwala, 2022). This stance emphasises how energy is a tool for engagement in society and well-being. Despite using the same nomenclature, developed and developing regions have historically had different perspectives on and approaches to measuring energy poverty, sometimes moving forward independently. In addition to fuel shortages, Bouzarovski and Petrova (2015) contend that larger socio-technical inadequacies in delivering adequate household energy services are the primary cause of energy deprivation. According to empirical research such as Akintunde et al. (2024), energy poverty is very common in Nigerian rural and urban areas, especially among low-income households and those without jobs. Using NDHS data, similar results by Afaha and Ifarajimi (2021) reveal glaring geographical differences, with the North East zone experiencing the highest prevalence. These studies affirm that energy poverty is deeply entrenched in broader socio-economic inequalities and infrastructural deficits.

Recent global studies document a significant link between energy access and development outcomes. Analysis across 50 developing countries from 1990 to 2017 shows that greater access to electricity correlates with improved health and education indicators, particularly in high-poverty settings (Nguyen, 2021). Geospatial models demonstrate that providing photovoltaic systems with energy storage could reach nearly all populations currently lacking electricity, around 1.1 billion people, with household-level costs of $0.20 per kW h or less (LHer et al., 2023). These findings underscore both the feasibility and urgency of expanding affordable, sustainable energy services worldwide.

In Africa, studies highlight the role of institutions and finance. Across 32 countries between 2002 and 2021, stronger institutional quality and financial sector development supported access to clean fuels, especially in contexts with rising trade and urbanization (Kwakwa,

2024). Solar mini-grid implementation in rural Kenya and Nigeria benefitted more than 2,600 households, quadrupling median income in Kenyan communities and improving health through reduced use of kerosene (Carabajal et al., 2024). These results suggest decentralized renewable energy offers tangible economic and social gains at the community level.

Nigeria exhibits persistent energy challenges in national and regional dimensions. A time-series study covering 1981 to 2023 reveals that energy poverty reduces life expectancy in both short and long terms (Aina, 2024). On a household scale, 74% of urban dwellers use the traditional fuels whereas 26% utilizes modern fuels with wood most frequently used in the Northeast (Oluwoseun et al., 2024). These statistics require more investments into clean energy infrastructure, financial inclusion, and regional targeting to increase resilience and well-being.

Challenges Posed by Energy Poverty

Energy poverty presents substantial challenges to human well-being and sustainable development (Nwozor et al., 2019). It has serious negative effects on health, especially in the Global South, where the usage of polluting fuels causes respiratory ailments. Negative health effects are also a result of inadequate heating and cooling (Zhang et al., 2019). Empirical studies in China by Zhang et al. (2019) and Nie et al. (2021) established significant negative effects of multidimensional energy poverty on both physical and psychological health. Furthermore, energy poverty impedes educational attainment by limiting study lighting and information access. Equally, it also affects economic productivity, limiting their income generation and economic growth (Ogwumike & Ozughalu, 2016). Moreover, the inequalities that already exist are worsened leaving women the more affected by the fuel collection burden. Additionally, the enhancing use of conventional fuels is a threat to climate change and environmental destruction (Nie et al., 2021).

As Ogwumike and Ozughalu (2016) note, household size, education level, the region where people live in, are the crucial driver of energy poverty in Nigeria, and more than 75% of the population is exposed to it. There is simply periodicity related to gender where deprivation of energy directly influences not only academic but also economic performance as Famewo and Uwala (2022) noted in their study of the rural Nigerian women and female students.

Coping Strategies

People facing energy poverty adopt different strategies to handle their situation of power deprivation according to Bouzarovski & Petrova (2015). People who face energy poverty use different solutions to decrease their energy usage by controlling heating and illumination. Biomass-derived energy remains one of the main survival strategies in developing areas, although its usage endangers human health (Hihetah et al., 2024). People who cannot afford

high-end fuels often make such switches toward inferior but lower-cost energy sources. The cost-cutting measures for energy include decreasing expenses on essential items such as healthcare and food that would otherwise be used for other necessities (Amin et al., 2020). Sharing communal resources becomes vital for survival as people develop community-based solutions which serve to cope with unrelenting challenges. Local communities play a major role through their own adapted initiatives, but these prove successful at differing levels. The findings of Olurode et al. (2018) demonstrate that Lagos, Nigeria, urban residents use generators and rechargeable lamps as alternative power sources because of unreliable electricity. The selected coping strategies support immediate needs yet trap families in poverty while increasing their exposure to health problems and financial instability, indicating the importance of comprehensive governmental policy solutions.

Recent studies converge on the view that energy poverty is multidimensional, affecting health, education, productivity, and equity. Global and African evidence shows that poor access to modern energy constrains life expectancy, learning outcomes, and income growth (Nguyen, 2021; Kwakwa, 2024). In sub-Saharan Africa, the reliance on biomass and kerosene remains high, with negative effects on respiratory health and time allocation, particularly among women (Hihetah et al., 2024). Empirical findings from Nigeria reinforce these patterns. Households remain highly dependent on firewood and kerosene, while electricity supply is erratic and costly (Ogwumike & Ozughalu, 2016; Afaha & Ifarajimi, 2021). Evidence from Adamawa State confirms the intensity of deprivation, as households experience prolonged outages and minimal grid supply. These findings highlight the persistence of structural inequalities in energy access despite abundant national resources.
At the same time, contradictions arise in the literature regarding effective responses. Decentralised renewable energy projects in Kenya and Nigeria increased incomes and improved health outcomes (Carabajal et al., 2024), suggesting practical alternatives to grid expansion. Yet other studies stress that institutional quality and financing determine whether renewable options scale effectively (Kwakwa, 2024). In Nigeria, while solar and mini-grids show promise, adoption remains low due to cost barriers and poor government support (Oluwoseun et al., 2024). This tension underscores the need for context-specific evidence to inform interventions. By examining Adamawa State, this study responds to these gaps, aligning its objectives with the call for empirical insights into household-level realities that can guide targeted policies under Sustainable Development Goal 7.

3. Conceptual Framework

This study adopts the Energy Access–Livelihood Nexus as its guiding framework, which posits that socio-economic characteristics shape both access to energy and the capacity to adopt alternative sources. Empirical research shows that income, education, and household

size strongly influence energy choices, with low-income and less-educated households more reliant on biomass and kerosene (Oluwoseun et al., 2024). In Nigeria, women in rural households disproportionately bear the health burden of traditional fuels, linking gender to energy deprivation (Famewo & Uwala, 2022). Evidence from sub-Saharan Africa further confirms that institutional quality, financial access, and urbanization interact with socio-economic factors to determine energy transitions (Kwakwa, 2024).

Based on this framework, the study links the level of energy poverty to the socio-economic characteristics of households living in Adamawa State, its impact on health, productivity, and education and the strategies used to cope with this situation. This methodology places the study in context of other debates in addition to the fact provide empirical basis in the evaluation of how the vulnerability of communities to energy poverty is perpetuated by socio-economic inequality.

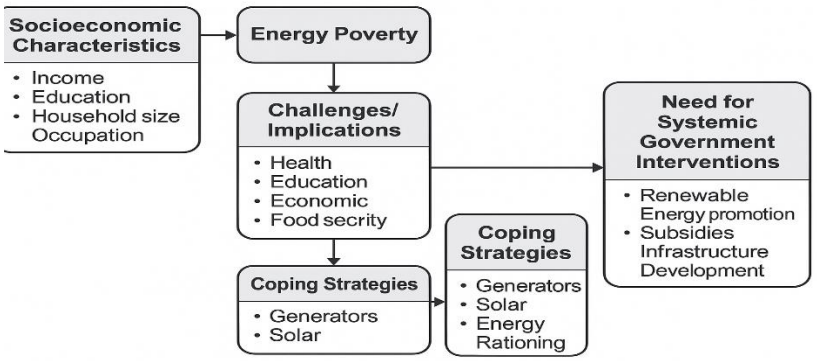

Figure 1: Conceptual Framework

4. Research Methodology

In order to achieve the set objectives of the study, a descriptive survey design was adopted to investigate energy poverty, its associated challenges, and the coping strategies adopted by households in Adamawa State, Nigeria.

4.1 Data Source

Data were obtained through an online survey of 389 respondents across Adamawa State, using a structured questionnaire designed to capture socio-economic characteristics, energy access, and coping mechanisms. Descriptive statistics were employed to summarize the data and highlight key patterns. While this approach offers clarity and ease of interpretation, it limits the depth of analysis and does not establish causality. The online method also excludes

households without internet access, which are often the most energy-poor, creating potential bias. Similar limitations have been noted in household energy surveys in sub-Saharan Africa where remote communities remain underrepresented (Hihetah et al., 2024).

The questionnaire was subjected to validity and reliability checks to ensure data quality. Experts in energy studies and survey design reviewed the instrument for content validity, confirming that the items adequately captured socio-economic characteristics, energy access, and coping strategies. A pilot test involving 30 respondents in a comparable community produced a Cronbach's alpha of 0.81, indicating acceptable internal consistency. Ethical considerations guided the entire process. Participation was voluntary, respondents provided informed consent, and confidentiality was assured by anonymizing responses and restricting data use to academic purposes only. These measures safeguarded both methodological rigor and ethical integrity.

4.2 Sample Size and Sampling Technique

In determining the sample size for this study, Krejcie and Morgan (1970) Table for sample size determination was uses and a sample size of 389 respondents was drawn from the population. This sample size was considered representative of the population of the study area. Considering the geographical scope and diversity of the state, a non-probability sampling technique (purposive sampling) was used to select respondents. This sampling technique was considered appropriate because it allowed the researchers to intentionally target individuals who had access to the internet and who were presumed to have experiences relevant to the study's objectives. The criteria for participation included residency in Adamawa State and experience with household energy usage. The dissemination of the questionnaire were made through links that were widely distributed through community networks, social media platforms, and local organisations to ensure a diverse pool of respondents across urban and rural areas.

4.3 **Method of Data Analysis**

Data analysis relied on descriptive statistical techniques, including frequencies, percentages, and means, to summarize respondents' socio-economic characteristics, energy access, challenges, and coping mechanisms. This approach aligns with the descriptive survey design, which emphasizes identifying patterns rather than testing causal relationships. No econometric model was applied, as the study focused on providing a clear profile of energy poverty rather than estimating determinants. Similar approaches have been used in energy poverty studies where the objective is to generate baseline evidence for policy and intervention design (Afaha & Ifarajimi, 2021; Hihetah et al., 2024).

5. Results and Discussion

Table 1: Socioeconomic Characteristics of Respondents (n=389)

Variable	Frequency	Percentage (%)
Age		
18–30 years	117	30.1%
31–50 years	190	48.8%
Above 50 years	82	21.1%
Gender		
Male	233	59.9%
Female	156	40.1%
Marital Status		
Single	83	21.3%
Married	261	67.1%
Widowed	30	7.7%
Divorced	15	3.9%
Highest Educational Qualification		
No formal education	58	14.9%
Primary education	97	24.9%
Secondary education	142	36.5%
Tertiary education	92	23.7%
Primary Occupation		
Farming	174	44.7%
Business/Trading	116	29.8%
Civil Service	64	16.5%
Unemployed	35	9.0%
Estimated Monthly Income		
₦0–₦50,000	201	51.7%
₦51,000–₦100,000	122	31.4%
>₦100,000	66	17.0%
Household Size		
1–3 members	78	20.1%
4–6 members	155	39.8%
7–9 members	113	29.0%
Above 9 members	43	11.1%

Source: Field Survey, 2025

The socio-economic characteristics of the respondents are presented in Table 1. In terms of

age, the majority of respondents (48.8%) were aged between 31 and 50 years, 30.1% were aged 18–30 years, and 21.1% were above 50 years. With respect to gender, males constituted 59.9% while females accounted for 40.1% of the respondents. Based on marital status, most of the respondents (67.1%) were married, 21.3% were single, and 7.7% were widowed, while 3.9% were divorced. Educationally, the highest proportion had secondary education (36.5%), with others having primary (24.9%), tertiary (23.7%), or no formal education (14.9%). Regarding occupation, farming was the predominant occupation (44.7%), business/trading were 29.8%, civil service were 16.5%, while the unemployment was 9.0%. In terms of income, over half (51.7%) of the respondents earned between ₦0 and ₦50,000 monthly, 31.4% earned between ₦51,000 and ₦100,000, while 17.0% earned above ₦100,000. According to data on household size, 39.8% of households had four to six people, 29.0% had seven to nine people, 20.1% had one to three people, and 11.1% had more than nine people. These results reflect the larger socio-economic background of Adamawa State, showing a population with a largely agrarian occupational structure, low income, large household sizes, and modest levels of education.

Table 2: Energy Poverty Status of Respondents (n=389)

Variable	Frequency	Percentage (%)
Primary Source of Lighting		
National grid	120	30.8%
Generator	80	20.6%
Solar energy	92	23.7%
Kerosene lamps	97	24.9%
Hours of Electricity Access		
Less than 4 hours	225	57.8%
4–8 hours	110	28.3%
9–15 hours	35	9.0%
More than 15 hours	19	4.9%
Primary Source of Cooking Energy		
Firewood	238	61.2%
Charcoal	71	18.3%
Gas	54	13.9%
Electricity	26	6.6%
Monthly Energy Expenditure		
₦0–₦5,000	208	53.5%
₦5,001–₦10,000	125	32.1%
Above ₦10,000	56	14.4%
Frequency of Power Outages		

Daily	286	73.5%
Weekly	60	15.4%
Monthly	26	6.7%
Rarely	17	4.4%
Alternative Energy Source	39	10.0%
Generator	138	35.5%
Solar panel	39	10.0%
Kerosene lamp	94	24.2%
None	118	30.3%
Perception of Energy Poverty		
Yes	278	71.5%
No	61	15.7%
Not sure	50	12.9%

Source: Field Survey, 2025

The analysis of the energy poverty status of respondents presented in Table 2 illustrates widespread deprivation. The primary source of lighting for most households was the national grid (30.8%), closely followed by kerosene lamps (24.9%), solar energy (23.7%), and generators (20.6%). Access to electricity was notably limited; 57.8% of respondents reported receiving less than 4 hours of electricity per day, while only 4.9% had access for more than 15 hours. Firewood remained the main source of cooking energy for 61.2% of households, with others relying on charcoal (18.3%), gas (13.9%), and electricity (6.6%). Monthly energy expenditures were relatively low, with 53.5% spending less than ₦5,000, 32.1% spending between ₦5,001–₦10,000, and 14.4% spending more than ₦10,000. Power outages were pervasive, occurring daily for 73.5% of respondents. When electricity was unavailable, alternative sources included generators (35.5%), solar panels (10.0%), and kerosene lamps (24.2%), although 30.3% had no alternatives. Notably, 71.5% of respondents considered themselves energy-poor, indicating a high prevalence of energy poverty in the area. These findings highlight severe energy deprivation, overdependence on traditional energy sources, and the urgent need for sustainable energy solutions.

Table 3: Challenges Posed by Energy Poverty in the Study Area (n=389)

Variable	**Frequency**	**Percentage (%)**
Main Challenge		
High cost of alternative energy	160	41.1%
Poor access to modern energy	99	25.5%
Health problems	75	19.3%
Reduced productivity	55	14.1%

Effect on Occupation		
Significant	204	52.4%
Moderate	112	28.8%
No impact	54	13.9%
Don't know	19	4.9%
Impact on Children's Education		
Reduced study time	174	44.7%
Increased cost	96	24.7%
No significant impact	79	20.3%
No children	40	10.3%
Health Issues Experienced		
Respiratory problems	157	40.4%
Eye strain	98	25.2%
Stress	81	20.8%
No health issues	53	13.6%
Effect on Information Access		
Significant	175	45.0%
Moderate	120	30.8%
No impact	61	15.7%
Not sure	33	8.5%
Effect on Food Security		
Food spoilage	140	36.0%
Inability to cook frequently	110	28.3%
Increased cooking fuel cost	83	21.3%
No impact	56	14.4%

Source: Field Survey, 2025

In Table 3, respondents reported facing multiple challenges arising from energy poverty. The high cost of alternative energy sources was the most common challenge, cited by 41.1% of respondents, while 25.5% reported poor access to modern energy, 19.3% mentioned health problems, and 14.1% experienced reduced productivity. Equally, in terms of the effect on occupation, it was significant for 52.4% of respondents and moderate for 28.8%, indicating that energy poverty substantially disrupts economic activities. Furthermore, regarding children's education, 44.7% of households experienced reduced study time due to a lack of lighting, while 24.7% noted increased costs associated with alternative energy usage. Equally, health challenges were also prevalent, with 40.4% reporting respiratory problems, 25.2% experiencing eye strain, and 20.8% suffering stress. Access to information was significantly affected for 45.0% of respondents, limiting access to media and communication

tools. Additionally, food security was affected; 21.3% reported higher cooking fuel prices, 28.3% claimed an inability to cook frequently, and 36.0% mentioned food spoiling from lack of refrigeration. These findings demonstrate that energy poverty adversely affects health, education, productivity, information access, and food security in Adamawa State.

Table 4: Coping Strategies Adopted by Residents (n=389)

Variable	Frequency	Percentage (%)
Primary Strategy for Outages		
Use generator	145	37.3%
Switch to solar energy	95	24.4%
Use rechargeable lamps	113	29.1%
Do nothing	36	9.2%
Coping with High Electricity Costs		
Reduce usage	171	44.0%
Use alternative sources	140	36.0%
Share bills with neighbours	40	10.3%
Do nothing	38	9.7%
Frequency of Renewable Energy Use		
Daily	78	20.0%
Weekly	101	26.0%
Occasionally	140	36.0%
Never	70	18.0%
Preferred Solution		
Government subsidy	140	36.0%
Investment in solar energy	110	28.3%
Improved infrastructure	95	24.4%
Community initiatives	44	11.3%
View on Government Intervention		
Strongly agree	261	67.1%
Somewhat agree	84	21.6%
Somewhat disagree	26	6.7%
Strongly disagree	18	4.6%

Source: Field Survey, 2025

As shown in Table 4, residents have adopted various coping strategies to manage energy poverty. The most common primary strategy during power outages was the use of generators (37.3%), this is followed by the use of rechargeable lamps (29.1%) and switching to solar energy (24.4%), while 9.2% did nothing but wait for power restoration. In order to cope with

high electricity costs, 44.0% of respondents reduced their electricity usage, 36.0% turned to alternative energy sources, 10.3% shared bills with neighbours, and 9.7% took no action. Regarding the frequency of renewable energy use, 36.0% reported using it occasionally, 26.0% weekly, 20.0% daily, and 18.0% never used renewable energy sources. As for preferred solutions, 36.0% advocated for government subsidies on energy, 28.3% favoured investment in solar energy, 24.4% desired improved national grid infrastructure, and 11.3% supported community-based initiatives. Regarding the function of government intervention, there was broad agreement, with 67.1% strongly agreeing and 21.6% somewhat agreeing that it is necessary. These findings point to a resilient populace that adjusts using a variety of technological, social, and personal coping mechanisms while overwhelmingly acknowledging the necessity of structural government assistance to solve energy poverty in a sustainable manner.

Discussion of Findings

The socio-economic profile of the respondents revealed a predominantly youthful and middle-aged population engaged mainly in farming and trading, with a considerable proportion having secondary or primary education. This demographic pattern aligns with findings by Akintunde et al. (2024), who observed that occupation and education significantly influence energy poverty levels in Nigeria. The high representation of low-income households and large household sizes further corroborates previous evidence suggesting that poverty and household demographics are critical drivers of energy vulnerability (Ogwumike & Ozughalu, 2016). These characteristics highlight the structural factors that predispose households in Adamawa State to energy poverty, suggesting that interventions must not only address energy access but also broader issues of economic empowerment and educational improvement.

Given that over 50% of the participants relied on traditional forms of energy such as firewood and kerosene, limited energy supply at certain times of the day, and a low consumption of the amount of money spent on energy, there was a high level of energy poverty status. Respondents were also notable with 71.5 reporting that they were energy deficient. These findings correspond to the works of Afaha and Ifarajimi (2021) and Bouzarovski and Petrova (2015), who pointed out how energy poverty continues to be present even as the rates of electrification in regions improve due to the insecurity and high price of modern energy services. Most of the respondents said that they experienced power outage on a daily basis which is an indication of the poor level of the current infrastructure. Such trends can be attributed to the multidimensional character of energy poverty reported by Day et al. (2016), in which an understanding of energy access incorporates its availability, reliability, safety, and affordable price.

The paper examined the numerous critical challenges that emanate due to energy poverty conditions. Some health issues such as respiratory problems and stress were frequently

mentioned by the performers in line with the findings of Nie et al. (2021) and Zhang et al. (2019) showing traditional fuels usage brings some health impacts. The mixture of decreased working efficiency and the learning barriers to children and the destruction of food issues because of the lack of lighting and electricity was one of the main issues. The research shows energy poverty creates widespread negative consequences which affect multiple wellness factors thus validating Famewo and Uwala's (2022) and Nwozor et al.'s (2019) assessment about how energy poverty strengthens social risks while damaging sustainable initiatives. Further, the tendencies towards the disproportional load on women and children, especially in the educational fields and health, reflect the global regimes of energy inequality.

In terms of coping strategies, respondents employed a combination of adaptive behaviours, including the use of generators, solar panels, rechargeable lamps, and reduction of energy consumption. However, these strategies, while necessary, often entailed trade-offs such as financial strain and health risks. The preference for government interventions, such as subsidies and infrastructure improvements, underscores the population's recognition of the structural nature of energy poverty. These findings support Bouzarovski and Petrova's (2015) argument that energy poverty cannot be solved solely through individual household adaptations but requires systemic policy responses. The recommendation made by Hietah et al. (2024) that policy solutions be context-specific and based on the lived experiences of energy-poor populations is especially relevant for Adamawa State, where socio-economic vulnerabilities and infrastructure interplay to worsen energy poverty.

6. Conclusion and Recommendation

This study has revealed the widespread incidence of energy poverty in Adamawa State, with most households experiencing limited access to reliable and affordable energy sources. The socio-economic characteristics of respondents, including low-income levels, large household sizes, and predominantly agrarian occupations, were found to significantly influence their vulnerability to energy poverty. Furthermore, the challenges posed by energy deprivation, including health risks, educational disruption, reduced productivity, and food insecurity, underscore the multidimensional nature of the problem. Despite adopting various coping strategies such as the use of generators, solar panels, and energy rationing, residents overwhelmingly identified the need for systemic government interventions to sustainably address the issue.

To address the challenges of energy poverty, the following measures should be implemented;

i. The Rural Electrification Agency and the Ministry of Power should invest in solar mini-grids and off-grid renewable systems in underserved communities.
ii. The Federal Government in collaboration with state governments and NGOs should subsidize clean cooking stoves, solar home systems, and other affordable

alternatives.

iii. The Ministry of Health should include awareness on the health risks of traditional fuels in rural health education and outreach programs.

iv. Financial institutions should introduce microcredit and flexible loan schemes that help low-income households adopt renewable energy solutions.

v. Community-based organizations should lead awareness campaigns, monitor implementation, and ensure sustainability of interventions at the grassroots level.

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