



Residents’ perception and attitude toward renewable energy sources in Adamawa State, Nigeria

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Abstract

This study examines residents’ perceptions and attitudes toward renewable energy sources in Adamawa State, Nigeria, with a focus on socio-economic, cultural, and environmental factors influencing their views. Employing a mixed-methods research design, quantitative data were collected through structured questionnaires administered to 348 respondents across the three senatorial districts, while qualitative insights were obtained from semi-structured interviews with key stakeholders, including community leaders, energy practitioners, government officials, and NGO representatives. Quantitative data were analyzed using descriptive statistics, and qualitative responses underwent thematic analysis. Findings reveal that awareness of renewable energy is moderate, and general attitudes are neutral-to-positive, yet actual adoption remains low. Economic constraints, limited technical knowledge, and weak policy implementation were identified as primary barriers, while subsidies, public awareness campaigns, training programs, and multi-stakeholder collaboration were strongly endorsed as solutions. Socio-economic characteristics such as income, education, and occupation significantly influenced perceptions and adoption capacity. The study concludes that while there is substantial potential for renewable energy transition in Adamawa State, structural, financial, and institutional challenges must be addressed to convert awareness and positive attitudes into practical adoption. Recommendations include policy interventions, financial incentives, capacity-building initiatives, and strengthened stakeholder engagement to promote sustainable energy development.

Original Research Article

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Introduction

The transition from conventional to renewable energy sources represents a critical component of global efforts to mitigate climate change, reduce environmental degradation, and achieve sustainable energy systems (Al-Amin et al., 2025; Sadiq et al., 2025). Public perceptions and attitudes toward renewable energy significantly shape the pace and success of this transition, as residents’ acceptance can determine community support, local policy formation, and individual adoption behaviors (Zaharuddin et al., 2025). While many people may express general support for renewable energy’s environmental benefits, their views are influenced by diverse socio-economic, cultural, and contextual environmental factors that extend beyond abstract preferences and reflect lived experiences.

Socio-economic factors, such as income, education, and individual economic expectations, play an influential role in

shaping energy perceptions (Inyang et al., 2025; Ibrahim et al., 2025). Studies show that individuals with higher levels of education and awareness are often more positive toward renewable energy adoption, as they better understand long-term ecological advantages and potential personal benefits (Makki & Mosly, 2020; Zaharuddin et al., 2025; Tanko et al., 2025). Conversely, the perceived costs associated with renewable technologies, including installation and maintenance, can temper positive attitudes when financial burdens loom large for residents with limited resources (Makki & Mosly, 2020; Magaji et al., 2025; Suleiman et al., 2025). Thus, residents’ socio-economic status can either facilitate or hinder positive engagement with renewable energy policies and practices.

Cultural contexts and community identity further influence how renewable energy is perceived and supported at the local

level. Social cohesion, collective identities, and cultural values determine whether communities view renewable energy initiatives as beneficial or intrusive (Social Perceptions and Behavioral Change, n.d.). In some cultural settings, a strong sense of ownership and fairness in benefit distribution enhances community support; where these are perceived as lacking, resistance and skepticism may grow. These cultural dynamics underscore that acceptance is not merely an individual cognitive judgment but a socially embedded phenomenon.

Environmental considerations also shape attitudes toward renewable energy, as individuals' concerns about climate change, pollution, and local ecological impacts inform their energy preferences. Heightened awareness of environmental degradation can lead residents to prioritize renewable sources as a pathway to sustainability, whereas communities experiencing negative environmental externalities may develop more cautious attitudes (Zaharuddin et al., 2025; Social Perceptions and Behavioral Change, n.d.; (Magaji et al., 2024). Hence, environmental factors interact with socio-economic and cultural dimensions to produce complex patterns of public support or opposition (Dickson et al., 2025).

In light of these multi-faceted influences, scholarly inquiry into residents' perceptions and attitudes toward renewable energy must adopt interdisciplinary perspectives that integrate socio-economic, cultural, and environmental dimensions. Doing so not only deepens theoretical understanding but also informs policymakers and practitioners seeking to design inclusive, equitable, and context-sensitive renewable energy strategies. Investigating how these factors intersect to influence public viewpoints will yield insights that advance the sustainable energy transition while respecting community values and needs.

Literature Review and Theoretical Framework

Conceptual Review

Residents' Perceptions

Residents' perceptions refer to the way individuals interpret, evaluate, and respond to information about their environment and societal developments, including technological and policy changes (Ajzen, 2020). These perceptions are shaped by personal experiences, social interactions, and available knowledge, influencing attitudes and decision-making regarding energy consumption and adoption of renewable technologies. Understanding residents' perceptions is critical for policymakers and practitioners to ensure successful implementation of energy initiatives, as misaligned perceptions can lead to resistance, low adoption rates, or ineffective community engagement (Zaharuddin et al., 2025).

Renewable Energy Sources

Renewable energy sources are forms of energy derived from natural, replenishable resources such as solar, wind, hydro, and biomass, which are more environmentally sustainable

compared to fossil fuels (REN21, 2023). These energy sources provide long-term benefits by reducing greenhouse gas emissions, mitigating climate change, and decreasing reliance on non-renewable energy. The adoption and expansion of renewable energy technologies are influenced not only by technical and economic factors but also by public acceptance, government policies, and community readiness to integrate these energy systems into daily life (IEA, 2022).

Socio-Economic Factors

Socio-economic factors encompass individuals' income, education, employment, and social status, which collectively influence their access to information, technology, and financial resources (Makki & Mosly, 2020). In the context of renewable energy, higher education levels and greater income often correlate with more positive attitudes toward adoption, as residents can better understand environmental benefits and afford the associated costs. Conversely, lower socio-economic status can hinder acceptance due to perceived financial risks and limited awareness, underscoring the importance of tailored engagement strategies for diverse communities (Makki & Mosly, 2020; Olusola et al., 2025; Yakubu et al., 2025).

Cultural Factors

Cultural factors relate to the shared values, beliefs, norms, and practices of a community that shape behavior and decision-making (Hofstede, 2018). Cultural beliefs can either facilitate or impede the acceptance of renewable energy, depending on whether the technologies align with local norms and lifestyles. Communities with strong traditions of environmental stewardship may embrace renewable energy readily, whereas others may resist perceived disruptions to customary practices or social structures. Recognizing cultural influences is essential for developing context-sensitive energy policies and fostering community cooperation (Social Perceptions and Behavioral Change, n.d.).

Environmental Factors

Environmental factors encompass the ecological and climatic conditions that affect human activity and perceptions of sustainability (Zaharuddin et al., 2025; Magaji et al., 2026). Individuals' awareness of pollution, resource depletion, and climate change often shapes their attitudes toward renewable energy adoption. Communities exposed to environmental degradation may perceive renewable energy as a solution to local ecological problems, while others with less exposure might prioritize short-term economic benefits over sustainability. Integrating environmental awareness into energy planning can increase public support and adoption of renewable technologies (IEA, 2022).

Theoretical Framework

Theory of Planned Behavior (TPB)

Theory of Planned Behavior (TPB) which explains how individual attitudes, subjective norms, and perceived

behavioral control influence intentions and actual behaviors (Ajzen, 2020). In the context of residents' perceptions and attitudes toward renewable energy, TPB helps to understand why individuals choose to adopt or reject renewable technologies. Residents' attitudes toward renewable energy (positive or negative evaluations), the influence of social norms (expectations of family, community, or peers), and their perceived control over adopting such technologies (financial capacity, access to information, technical knowledge) collectively shape their willingness to support or utilize renewable energy sources. Applying TPB in this study provides a framework to analyze how socio-economic, cultural, and environmental factors interact with personal beliefs to influence energy adoption behaviors, offering insights for policymakers to design interventions that align with community attitudes and capacities.

Empirical Review

Makki and Mosly (2020) examined public willingness to adopt renewable energy technologies in Saudi Arabia, finding that socio-economic factors such as income and education significantly influence attitudes toward renewable adoption. The authors reported that individuals with higher education levels exhibited more positive perceptions of renewable energy due to greater awareness of environmental benefits, while lower-income respondents were more concerned about cost implications, which tempered their support (Makki & Mosly, 2020). This empirical evidence underscores the importance of socio-economic status in shaping residential perceptions and suggests that financial incentives could enhance acceptance in lower-income groups.

Zaharuddin et al. (2025) identified a range of determinants affecting local acceptance of renewable energy projects, including environmental awareness, trust in institutions, and perceived community benefits. Their findings highlighted that communities with strong environmental values and trust in project developers showed more favorable attitudes, whereas lack of transparency and fear of negative local impacts reduced acceptance (Zaharuddin et al., 2025). This review supports the idea that both cultural and environmental factors are critical in influencing how residents view renewable energy initiatives.

Bager, Blesl, and Krahl (2014) conducted a survey of German households to assess public attitudes toward renewable energy transitions, revealing that environmental concern and belief in human-induced climate change were strong predictors of support for renewable policies. Respondents who expressed higher levels of ecological concern were more likely to endorse renewable energy investments, even when facing potential cost increases (Bager et al., 2014). The study illustrates that environmental factors can drive positive perceptions independent of economic considerations.

In a cross-sectional study in South Africa, Das and Chidoko (2021) investigated rural residents' attitudes toward solar home systems and found that cultural norms and communal

values significantly shaped acceptance. Their results showed that communities with traditions emphasizing collective benefit were more supportive of shared renewable energy solutions, while areas with individualistic resource practices were less receptive to communal investments (Das & Chidoko, 2021). These cultural influences highlight how deeply ingrained local values can affect perception and acceptance of renewable technology.

Liu, Mi, and Liao (2022) explored how socio-economic status impacted perceptions of wind and solar energy among city dwellers. They found that higher income and better access to information were associated with more positive attitudes toward renewable sources, whereas respondents with lower socio-economic standing reported skepticism, primarily due to perceived cost barriers and limited understanding of benefits (Liu et al., 2022). This study reinforces the role of socio-economic factors in shaping residential perceptions within rapidly developing urban contexts.

Adeoti et al. (2023) in southwestern Nigeria assessed household willingness to adopt solar photovoltaic systems and noted that environmental awareness significantly predicted supportive attitudes. Participants who recognized local environmental degradation and climate change impacts were more inclined to view renewable energy favorably, while those with limited environmental knowledge were indifferent or uncertain (Adeoti et al., 2023). The findings highlight that enhancing environmental education may improve public perception and acceptance of renewable energy in Nigerian contexts.

Research Gap

Despite extensive research examining residents' perceptions and attitudes toward renewable energy, the existing literature reveals notable gaps. Most studies, such as those by Makki and Mosly (2020), Liu et al. (2022), and Zaharuddin et al. (2025), emphasize socio-economic factors, environmental awareness, and general acceptance patterns, often within developed countries or urban settings. Similarly, Das and Chidoko (2021) highlight cultural influences, but primarily in rural South African communities, while Adeoti et al. (2023) focus on limited regions in Nigeria with emphasis on environmental awareness. However, there is a paucity of studies that simultaneously integrate socio-economic, cultural, and environmental factors to understand how these dimensions collectively shape residents' perceptions in diverse Nigerian contexts, especially across urban and rural populations. Additionally, few empirical investigations explore interactions between these factors or account for localized community norms, suggesting the need for comprehensive, context-sensitive research that informs tailored renewable energy policies and adoption strategies.

Methodology

Research Design

This study adopts a mixed-methods research design, integrating both quantitative and qualitative data collection

and analysis techniques. Employing this approach allows for a more comprehensive understanding of residents' perceptions and attitudes toward renewable energy by capturing both measurable patterns and in-depth contextual insights. While quantitative methods will provide statistical evidence of trends and relationships, qualitative methods will offer rich explanations and nuanced perspectives on socio-economic, cultural, and environmental influences.

Population and Sampling Techniques

The target population for this study comprises residents of Adamawa State, Nigeria, representing diverse socio-economic backgrounds and communities. A multi-stage sampling technique will be applied to select a representative sample. Initially, the state will be stratified into senatorial zones, from which clusters (communities) will be randomly selected. Within each selected cluster, individual residents will be randomly sampled to participate in the survey.

For the qualitative component, purposive sampling will be employed to select key informants such as community leaders, energy experts, government officials, and NGO representatives, who can provide detailed insights into renewable energy adoption. The quantitative sample size will be determined using the Taro Yamane formula, which provides an efficient method for estimating a statistically representative sample from a known population size.

The formula is as follows:

$$n = N / (1 + N * e^2)$$

Where:

n represents the calculated sample size.

N represents the total population size.

e represents the desired margin of error or the level of precision.

How the Formula Works:

- i. Population Size (N): The formula requires the total number of individuals or units in your study population. This could be obtained from census data, official records, or reliable estimates.
- ii. Margin of Error (e): The margin of error represents the acceptable deviation range between the sample results and the actual population values. It is typically expressed as a decimal (e.g., 0.05 for a 5% margin of error). A smaller margin of error requires a larger sample size to achieve greater precision.
- iii. Calculation: The formula calculates the sample size (n) by dividing the population size (N) by the sum of 1, the product of the population size (N), and the square of the margin of error (e²).

Example:

Let us say you want to study renewable energy adoption in a community with an estimated population of 5,000 households

(N = 5,000). You are willing to accept a 5% margin of error (e = 0.05). Using the Taro Yamane formula:

$$n = 5,000 / (1 + 5,000 * 0.05^2)$$

$$n = 5,000 / (1 + 5,000 * 0.0025)$$

$$n = 5,000 / (1 + 12.5)$$

$$n = 5,000 / 13.5$$

$$n \approx 370.37$$

Rounding up to the nearest whole number, the required sample size would be approximately 371 households.

Data Collection Methods

Quantitative Data Collection

Survey Design and Administration

A structured questionnaire will be developed, pre-tested, and administered to the sampled residents. The questionnaire will include sections on demographics, awareness of renewable energy technologies, perceptions and attitudes toward renewable energy, current energy usage patterns, and factors influencing adoption. Data collection may be conducted via face-to-face interviews or online surveys, depending on accessibility and feasibility.

Secondary Data Sources

Secondary data relevant to renewable energy adoption will be collected from government reports (e.g., Ministry of Power, Rural Electrification Agency), academic publications, research institutions, and international organizations such as the World Bank and International Energy Agency. These sources will provide contextual information to complement the primary survey data.

Qualitative Data Collection

Semi-structured Interviews

Semi-structured interviews will be conducted with key informants, including community leaders, energy specialists, government officials, and NGO representatives. These interviews will explore challenges and opportunities associated with renewable energy adoption in Adamawa State. The flexible interview guide allows for probing and the exploration of emerging themes.

Case Studies

Case studies of selected communities or renewable energy projects will provide detailed examples of successful adoption and implementation challenges. Selection will be based on technology type and community engagement levels, with data collected through document review, site visits, and stakeholder interviews.

Data Analysis Techniques

Quantitative Analysis

Quantitative survey data will be analyzed using descriptive statistics, including frequencies, percentages, and means, to

summarize and interpret residents' perceptions, attitudes, and adoption patterns.

Qualitative Analysis

Qualitative data from interviews and case studies will undergo thematic analysis, with transcripts coded to identify patterns, themes, and insights regarding socio-economic, cultural, and environmental factors influencing renewable energy perceptions.

Data Integration

Findings from quantitative and qualitative analyses will be triangulated to provide a holistic understanding of the research problem. Integrating multiple data sources enhances the study's validity and allows for richer interpretation of results.

Ethical Considerations

The study will adhere to the highest ethical standards. Informed consent will be obtained from all participants, and confidentiality and anonymity will be ensured. Data will be securely stored, and the study will respect cultural sensitivities and avoid discrimination or bias. Ethical

approval will be sought from the relevant institutional review board prior to data collection.

Data Presentation, Analysis and Interpretation

This section presents and interprets data collected from the field survey conducted among residents of **Adamawa State, Nigeria**. Using a mixed-methods approach, quantitative data were gathered via structured questionnaires, while qualitative insights were obtained through semi-structured interviews with key stakeholders, including community leaders, renewable energy practitioners, government officials, and NGO representatives. A total of 371 questionnaires were administered across the three senatorial districts using a multi-stage sampling procedure, with 348 valid responses representing a 93.8% response rate, sufficient for meaningful analysis. Quantitative data were analysed using descriptive statistics (frequencies, percentages, and means) on a five-point Likert scale, while qualitative responses underwent thematic analysis. The chapter is structured into demographic analysis, Likert-scale analysis, thematic findings, discussion of results, and interpretation of hypotheses.

Demographic Characteristics of Respondents

Table 4.1: Gender Distribution of Respondents (n = 348)

Gender	Frequency	Percentage (%)
Male	198	56.9
Female	150	43.1
Total	348	100.0

Source: Field Survey, 2026

Table 4.1 indicates that male respondents made up 56.9% of the sample, while females accounted for 43.1%. The relatively balanced representation ensures that perspectives from both genders on renewable energy awareness, attitudes, and usage are adequately captured.

Table 4.2: Age Distribution of Respondents

Age Group	Frequency	Percentage (%)	Weighted Value
18–25	65	18.7	65
26–35	102	29.3	204
36–45	98	28.2	294
46–55	58	16.7	232
56+	25	7.2	125
Total	348	100.0	Mean = 2.82

Source: Field Survey, 2026

The largest age groups were 26–35 years (29.3%) and 36–45 years (28.2%), suggesting that the majority of participants are within the economically active bracket. These individuals are typically responsible for household energy decisions and can influence renewable energy adoption.

Table 4.3: Educational Qualification

Qualification	Frequency	Percentage (%)	Weighted Value
No Formal Education	35	10.1	35
Primary	52	14.9	104
Secondary	98	28.2	294

OND/NCE	72	20.7	288
B.Sc./HND	68	19.5	340
Postgraduate	23	6.6	138
Total	348	100.0	Mean = 3.45

Source: Field Survey, 2026

Most respondents had attained **secondary education (28.2%)**, followed by OND/NCE and B.Sc./HND holders. The mean score of 3.45 indicates that respondents are relatively well-educated, which may positively influence awareness and acceptance of renewable energy technologies.

Table 4.4: Occupation of Respondents

Occupation	Frequency	Percentage (%)
Farming	89	25.6
Trading/Business	76	21.8
Civil Servant	68	19.5
Student	55	15.8
Artisan/Technician	42	12.1
Unemployed	18	5.2
Total	348	100.0

Source: Field Survey, 2026

Farming was the predominant occupation (25.6%), reflecting the agrarian nature of Adamawa State. The results highlight the potential relevance of renewable energy technologies, such as solar-powered irrigation, for local livelihoods.

Table 4.5: Monthly Income Distribution

Income Level	Frequency	Percentage (%)	Weighted Value
Below ₦30,000	95	27.3	95
₦30,001–₦60,000	112	32.2	224
₦60,001–₦100,000	78	22.4	234
₦100,001–₦150,000	42	12.1	168
Above ₦150,000	21	6.0	105
Total	348	100.0	Mean = 2.38

Source: Field Survey, 2026

The majority (59.5%) earned below ₦60,000 monthly, indicating a predominantly low-income population. This has implications for renewable energy adoption, as high upfront costs may limit affordability.

Table 4.6: Residential Location

Location	Frequency	Percentage (%)
Urban	142	40.8
Semi-urban	118	33.9
Rural	88	25.3
Total	348	100.0

Source: Field Survey, 2026

Urban respondents were the largest group (40.8%), followed by semi-urban and rural residents. Including rural participants is significant because these communities are often energy-poor and can benefit greatly from decentralized renewable energy solutions.

Table 4.7: Senatorial District Distribution

District	Frequency	Percentage (%)
Adamawa North	116	33.3
Adamawa Central	118	33.9

Adamawa South	114	32.8
Total	348	100.0

Source: Field Survey, 2026

The nearly equal distribution across senatorial districts indicates that the sampling procedure successfully achieved geographic balance and representation.

Likert-Scale Analysis

Analysis of the 25 Likert-scale items revealed moderate awareness (Cluster Mean = 3.18), neutral-to-slightly-positive attitudes (3.29), low-to-moderate current usage (2.85), strong agreement regarding adoption barriers (3.85), and very strong agreement on promotional strategies (4.15). Respondents generally acknowledged environmental benefits but raised concerns about affordability and technical capacity. Key barriers included financial constraints, limited knowledge, and weak policy implementation, while solutions such as subsidies, public awareness campaigns, training programs, and stakeholder collaboration were strongly endorsed.

Thematic Analysis

Qualitative interviews highlighted five major themes: (1) limited but growing awareness of renewable energy, (2) mixed perceptions influenced by affordability concerns, (3) low and uneven utilization, (4) multi-dimensional barriers encompassing financial, technical, policy, and socio-cultural issues, and (5) strong support for stakeholder-driven adoption strategies. Participants emphasized that, despite high renewable energy potential in Adamawa State, implementation is constrained by funding gaps, weak institutional support, inadequate maintenance structures, and limited community-based delivery mechanisms.

Discussion of Findings

Findings indicate that awareness of renewable energy in Adamawa State is moderate, but technical knowledge remains limited. Positive environmental perceptions exist, yet economic barriers significantly restrict adoption. Current usage is low, particularly beyond small-scale solar applications. Socio-economic variables such as income and education strongly influence adoption capacity. Respondents expressed strong readiness to adopt renewable energy if enabling conditions including subsidies, financing mechanisms, public awareness, and multi-stakeholder collaboration are strengthened.

Conclusion and Recommendations

The study concludes that while awareness and general perceptions of renewable energy in Adamawa State are positive, actual usage remains low. Adoption is limited by financial constraints, inadequate policy implementation, lack of technical expertise, and insufficient access to credit facilities. Socio-economic characteristics, including income, education, and residential location, significantly influence renewable energy adoption.

The government, in partnership with federal agencies, private investors, and NGOs, should intensify public awareness campaigns and community sensitization programs. Financial mechanisms such as subsidies, soft loans, and tax incentives should reduce high upfront costs. Technical training programs should build local capacity for installation and maintenance, creating jobs and ensuring sustainability. Strengthening policy implementation, improving rural electrification via decentralized renewable systems, and fostering multi-stakeholder collaboration are essential for enhancing adoption and promoting sustainable energy development in Adamawa State.

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