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Assessment of Electricity Access Among Urban Households in Makurdi, Benue State, Nigeria

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Abstract- ***This study assesses electricity access among urban households in Makurdi, Benue State, with particular attention to disparities in supply, reliability, metering, and their implications for livelihood diversification. A descriptive cross-sectional survey design was employed, using a structured questionnaire administered to 400 sampled households selected through a multi-stage sampling procedure involving stratification and systematic random sampling across eight neighbourhoods. A total of 381 valid responses were obtained. Quantitative data were analysed using descriptive statistics, composite indices, including the Electricity Reliability Index (ERI). Findings show that 89.5% of households were connected to the national grid, although access varied widely across neighbourhoods. Planned, high-income areas such as Old GRA and Owner Occupier recorded the highest connection rates (over 95%), prepaid metering, and grid reliability, whereas informal and low-income areas including Fiidi and Wadata exhibited lower access, higher informality, and weak service regulation. Although 60.1% of households used prepaid meters, 21.1% had no formal metering, reflecting uneven implementation of electricity governance. Grid supply was complemented by generators (used by 38.7% of households) and emerging solar installations, highlighting persistent reliability challenges. The overall ERI of 3.10 indicates moderate reliability, with Old GRA achieving good reliability (ERI = 3.50) and Wadata showing poor performance (ERI = 2.75). Daily hours of supply remained low in many neighbourhoods, constraining electricity-dependent livelihood activities. The study concludes that electricity access in Makurdi is relatively high but inequitable, with significant implications for household productivity and livelihood diversification. Strengthening reliability, expanding metering coverage, and supporting decentralised energy solutions are essential for improving urban energy security.***

Key Words: Electricity; access; livelihood; diversification; urban household

I. INTRODUCTION

Access to electricity is a critical driver of socio-economic development, influencing various aspects of human life, including education, health, and economic productivity (International Energy Agency, 2023). In developing countries like Nigeria, electricity access remains a significant challenge, particularly in urban areas where rapid population growth and urbanization exacerbate demand (Adeoye & Adebayo, 2020). Despite Nigeria's abundant energy resources, including natural gas and renewable energy potential, the country struggles with inadequate power supply, frequent outages, and unreliable grid infrastructure (Oyedepo, 2019). According to the International Energy Agency (2023), approximately 85 million Nigerians, representing about 43% of the population, lack access to reliable electricity, with urban areas experiencing intermittent supply and rural areas often entirely unconnected.

Makurdi, the capital of Benue State, is a rapidly growing urban center in Nigeria. As an administrative and commercial hub, Makurdi has witnessed significant population growth, increasing the demand for basic services such as electricity (Ortserga, 2021). Urban households in Makurdi rely on electricity for domestic activities, small-scale businesses, and livelihood diversification strategies. However, the inconsistent power supply, characterized by frequent blackouts and reliance on alternative energy sources like generators and solar systems, poses challenges to households' socio-economic activities (Akpan & Essien, 2022). The lack of reliable electricity limits the ability of households to engage in income-generating activities, particularly those requiring modern technology and equipment (Emodi & Boo, 2018).

Livelihood diversification refers to the process by which households engage in multiple income-generating activities to enhance economic resilience

and reduce vulnerability to shocks (Ellis, 2000). In urban contexts, diversification often includes non-agricultural activities such as trading, artisanal work, and service-based enterprises, many of which depend on electricity (Bryceson, 2002). Access to electricity enables households to adopt modern technologies, extend working hours, and improve productivity, thereby facilitating diversification (Karekezi & Kithyoma, 2008). For instance, electricity-powered tools and appliances, such as sewing machines, refrigerators, and computers, allow households to engage in tailoring, food vending, and digital services, respectively (Dinkelman, 2011). In Makurdi, where agriculture remains an important livelihood source, electricity access could enable households to transition to or complement agricultural activities with non-farm enterprises, enhancing income stability (Ortserga, 2021).

The relationship between electricity access and livelihood diversification is well-documented in development literature. Studies have shown that reliable electricity access enhances household productivity, promotes entrepreneurship, and supports the adoption of income-generating activities (Khandker et al., 2014). In urban areas, where economic opportunities are diverse, electricity serves as a catalyst for small-scale enterprises, enabling households to move beyond subsistence activities (Toman & Bluffstone, 2017). However, in Nigeria, the erratic power supply often forces households to rely on costly alternatives, such as diesel generators, which increase operational costs and limit the scope of diversification (Adeoye & Adebayo, 2020). Furthermore, disparities in electricity access, influenced by socio-economic factors such as income, education, and location, create inequalities in households' ability to diversify livelihoods (Ogundipe & Akinyemi, 2019).

While existing studies have explored electricity access and its socio-economic impacts in Nigeria, there is limited research focusing specifically on urban households in Makurdi. Most studies concentrate on rural electrification or national-level analyses, leaving a gap in understanding how electricity access influences livelihood diversification in rapidly urbanizing areas like Makurdi (Akpan & Essien, 2022). In addition, there is a need to examine the specific factors that determine the use of electricity for livelihood activities, such as affordability, infrastructure quality, and household characteristics (Emodi & Boo, 2018). This study seeks to address these gaps by assessing the level of electricity access, the extent of livelihood diversification, and the relationship between these variables among urban households in Makurdi, Benue State. By examining the level of electricity access, the extent of livelihood diversification, and the factors influencing the use of electricity for income-generating activities, this study aims to contribute to the growing body of knowledge on energy access and socio-economic development in Nigeria.

II. MATERIAL AND METHODS

Study Area

Makurdi is located between latitude 7 ^{O} 00'N and7^{o}45$^{`}$N and Longitude 8$^{O}$ 32$^{`}$E and 8 ^{O}45'E. It is bound by Guma Local Government Area to the north; Gwer East to the south and Gwer-West to the west. Makurdi is divided into the North and South banks; separated by the old and the new bridges (Figure 1). Makurdi is the administrative capital of the state from where the Governor resides and governs the whole state from. Makurdi also enjoys the presence of the headquarters of all the state ministries, departments and agencies with most of them located at the state secretariat.

Makurdi Urban Area is characterised by a mix of planned and unplanned neighbourhoods, with several areas laid out in a grid-iron pattern and differentiated by density. High-density neighbourhoods such as Wurukum, Wadata, Ankpa Ward and parts of High Level have comparatively lower housing quality, while low-density areas, including the old and new G.R.A., Lobi Quarters and Commissioners' Quarters, feature better residential environments. Makurdi serves as Benue State's capital and accommodates a rapidly growing population, projected to reach about 430,000 by 2025.

The urban environment is further shaped by the city's wet-and-dry tropical (Aw) climate, with heavy rains between April and October and dry, dusty harmattan conditions from November to March. This climate supports crop cultivation but also exposes low-lying

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areas to seasonal flooding. Vegetation ranges from Guinea Savanna grasslands to riparian forests along the River Benue, though urbanisation has fragmented these ecosystems over time. Residents engage in market gardening along the floodplains, while fishing, largely by the Jukun ethnic group, remains a seasonal livelihood. Electricity supply is anchored on the national grid through JEDCO's distribution network, yet power availability remains inconsistent due to ageing infrastructure, overloaded feeders and transmission losses, particularly in peri-urban settlements like North Bank.

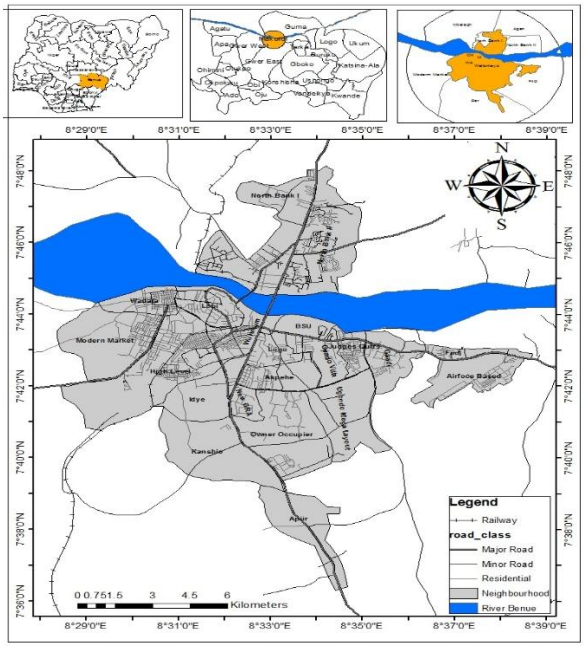

Figure 1: Makurdi Urban Area
Source: Benue State University GIS Lab (2024).

Methods

The study employed a descriptive cross-sectional survey design to examine electricity access and its influence on livelihood diversification among urban households in Makurdi. This design enabled the collection of quantitative data at a single point in time, capturing households' socio-economic, demographic, and technical characteristics, as well as patterns of electricity usage and income-generating activities. Data were collected primarily through a structured questionnaire administered to household heads or adult representatives across selected neighbourhoods. A multi-stage sampling procedure was used, beginning with stratification of Makurdi into high-, medium-, and low-density residential areas, followed by systematic random sampling of 50 households in each of the eight selected neighbourhoods. Using Yamane's formula, a sample size of 400 households was determined, with 381 valid responses retrieved, representing a high response rate of 95.25%.

Data collection relied on a well-structured questionnaire divided into four sections covering socio-demographic characteristics, electricity access. Both closed and open-ended questions were used, allowing for quantitative analysis and supporting qualitative insights. The collected data were analysed using SPSS version 21. Descriptive statistics, frequencies, percentages, means, and composite indices such as the Electricity Reliability Index (ERI) and the Engagement Ratio Index, were used to assess electricity access and livelihood diversification.

III. RESULTS AND DISCUSSION

Results

1. Socio-economic and Demographic Characteristics

The result of the socio-economic and demographic characteristics of respondents is presented in Table 1. The variables assessed are sex, age, marital status, education, main occupation, household size and tenancy status of respondents.

Table 1: Socio-economic and Demographic Characteristics of Respondents

Variable/Category	Frequency	Percentage
Sex		
Male	217	56.9
Female	164	43.1
Age		
18–30	72	18.9
31–40	131	34.4
41–50	109	28.6
Above 50	69	18.1
Marital Status		
Single	84	22
Married	253	66.4
Widowed	27	7.1
Divorced/Separated	17	4.5

Highest level of education completed		
No formal education	14	3.7
Primary	38	10
Secondary	111	29.1
Tertiary (ND/NCE/First Degree)	176	46.2
Postgraduate	42	11
Household size		
1–3 members	67	17.6
4–6 members	192	50.4
7–10 members	94	24.7
Above 10 members	28	7.3
Main occupation of household head		
Farming	49	12.9
Trading	116	30.4
Formal salaried job	83	21.8
Artisan/Repair	66	17.3
Transport	28	7.3
Other such as services, tailoring, motor cycling	39	10.2
Approximate monthly household income (₦)		
Below 50,000	64	16.8
50,000–100,000	153	40.2
100,001–200,000	118	30.9
Above 200,000	46	12.1
Tenure status of dwelling		
Owner-occupied	142	37.3
Rented	203	53.3
Employer provided	19	5
Relative/Free	17	4.5

Source: Researcher's Field Survey, 2025; Note: (N = 381)

The result shows that 56.9% of respondents were male and 43.1% female, indicating a dominance of male-headed households, which aligns with gendered decision-making patterns in urban Makurdi. The age distribution shows that most respondents were within the economically active age range: 34.4% were 31–40 years, 28.6% were 41–50 years, 18.9% were 18–30 years, and 18.1% were above 50 years. Regarding marital status, 66.4% were married, 22% single, 7.1% widowed, and 4.5% divorced or separated, reflecting predominantly family-based households. Educational attainment indicates a relatively literate population, with 46.2% holding tertiary qualifications, 29.1% secondary education, 11% postgraduate education, 10% primary education, and 3.7% with no formal education. Household size varied, but most respondents had medium-sized households: 50.4% had 4–6 members, 24.7% had 7–10 members, 17.6% had 1–3 members, and 7.3% had more than 10 members. Occupationally, the sample reflects a diverse urban economy: 30.4% were traders, 21.8% in formal salaried employment, 17.3% artisans/repair workers, 12.9% farmers, 10.2% in other service-related jobs, and 7.3% in transport. Monthly household income levels show that 40.2% earned ₦50,000–100,000, 30.9% earned ₦100,001–200,000, 16.8% earned below ₦50,000, and 12.1% earned above ₦200,000, suggesting a predominance of middle-income households. In terms of housing, 53.3% of respondents lived in rented accommodation, 37.3% were owner-occupiers, 5% lived in employer-provided housing, and 4.5% lived rent-free with relatives. Altogether, these socio-economic and demographic characteristics provide a comprehensive profile of urban households in Makurdi and offer important context for analysing electricity access and livelihood diversification.

Level of Electricity Access Among Households in Makurdi Urban Area

The results presented in Tables 2 reveal considerable variation in household electricity access and connection across neighbourhoods in Makurdi. Overall, about 89.5% of urban households reported being connected to the national grid, while 10.5% remain unconnected. Electricity access is highest in Owner Occupier (95.8%) and Old GRA (95.3%), both of which are planned residential areas with stable infrastructure and higher-income residents. Conversely, Fiidi (80.4%) and Wadata (83.0%) recorded relatively low connection rates, reflecting infrastructural gaps and the presence of informal or mixed-income settlements. These differences highlight the influence of settlement pattern, income level, and infrastructure investment on electricity access across Makurdi.

Table 2: Electricity Connection

Neighbourhood	HH with Electricity Connection (%)	HH without Electricity Connection (%)
Wadata	39 (83.0)	8 (17.0)
High-Level	47 (94.0)	3 (6.0)
Fiidi	37 (80.4)	9 (19.6)
Wurukum	45 (90.0)	5 (10.0)
Owner Occupier	46 (95.8)	2 (4.2)
Modern Market	44 (91.7)	4 (8.3)
Old GRA	41 (95.3)	2 (4.7)
Idye Area	42 (85.7)	7 (14.3)

Source: Source: Researcher's Field Survey, 2025

The type of metering also varies widely, revealing disparities in service regulation and billing mechanisms. At the city level, 60.1% of households use prepaid meters, 18.8% use postpaid, and 21.1% have no formal meter connection. Prepaid meter adoption is most prominent in Old GRA (73.2%) and Owner Occupier (71.7%), where households are better regulated and financially capable of maintaining regular payments (Table 3). By contrast, Fiidi (45.9%) and Wadata (51.3%) have the lowest prepaid usage and the highest share of unmetered or estimated billing, indicating widespread informal connections and possible losses in revenue collection. This pattern underscores the uneven enforcement of metering regulations across socio-economic zones of the city.

Table 3: Type of Meter/Connection

Neighbourhood	Prepaid (%)	Postpaid (%)	No meter (Estimated) (%)	No meter (Shared/Informal) (%)
Wadata	20 (51.3)	7 (17.9)	8 (20.5)	4 (10.3)
High-Level	32 (68.1)	9 (19.1)	4 (8.5)	2 (4.3)
Fiidi	17 (45.9)	6 (16.2)	9 (24.3)	5 (13.5)
Wurukum	26 (57.8)	10 (22.2)	6 (13.3)	3 (6.7)
Owner Occupier	33 (71.7)	9 (19.6)	3 (6.5)	1 (2.2)
Modern Market	25 (56.8)	8 (18.2)	7 (15.9)	4 (9.1)
Old GRA	30 (73.2)	7 (17.1)	3 (7.3)	1 (2.4)
Idye Area	22 (52.4)	8 (19.0)	8 (19.0)	4 (9.5)

Source: Source: Researcher's Field Survey, 2025

In terms of electricity sources, the national grid remains the principal supplier, serving 92.1% of households. However, a growing share of urban residents, particularly in Fiidi, Modern Market, and Idye Areas, are turning to solar systems (11.9%–20.5%) and mini/private grids (7.6%) to supplement unreliable public supply (Table 4). These emerging alternative sources reflect both the persistent challenges of grid instability and the adaptive responses of households seeking dependable electricity for domestic and livelihood purposes.

In general, while most urban households in Makurdi are connected to electricity, clear disparities remain in access, metering, and source diversification. Planned and affluent neighbourhoods enjoy more reliable and formalised electricity services, whereas informal and low-income areas face persistent exclusion, irregular supply, and informal connections. These inequalities have direct implications for livelihood diversification, household productivity, and equitable urban development.

Table 4: Electricity Supplier

Neighbourhood	Main Supplier – National Grid (%)	Mini/private grid (%)	Solar company (%)	Generator only (%)	Other (%)
Wadata	35 (89.7)	3 (7.7)	4 (10.3)	15 (38.5)	2 (5.1)
High-Level	45 (95.7)	4 (8.5)	6 (12.8)	17 (36.2)	1 (2.1)
Fiidi	30 (81.1)	5 (13.5)	7 (18.9)	20 (54.1)	2 (5.4)
Wurukum	42 (93.3)	3 (6.7)	5 (11.1)	18 (40.0)	1 (2.2)
Owner Occupier	44 (95.7)	2 (4.3)	8 (17.4)	14 (30.4)	0 (0.0)
Modern Market	40 (90.9)	3 (6.8)	9 (20.5)	16 (36.4)	1 (2.3)
Old GRA	40 (97.6)	2 (4.9)	6 (14.6)	13 (31.7)	0 (0.0)
Idye Area	38 (90.5)	4 (9.5)	5 (11.9)	19 (45.2)	1 (2.4)

Source: Source: Researcher's Field Survey, 2025

Generator use and alternative supply patterns provide additional insight into the reliability of electricity access and its socio-economic implications. In Wadata, 38.5% of households use generators, indicating frequent grid outages or insufficient supply. High-Level records 36.2% generator use, despite high connection levels, suggesting that reliability issues persist even in well-serviced neighbourhoods. Fiidi has the highest generator reliance at 54.1%, reflecting chronic supply gaps and their impact on livelihood activities. Wurukum and Modern Market also show significant generator use at 40.0% and 36.4%, respectively, while Owner Occupier and Old GRA report lower usage at 30.4% and 31.7%, correlating with more stable supply. Idye Area records 45.2% generator reliance, underscoring the persistent electricity deficit. At the city level, 38.7% of households use generators as a supplementary source, revealing a heavy dependence on backup power to sustain economic activities, home-based enterprises, and household functions. This reliance on generators suggests the inadequacy of the main grid in meeting demand and has direct implications for cost, productivity, and the sustainability of livelihood diversification efforts.

The findings therefore, indicate that electricity access in Makurdi is relatively high but unevenly distributed across neighbourhoods, with disparities in metering, supply sources, and reliability significantly shaping households' capacity to diversify their livelihoods. Planned and high-income areas enjoy better access, formal connections, and more stable supply, while informal and low-income areas experience higher levels of informality, generator dependence, and energy insecurity. These dynamics suggest that improving equitable access, expanding metering coverage, enhancing grid reliability, and supporting decentralised solutions are crucial for leveraging electricity as a driver of urban livelihood diversification.

Electricity Reliability and Quality

The result of the Reliability and Quality of Electricity Supplied to Urban Households in Makurdi are presented in Tables 5 - 8. The results indicate a heterogeneous pattern of electricity reliability, quality, duration, and overall perception across neighbourhoods, which collectively shape the extent to which urban households can diversify their livelihoods.

The results in Table 5 show that electricity reliability and quality remain moderately satisfactory across the study area. About 47.2% of respondents agreed or strongly agreed that electricity is available for most hours of the day, while 30% disagreed, resulting in a mean score of 3.24. Similarly, 47.6% indicated that voltage levels are acceptable and do not damage appliances, with a slightly higher mean of 3.30. However, outage frequency remains a challenge, as shown by a reverse-coded mean of 2.62, suggesting frequent interruptions. This is further corroborated by the finding that only 46.2% agreed that interruptions

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are usually restored within a few hours, yielding a mean of 3.18. Despite these challenges, 42.8% expressed satisfaction with the overall quality of supply, although the mean satisfaction level remained moderate at 3.15. The negative skewness values for most indicators show a slightly favourable perception, while kurtosis values below zero indicate a flatter distribution, implying variability in household experiences. Overall, the data suggest that while electricity supply in Makurdi is improving in terms of availability and voltage stability, frequent outages and slow restoration times still constrain its reliability, which in turn affects households' ability to sustain diversified livelihoods that depend on stable power.

Table 5: Reliability and Quality Electricity Supplied to Urban Households in Makurdi

Statement	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Skew.	Kurt.
Electricity supply in this household is available for most hours of the day.	36 (9.5)	78 (20.5)	87 (22.8)	119 (31.2)	61 (16.0)	3.24	-0.32	-0.71
Voltage levels are acceptable and do not damage appliances.	29 (7.6)	69 (18.1)	102 (26.8)	121 (31.8)	60 (15.8)	3.3	-0.27	-0.63
*Outages occur frequently in this neighbourhood. (Reverse-coded)	19 (5.0)	48 (12.6)	79 (20.7)	136 (35.7)	99 (26.0)	2.62*	0.58	-0.21
Supply interruptions are usually restored within a few hours.	48 (12.6)	65 (17.1)	92 (24.1)	122 (32.0)	54 (14.2)	3.18	-0.25	-0.76
I am satisfied with the overall quality of electricity supply.	41 (10.8)	74 (19.4)	103 (27.0)	110 (28.9)	53 (13.9)	3.15	-0.21	-0.85

Source: Source: Researcher's Field Survey, 2025

Note: (1 = Strongly disagree; 2 = Disagree; 3 = Neutral/moderate 4 = Agree; 5 = Strongly agree).

**Reverse-coded, so lower mean indicates higher outage frequency*

A neighbourhood-level analysis in Table 6 reveals significant disparities in electricity reliability across Makurdi. Old GRA consistently outperforms other areas, recording the highest mean availability (3.66), voltage stability (3.71), and satisfaction (3.61) with a corresponding Electricity Reliability Index (ERI) of 3.50, which falls within the *good reliability* range. This high reliability supports broader livelihood diversification options, especially for households engaged in electricity-dependent economic activities. Conversely, Wadata exhibits the weakest performance across all indicators, with mean availability (2.86), voltage stability (2.95), and satisfaction (2.78) translating into an ERI of 2.75, indicating *poor reliability*. Mid-level performance is observed in High-Level (ERI = 3.04), Wurukum (ERI = 3.06), and Idye (ERI = 3.09), all characterised by *moderate reliability*. The overall ERI across the study area is 3.10, suggesting a *moderate level* of electricity reliability in Makurdi. These results underscore the influence of neighbourhood infrastructure and network quality on electricity supply. Areas with better supply reliability are more likely to experience improved household income diversification through small-scale manufacturing, services, and digital enterprises, while those with poor supply remain constrained.

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Table 6: Reliability and Quality Electricity Supplied Index

Neighbourhood	Mean Availability	Mean Voltage Stability	Mean Outage Frequency*	Mean Restoration	Mean Satisfaction	ERI
Wadata	2.86	2.95	2.38	2.8	2.78	2.75
High-Level	3.19	3.23	2.58	3.11	3.09	3.04
Fiidi	2.95	3.02	2.41	2.91	2.83	2.82
Wurukum	3.18	3.24	2.62	3.14	3.13	3.06
Owner Occupier	3.26	3.31	2.7	3.21	3.19	3.13
Modern Market	3.28	3.34	2.73	3.25	3.22	3.16
Old GRA	3.66	3.71	2.94	3.59	3.61	3.5
Idye	3.21	3.28	2.63	3.17	3.15	3.09
Total	3.24	3.3	2.62	3.18	3.15	3.1

Source: Source: Researcher's Field Survey, 2025

*Note: *Reverse-coded, so lower mean indicates higher outage frequency*

ERI = Electricity Reliability Index (1.0 – 1.9 = Very Poor Reliability; 2.0 – 2.9 = Poor Reliability; 3.0 – 3.4 = Moderate Reliability; 3.5 – 4.0 = Good Reliability; 4.1 – 5.0 = Excellent Reliability)

The distribution of daily electricity access hours (Table 7) further highlights disparities that directly affect household economic activities. Old GRA again leads, with 34.9% of respondents enjoying 13–24 hours of electricity daily and 46.5% having 9–12 hours, demonstrating a relatively stable supply. Owner Occupier and Modern Market follow, with 18.8% each accessing power for over 13 hours and over 40% receiving between 9–12 hours. In contrast, Wadata faces the most severe limitations, where 25.5% receive only 1–4 hours daily, and nearly 49% receive just 5–8 hours. The aggregate data show that only 15.5% of all households in Makurdi enjoy 13–24 hours of electricity, while a significant 47.3% receive less than 9 hours per day. Limited hours of supply directly constrain livelihood diversification by reducing the operational time available for home-based businesses, refrigeration, digital services, and small-scale manufacturing. Areas with extended supply hours tend to have greater economic opportunities, highlighting the strong linkage between electricity access duration and livelihood resilience.

Table 7: Daily Hours of Electricity Access by Neighbourhood

Neighbourhood	1–4 hrs (%)	5–8 hrs (%)	9–12 hrs (%)	13–24 hrs (%)	Total
Wadata	12 (25.5)	23 (48.9)	9 (19.1)	3 (6.5)	47
High-Level	6 (12.0)	17 (34.0)	19 (38.0)	8 (16.0)	50
Fiidi	9 (19.6)	21 (45.7)	12 (26.1)	4 (8.7)	46
Wurukum	5 (10.0)	17 (34.0)	21 (42.0)	7 (14.0)	50
Owner Occupier	4 (8.3)	14 (29.2)	21 (43.8)	9 (18.8)	48
Modern Market	4 (8.3)	15 (31.3)	20 (41.7)	9 (18.8)	48
Old GRA	1 (2.3)	7 (16.3)	20 (46.5)	15 (34.9)	43
Idye	8 (16.3)	17 (34.7)	20 (40.8)	4 (8.2)	49
Total	49 (12.9)	131 (34.4)	142 (37.3)	59 (15.5)	381

Source: Source: Researcher's Field Survey, 2025; (N = 381)

Perceptions of overall reliability presented in Table 11 align with the objective indicators, reinforcing the neighbourhood disparities observed. Old GRA again records the most favourable perception, with 48.8% rating electricity as *reliable* and 27.9% as *very reliable*, reflecting widespread satisfaction. Similarly, Owner Occupier and Modern Market show higher positive perceptions, with about 37.5% of respondents rating electricity as *reliable* in both areas. In contrast, Wadata stands out for its dissatisfaction, as 34.0% rated supply as *unreliable* and 19.1% as *very unreliable*, while only 17.0% considered it *reliable*. Across the entire study area, only 30.2% rated electricity as *reliable*, and 12.1% as *very reliable*, while 25.2% considered it *unreliable*. These perceptions align closely with the quantitative indicators and underscore the importance of reliable supply in shaping household attitudes and decisions. Poor perceptions of reliability often discourage investment in electricity-dependent livelihood ventures, whereas positive perceptions encourage innovation and diversification.

Table 8: Overall Reliability Rating by Neighbourhood (Respondents' Perception)

Neighbourhood	Very Unreliable (%)	Unreliable (%)	Neutral (%)	Reliable (%)	Very Reliable (%)	Total
Wadata	9 (19.1)	16 (34.0)	12 (25.5)	8 (17.0)	2 (4.3)	47
High-Level	5 (10.0)	13 (26.0)	11 (22.0)	16 (32.0)	5 (10.0)	50
Fiidi	7 (15.2)	15 (32.6)	10 (21.7)	11 (23.9)	3 (6.5)	46
Wurukum	5 (10.0)	11 (22.0)	11 (22.0)	18 (36.0)	5 (10.0)	50
Owner Occupier	4 (8.3)	11 (22.9)	10 (20.8)	18 (37.5)	5 (10.4)	48
Modern Market	4 (8.3)	11 (22.9)	9 (18.8)	18 (37.5)	6 (12.5)	48
Old GRA	1 (2.3)	4 (9.3)	5 (11.6)	21 (48.8)	12 (27.9)	43
Idye	6 (12.2)	15 (30.6)	15 (30.6)	11 (22.4)	2 (4.1)	49
Total	41 (10.8)	96 (25.2)	83 (21.8)	115 (30.2)	46 (12.1)	381

Source: Source: Researcher's Field Survey, 2025; (N = 381)

The combined results from Tables 5–8 present a comprehensive picture of electricity reliability and quality in Makurdi. They reveal moderate reliability overall (ERI = 3.10) but significant spatial disparities across neighbourhoods. Old GRA and Modern Market enjoy higher supply stability, longer daily access, and more favourable user perceptions, which collectively enable households to diversify livelihoods into sectors such as ICT, retail, services, and production. In contrast, neighbourhoods such as Wadata and Fiidi, characterised by low availability, frequent outages, short daily supply hours, and negative reliability perceptions, face constraints in leveraging electricity for economic diversification. These disparities highlight the need for targeted infrastructure upgrades, improved grid maintenance, and investment in distribution systems to ensure equitable access. Enhanced reliability would not only improve household welfare but also expand livelihood opportunities, fostering socio-economic resilience and inclusive urban development in Makurdi.

Electricity Affordability and Cost

The results of the study on electricity affordability and its cost implications for urban households in Makurdi are presented in Tables 9–13. The results indicate significant variations in household electricity expenditure, perceived affordability, impacts on productive use, reliance on backup power, and the frequency of alternative energy use across different neighbourhoods. These findings provide critical insights into how electricity costs influence livelihood diversification among urban households.

The analysis in Table 9 shows that electricity affordability varies considerably across neighbourhoods in Makurdi, reflecting differences in household income levels and consumption patterns. In Wadata, 44.7% of households spend between ₦5,000 and ₦10,000 monthly, while only 8.5% spend above ₦20,000, indicating relatively moderate expenditure with a mean cost of 2.26. Fiidi shows a similar pattern, with 52.2% spending ₦5,000–₦10,000 and a mean of 2.24, suggesting affordability remains within lower income thresholds. In contrast, Old GRA and Owner Occupier areas record higher spending, with 46.5% and 41.7% of households, respectively, paying ₦10,001–₦20,000, and substantial proportions (23.2% and 18.7%) spending above ₦20,000. These higher means of 2.88 and 2.73 respectively indicate greater electricity consumption, possibly due to larger households or business operations linked to diversified livelihoods. Across the city, 41.2% of households spend ₦5,000–₦10,000 monthly, while 13.1% spend above ₦20,000, with an overall mean of 2.5. This distribution suggests that while most households fall within the moderate spending range, a significant portion faces high electricity costs, potentially constraining their capacity to channel resources into income-diversifying ventures.

Table 9: Affordability and Cost of Electricity Among Urban Households in Makurdi

Neighbourhood	Below ₦5,000 (%)	₦5,000–10,000 (%)	₦10,001–20,000 (%)	Above ₦20,000 (%)	Mean	Total
Wadata	9 (19.1)	21 (44.7)	13 (27.7)	4 (8.5)	2.26	47
High-Level	5 (10.0)	20 (40.0)	17 (34.0)	8 (16.0)	2.56	50
Fiidi	7 (15.2)	24 (52.2)	12 (26.1)	3 (6.5)	2.24	46
Wurukum	6 (12.0)	23 (46.0)	15 (30.0)	6 (12.0)	2.42	50
Owner Occupier	3 (6.3)	16 (33.3)	20 (41.7)	9 (18.7)	2.73	48
Modern Market	5 (10.4)	19 (39.6)	18 (37.5)	6 (12.5)	2.52	48
Old GRA	2 (4.7)	11 (25.6)	20 (46.5)	10 (23.2)	2.88	43
Idye	6 (12.2)	23 (46.9)	16 (32.7)	4 (8.2s)	2.37	49
Total	43 (11.3)	157 (41.2)	131 (34.4)	50 (13.1)	2.5	381

Source: Source: Researcher's Field Survey, 2025; (N = 381)

Perceptions of affordability further reveal disparities across neighbourhoods (Table 10). In lower-income areas like Wadata and Fiidi, affordability perception is weaker, with means of 2.90 and 2.92, respectively, and a combined 42.6% and 39.2% of respondents viewing electricity as unaffordable or very unaffordable. Conversely, more affluent areas like Owner Occupier (mean = 3.63) and Old GRA (mean = 3.53) perceive electricity as relatively affordable, with 64.6% and 58.1% describing it as affordable or very affordable. High-Level, Wurukum, and Modern Market areas reflect moderate perceptions, with means between 3.14 and 3.37, indicating a balanced affordability experience. At the aggregate level, 35.2% of households perceive electricity as affordable, compared to 29.9% who find it unaffordable. This perception gap demonstrates that electricity affordability remains a challenge for a significant segment of Makurdi's population, which can limit the extent to which households invest in electricity-dependent livelihood activities such as small-scale manufacturing, cold storage, or ICT services.

Table 10: Perceived Affordability of Electricity for Household Needs

Neighbourhood	Very Unaffordable (%)	Unaffordable (%)	Neutral (%)	Affordable (%)	Very Affordable (%)	Mean
Wadata	6 (12.8)	14 (29.8)	10 (21.3)	13 (27.7)	4 (8.5)	2.9

High-Level	4 (8.0)	12 (24.0)	10 (20.0)	18 (36.0)	6 (12.0)	3.2
Fiidi	5 (10.9)	13 (28.3)	12 (26.1)	13 (28.3)	3 (6.5)	2.92
Wurukum	5 (10.0)	10 (20.0)	13 (26.0)	17 (34.0)	5 (10.0)	3.14
Owner Occupier	2 (4.2)	7 (14.6)	8 (16.7)	21 (43.8)	10 (20.8)	3.63
Modern Market	3 (6.3)	8 (16.7)	12 (25.0)	18 (37.5)	7 (14.6)	3.37
Old GRA	2 (4.7)	6 (14.0)	10 (23.3)	17 (39.5)	8 (18.6)	3.53
Idye	5 (10.2)	12 (24.5)	10 (20.4)	17 (34.7)	5 (10.2)	3.1
Total	32 (8.4)	82 (21.5)	85 (22.3)	134 (35.2)	48 (12.6)	3.22

Source: Source: Researcher's Field Survey, 2025; (N = 381)

Table 11 reveals that high electricity costs significantly affect productive use, thereby influencing livelihood diversification. The majority of households across all neighbourhoods acknowledge this impact, with Wadata (70.2%), Fiidi (65.2%), and Idye (65.3%) reporting the highest affirmative responses, reflecting their vulnerability to rising electricity costs. Even in more affluent areas like Owner Occupier and Old GRA, over half of the households (54.2% and 48.8%, respectively) acknowledge the negative effects. The overall mean ERI of 1.45 indicates a strong perception that high electricity costs reduce households' ability to engage in income-generating activities such as welding, tailoring, small-scale food processing, or home-based enterprises. With nearly 60% of respondents citywide affirming this constraint, it is evident that affordability challenges extend beyond domestic consumption to affect the productive utilisation of electricity, ultimately limiting opportunities for livelihood diversification in urban Makurdi.

Table 11: Perceived Impact of High Electricity Cost on Productive Use

Neighbourhood	Yes (%)	No (%)	Don't know (%)	Mean
Wadata	33 (70.2)	12 (25.5)	2 (4.3)	1.34
High-Level	29 (58.0)	20 (40.0)	1 (2.0)	1.44
Fiidi	30 (65.2)	14 (30.4)	2 (4.3)	1.39
Wurukum	27 (54.0)	20 (40.0)	3 (6.0)	1.52
Owner Occupier	26 (54.2)	19 (39.6)	3 (6.3)	1.52
Modern Market	29 (60.4)	17 (35.4)	2 (4.2)	1.44
Old GRA	21 (48.8)	20 (46.5)	2 (4.7)	1.56
Idye	32 (65.3)	15 (30.6)	2 (4.1)	1.39
Total	227 (59.6)	137 (35.9)	17 (4.5)	1.45

Source: Source: Researcher's Field Survey, 2025; (N = 381)

The results in Table 12 show a widespread reliance on alternative power sources due to grid unreliability, which further compounds affordability issues. Generators are the most common backup source, used by 61.7% of households citywide, with usage peaking in Owner Occupier (68.8%) and High-Level (64.0%). Solar adoption remains relatively low, with only 13.1% overall, although its uptake is slightly higher in Owner Occupier (16.7%) and Idye (16.3%), indicating emerging trends in renewable alternatives among higher-income groups. Notably, 18.1% of respondents do not use any backup source, likely reflecting affordability constraints. Heavy reliance on generators suggests additional financial burdens on households, as fuel costs further erode disposable income and limit the capacity for livelihood diversification. This dependence also highlights the inadequacy of grid electricity in meeting urban demand, forcing households to adopt costly coping mechanisms that

affect both domestic welfare and enterprise development.

Table 12: Backup Power Usage and Frequency Due to Grid Unreliability

Neighbourhood	Generator F(%)	Solar F(%)	No F(%)	Other F(%)
Wadata	29 (61.7)	5 (10.6)	10 (21.3)	3 (6.4)
High-Level	32 (64.0)	7 (14.0)	8 (16.0)	3 (6.0)
Fiidi	26 (56.5)	4 (8.7)	12 (26.1)	4 (8.7
Wurukum	30 (60.0)	5 (10.0)	10 (20.0)	5 (10.0)
Owner Occupier	33 (68.8)	8 (16.7)	5 (10.4)	2 (4.2)
Modern Market	29 (60.4)	6 (12.5)	9 (18.8)	4 (8.3)
Old GRA	26 (60.5)	7 (16.3)	7 (16.3)	3 (7.0)
Idye	30 (61.2)	8 (16.3)	8 (16.3)	3 (6.1)
Total	235 (61.7)	50 (13.1)	69 (18.1)	27 (7.1)

Source: Source: Researcher's Field Survey, 2025; (N = 381)

The frequency of backup power use (Table 13) underscores the severity of grid unreliability and its socio-economic implications. Across all neighbourhoods, a significant share of households uses backup power often or always, with Owner Occupier (mean = 3.77), High-Level (mean = 3.62), and Old GRA (mean = 3.61) reporting the highest frequencies. Citywide, 31.8% of respondents use backups often, while 24.1% use them always, with an overall mean of 3.56, reflecting regular dependence on alternative power. This frequent use not only increases household expenditure but also directly affects business operations, as enterprises reliant on consistent electricity supply must absorb higher operational costs or limit their activities. Consequently, high backup reliance reduces profit margins for small-scale businesses and discourages the diversification of household income sources. Moreover, frequent generator use highlights a broader structural challenge, unstable electricity supply, that undermines the potential role of electricity access in promoting livelihood diversification across Makurdi's urban landscape.

Table 16: Frequency of Backup Use

Neighbourhood	Never F(%)	Rarely F(%)	Sometimes F(%)	Often F(%)	Always F(%)	Mean
Wadata	3 (6.4)	7 (14.9)	11 (23.4)	15 (31.9)	11 (23.4)	3.52
High-Level	2 (4.0)	6 (12.0)	14 (28.0)	15 (30.0)	13 (26.0)	3.62
Fiidi	4 (8.7)	8 (17.4)	13 (28.3)	12 (26.1)	9 (19.6)	3.31
Wurukum	3 (6.0)	5 (10.0)	14 (28.0)	16 (32.0)	12 (24.0)	3.58
Owner Occupier	2 (4.2)	4 (8.3)	10 (20.8)	19 (39.6)	13 (27.1)	3.77
Modern Market	3 (6.3)	7 (14.6)	11 (22.9)	16 (33.3)	11 (22.9)	3.52
Old GRA	2 (4.7)	5 (11.6)	12 (27.9)	13 (30.2)	11 (25.6)	3.61
Idye	3 (6.1)	6 (12.2)	13 (26.5)	15 (30.6)	12 (24.5)	3.56
Total	22 (5.8)	48 (12.6)	98 (25.7)	121 (31.8)	92 (24.1)	3.56

Source: Source: Researcher's Field Survey, 2025; (N = 381)

Discussion

The findings of this study are consistent with several previous empirical studies on socio-economic characteristics and electricity utilisation for livelihood

diversification in urban contexts. For instance, Adeoye and Yusuf (2019) in their study of electricity access and small-scale enterprises in Ibadan found that male-headed households dominated electricity-dependent businesses, with 58% of respondents being male. This aligns with the present study, where 56.9% of respondents were male, suggesting that gender dynamics significantly influence household decision-making and electricity utilisation. Similarly, Eze and Nwankwo (2021) reported that households within the economically active age group (30–50 years) were more likely to engage in electricity-driven enterprises, a finding that resonates with the 63% of respondents in this study aged between 31 and 50. The dominance of married respondents (66.4%) and tertiary-educated individuals (46.2%) in the current research further supports findings by Oladipo et al. (2020), who concluded that education and marital status enhance household capacity to exploit electricity for income diversification.

Moreover, the occupational and income distribution patterns observed in this study corroborate the findings of previous research. Adeoye and Yusuf (2019) reported that trading and artisanal work were the most electricity-dependent occupations in urban areas, similar to this study's findings where 30.4% of respondents were traders and 17.3% artisans. The predominance of middle-income households in the current study (40.2% earning ₦50,000–100,000) reflects the results of Oladipo et al. (2020), who linked stable income levels to increased investment in electricity-powered ventures. In addition, Eze and Nwankwo (2021) highlighted that household size and tenure status influence electricity demand and utilisation patterns, an observation mirrored in this study, where most households were medium-sized and 53.3% rented their accommodation. Overall, these similarities suggest that socio-economic and demographic characteristics are consistent predictors of electricity use for livelihood diversification across different urban contexts in Nigeria.

The findings of this study on electricity access and reliability in Makurdi align with and extend evidence from previous empirical research on urban energy provision in Nigeria. Egesi and Onwuka (2021) found that household electricity access in Enugu metropolis stood at 88.4%, with disparities strongly associated with income levels and the formality of neighbourhood development—similar to the present study's finding of 89.5% overall access but significantly lower rates in informal areas like Fiidi (80.4%). Likewise, Okafor et al. (2020) reported that metering gaps and informal connections were prevalent in low-income urban settlements in Lagos, constraining billing efficiency and service reliability, a pattern mirrored in Makurdi where 21.1% of households lack formal meters. Additionally, Adeyemi and Olatunji (2019) emphasised the growing role of decentralised solar solutions in bridging access gaps, particularly in underserved communities, consistent with this study's observation of increased solar adoption (11.9%–20.5%) in neighbourhoods facing unreliable grid supply.

Also, the moderate reliability and persistent supply disruptions observed in Makurdi resonate with findings from similar Nigerian cities. Egesi and Onwuka (2021) reported that less than 40% of households in Enugu received electricity for more than 12 hours daily, comparable to Makurdi where only 15.5% of households enjoyed 13–24 hours of supply. Okafor et al. (2020) also highlighted that frequent outages and low reliability in Lagos were major deterrents to household livelihood diversification, paralleling this study's conclusion that unreliable supply constrains economic opportunities in neighbourhoods like Wadata and Fiidi. Similarly, Adeyemi and Olatunji (2019) noted that high reliance on generators (over 35%) significantly raised household energy costs, a finding reflected in Makurdi's 38.7% generator use rate. Collectively, these studies corroborate the present findings, underscoring the persistent challenges of uneven access, unreliable supply, and affordability constraints that continue to shape urban households' energy experiences and limit their capacity for livelihood diversification.

IV. CONCLUSION

The findings demonstrate that electricity access in Makurdi is relatively high but highly uneven across neighbourhoods, reflecting wider socio-economic and infrastructural disparities. Planned and higher-income areas such as Old GRA, Owner Occupier, and Modern Market exhibit the highest levels of grid connection,

prepaid metering, supply stability, and daily access hours, enabling households to sustain a wider range of electricity-dependent livelihood activities. By contrast, informal and lower-income neighbourhoods such as Wadata and Fiidi experience poorer connectivity, higher reliance on generators, more frequent outages, and shorter daily supply hours, which limit the viability and productivity of home-based enterprises and other income-diversifying activities. Generally, the results indicate that while Makurdi's urban households are generally connected to electricity, significant inequities in supply quality, metering, and reliability persist, suggesting that improving grid stability, expanding formal metering, and promoting decentralised energy options are essential for enhancing livelihood diversification and ensuring inclusive urban development.

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