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Socio-Economic Impacts of Energy Poverty on Households in Ikorodu Communities, Lagos State, Nigeria

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Abstract: The study investigated the Ikorodu community's energy poverty status by adopting the Multidimensional Energy Poverty Index to assess each sub-community, as it centers on energy poverty. The study used both quantitative and qualitative assessments of data obtained from primary and secondary sources. The primary data was sourced from a questionnaire administered to households while secondary data was sourced mostly from the National Bureau of Statistics' Nigeria Living Standard Survey (NLSS) dataset. Additional secondary data was obtained from the Lagos State socio-economic data survey which included the Ikorodu subset. The result showed that about half (42%) of the community was energy-poor while more than half (58%) were energy-non-poor. The study revealed energy poverty has a huge impact on the economic development of the studied communities, as there was a positive and significant correlation between energy poverty and educational, health, and economic activities. More specifically, energy poverty reduces social inclusion, diminishes the education level of the residents of the communities, lessens the quality of life and healthcare, and discourages business activities and the establishment of new businesses in the area. Given these findings, the study emphasizes the need for government intervention and public awareness to increase access to electricity through renewable energy sources. Additionally, it recommends promoting- clean and cost-effective energy alternatives to address the pressing issue of energy poverty within the community.

Keywords: *Energy Poverty, Ikorodu Lagos, Nigeria, Renewable energy, Socio-economic Development*

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1. Introduction

As the international community strives to achieve Sustainable Development Goals (SDGs), post-COVID-19 recovery, access to clean energy, and food for all, poverty reduction remains critical to economic growth issues in sub-Saharan Africa. Despite ample renewable and nonrenewable energy resources in Africa, the population continues to face energy poverty due to overall economic stagnation (Sarkodie & Adams, 2020). The availability of contemporary and adequate energy in Africa is limited, with a significant proportion of the population depending on conventional energy sources (SIRTE, 2008).

According to the International Energy Agency (2014), contemporary energy services have a substantial influence on various aspects such as health outcomes, education, productivity, lifestyle, communication, and overall communal well-being. Therefore, the augmentation of consumption in contemporary energy services is imperative to fulfill fundamental human necessities. In addition, it has been determined that the supply of modern energy services, such as gas and electricity, reduces poverty and is essential to achieving the Sustainable Development Goals (SDGs) (Kanagawa & Nakata, 2007). According to the United Nations, millions of individuals continue to face difficulties in accessing energy, and the limited advancement in adopting clean cooking methods is affecting the well-being of about 2.4 billion people (United Nations Report, 2022).

Nigeria, the most populated in Africa, is leading the continent in the number of energy-vulnerable regrettably, the phenomenon of energy poverty in the country has resulted in a significant proportion of the Nigerian population, particularly those residing in rural regions, being exposed to environmentally non-friendly form of energy, such as lanterns, kerosene, firewood, and candles (Famewo & Uwala, 2022) These difficulties involve the collection of firewood and preparation of dung cakes for cooking, and mobility to places like schools, hospitals, and markets. Furthermore, the indoor burning of traditional biomass-based fuels like charcoal, bagasse, and firewood incur the indirect costs of health damages and life threats. Health costs include respiratory issues, exposure to increased temperature, stillbirths, low birth weights, and increased fire hazard around the house, which also affects the human capabilities and functionings indirectly (Day et al., 2016)

The current circumstances have further intensified economic adversity thereby, prolonging the poverty cycle (Ogwumike & Ozughalu, 2016), most especially the rural communities in Northern Nigeria (Ogwumike & Ozughalu, 2016). Also, studies using multidimensional indices revealed that the population of Nigeria regarded as energy-poor is about 75% (Ozughalu & Ogwumike, 2019).

Multidimensional poverty reveals the problem analytically in light of the SDGs, where poverty eradication is one of the first goals to be implemented (Papada & Kaliampakos, 2016). This study investigated the energy poverty within Ikorodu communities and the socio-economic impact on the household through Multidimensional Poverty Index (MPI), and examines some of the SDGs such as: health, education, and small business as socio-economic variables (Alkire & Foster, 2011)

While several studies have looked at the problem of energy poverty in Nigeria from various angles, some have focused particularly on the relationship between energy poverty and economic development (Scott & Ose, 2020), energy and food waste, and household food security (Akande & Oghenetega, 2022) Therefore, this research analyzed the socioeconomic dimensions of energy poverty in Ikorodu communities. The dimensions examined include economic, social, educational, and health aspects intending to gain a thorough understanding of these impacts and contributes to the existing literature in energy poverty's and its impact on Ikorodu community using Multidimensional Energy Poverty Index technique. This study also contributes to the literature by conducting robustness analysis of computed measure of multidimensional energy poverty, which further guides policymakers in determining an official energy poverty line in Ikorodu and the entire Lagos State. Research on the socioeconomic impact of energy poverty on community development, according to Gouveia et al. (2019), will help to evaluate the scope, complexity, and effects of energy poverty in developing communities (Gouveia et al., 2019).

2. Relevant Literatures

Energy poverty has gained attraction because of its relationship with agriculture, public health, and education(Zhang et al., 2019& Asuka, 2022, Sarkodie & Adams, 2020)explained that the importance of having access to contemporary sources of power, such as electrical power, in attaining diverse community development goals has been widely acknowledged. Further supported by (Papada & Kaliampakos, 2016) access to cutting-edge sources of energy was revealed to be crucial for raising yields in agriculture, facilitating the provision of socially beneficial services, and unlocking endless possibilities in small and medium-sized businesses to create job opportunities that can contribute to the eradication of acute hunger and destitution.

The Multidimensional Energy Poverty Index (MEPI)is one of the most common evaluation techniques to examine energy poverty (Ashagidigbi et al., 2020) because it accommodates the multiple aspects of energy poverty. The MEPI analysis estimates energy poverty prevalence in rural communities in a developing country using cross-sectional data from a survey of hundreds of households (Rao & Pachauri, 2001, Bouzarovski & Petrova, 2015a).

The traditional biomass utilization in rural regions of Nigeria may be mostly linked to the government's inability to furnish reliable(Ouedraogo, 2013), cost-effective, and contemporary energy services. Rural communities frequently see a diminished allocation of electrical power from the centralized national grid. Therefore, the rural population relies on abundant forest reserves as an acceptable source of energy for heating and cooking purposes, as well as a way of sustaining their livelihoods (Fungisai Chipango, 2021). Nevertheless, this phenomenon carries significant implications for the preservation of the environment, as it poses a threat to the diverse fauna, timber resources, and fuelwood reserves that have traditionally been plentiful within the forest ecosystem(Day et al., 2016).

According to estimates, Nigeria saw an annual decrease in forest cover of 400,000 hectares (Ozughalu & Ogwumike, 2019), and If this trend continues, it is projected that Nigeria's forests will be greatly depleted by the year 2047, which will negatively impact the socio-economic development of the communities. Advanced power sources are relevant for meeting fundamental infrastructure requirements and serving as catalysts for growth in the economy(Sarkodie & Adams, 2020). The provision of sufficient access to contemporary alternative sources of energy contributes to the promotion of the preservation of the environment and the improvement of the overall well-being of the population(Papada & Kaliampakos, 2016). According to a researcher, having access to contemporary, clean energy can improve educational attainment and human health outcomes, boost productivity and food security and efficiency(Akande & Oghenetega, 2022), lessen gender inequality and other socioeconomic issues, and increase efficiency,(Husnain et al., 2021) (Khan et al., 2020,Bouzarovski & Petrova, 2015b).

In contrast, the utilization of conventional energy sources, like wood for cooking, fossil fuels, charcoal, and waste from animals, leads to significant levels of pollutants and degradation of the environment(House et al., 2011). These results give rise to adverse medical conditions, diminished productivity, and a considerable decline in overall quality of life(Kumar, 2020).

A researcher (Adams et al., 2018) analyzed the causal connection between the consumption of energy and economic growth in eleven Sub-Saharan African nations. The findings indicate a link of causation between energy usage and economic growth, albeit with varying paths of causality observed among the countries under investigation. The study by (Bouzarovski & Petrova, 2015b) also revealed that energy stability has a crucial role in enhancing the social and economic well-being of communities, hence contributing to improving their overall quality of life. The study by (Ashagidigbi et al., 2020) adopted multidimentional energy poverty index concept to investigate energy poverty in Ecuador.The findings of the study indicate that the problem of energy poverty remains prevalent among communities in developing countries, as well as on a nationwide scale. The measurement of the Multidimensional Energy Poverty Index (MEPI) utilized in the study was predicated upon assessing two key factors: delayed payments for utility bills and uneven charges.

It is also important to note that none of the studies that has been included in earlier evaluations has really looked into how energy poverty affects social inclusion, agriculture, and education(Ogwumike & Ozughalu, 2016). This study chose Ikorodu as one of the largest Local Governments in Lagos State and its cosmopolitan nature of various communities due to its relevance and the existing research gaps(Sadath & Acharya, 2017). The objective of the study is to investigates the socio-economic effects of energy poverty in Ikorodu (LGA), specifically focusing on the MEPI framework's fundamental energy needs, also how Nigerian rural communities, including Ikorodu, cope with energy shortages and analyzes the energy poverty's impact on community development.

3. Materials and methods

This study assessed the energy poverty status of various sub-communities within Ikorodu, Lagos State, Nigeria, using the Multidimensional Energy Poverty Index as a key analytical tool. The Multidimensional Energy Poverty Index is used because it compares the scale of energy poverty across countries and in Ikorodu Lagos State, Nigeria. Given that poverty is a complex phenomenon, it is necessary to assess it using a variety of indicators as supported by MEPI in both rural and semi-rural areas like Ikorodu Local Government Area(FAO, 2022). Furthermore, the index captures both the number of energy-poor households as well as the intensity of how energy-poor they are, in all sub-communities. The research closely adhered to the investigative protocols advocated by (Kumar, 2020), given its central emphasis on energy poverty. The research approach encompassed both quantitative and qualitative evaluations, drawing upon credible data sources from reputable databases to complement data obtained from the field. The selection of MEPI allows policymakers to tailor projects to meet specific needs, such as improving electricity availability, promoting clean cooking options, or addressing other energy-related challenges in Ikorodu community.

The extent of energy poverty in each sub-communities was evaluated using the Multidimensional Energy Poverty Index (MEPI). Researchers connected to the Oxford Poverty and Human Development Initiative developed the MEPI metric (Famewo & Uwala, 2022; Nussbaumer et al., 2012) A framework comprising four elements—health, living standards, education, and access to electricity—is used to determine a household's energy poverty status. Scholars (Olang et al., 2018; Villalobos et al., 2021; Wang et al., 2023) have extensively recognized and employed the multidimensional energy poverty index, which measures multidimensional energy poverty at the household level using four dimensions and nine indicators.

This project adopted the multidimensional energy poverty level scale for household energy indicator of 0.33 as proposed by(Bersisa & Heshmati, 2021) . Therefore, a sub-community with a cumulative weighted poverty score of 0.33 or more is classified as experiencing energy poverty, In contrast, a sub-community with a cumulative weighted poverty score below 0.33 is considered energy-non-poor.

3.1. Data and sampling

This study makes use of data from the Lagos state data survey, data from community surveys, and the Nigeria Living Standard Survey (NLSS) dataset from the National Bureau of Statistics (NBS). The data gathered from Lagos State surveys was used to delineate the communities for survey purposes, hence the 19 sub-communities (odogunyan, Baiyeku/Oreta, Erikorodu,Ijede I&II, Ipakodo, Isiu, Agbala, Ibeshe, Agura/Iponmu, Isele I, II &III, Igbogbo I &II, Imota I&II Olorunda/Igbaga, and Aga/Ijimu). Data from NBS and NLSS provided information about communities such as the number of businesses, name of businesses, number of healthcare facilities, farmers, schools, and the number of hours of electricity available. The study utilized a pre-designed questionnaire to gather data from the homes in all nineteen wards. Data was collected from various respondents using a self-administered statistical software survey approach conducted through WhatsApp. The contact information of the respondents was acquired via statistical software from their colleagues who are members of various WhatsApp groups.

The questionnaire was divided into three sections: the first asked questions about the respondents' and the community's characteristics; the second asked about energy demand and use; and the third asked about the socioeconomic effects of energy poverty, particularly about the main energy source used. A total of 2300 questionnaires were administered across the 19 sub-communities/wards and 2000 responded, while an average of 105 adults were randomly selected as respondents for each ward in Ikorodu. It investigates the variables which are the health, social inclusion, agricultural, educational, and economic implications experienced by participants and subcommunities within various sub-communities. Social inclusion is measured based on an individual with at least one active social media account who is considered socially connected. In terms of health, respondents who reported having access to health care were included in the analysis. We also incorporated data from two prominent healthcare facilities in each ward. Additionally, we assessed community development by examining factors such as the number of new businesses and the availability of key amenities, including healthcare, agriculture, and other social services, within the subcommunities. In this study, probability sampling is employed because it helps to complete large tasks in a short period of time with minimal cost. In probability sampling, equal chances are given to all the subjects the chance of being selected out of the entire population. However, according to W. Saunders et al., 2000 the non-probability sampling method focuses on samples that are gathered in a process that does not give equal chances of being selected in a given population (Sokołowski et al., 2019).

3.2. Data analysis

The threshold for energy poverty was set at 0.33. Since the endogenous variable's values fall between 0 and 1, the Tobit regression model was used to look into the reasons behind the energy poverty of subcommunities in Ikorodu. Four dimensions of energy poverty were determined by adopting the previously described study(Nussbaumer et al., 2012b)and four indicators were assigned to each of the four dimensions(Nussbaumer et al., 2012a)Every one of the four identified factors is given a weight related to energy poverty(Bazilian et al., 2011). For the purpose of the study, the weight attached indicates the degree of energy shortage or deficit and is used to calculate and evaluate the energy poverty level of each sub-community.

The four referenced indicators and assigned weights as adopted from (Nussbaumer et al., 2012b):

Forms of energy sources used by sub-communities for cooking - Use of traditional energy sources(firewood, stoves) (0.25).

Extent of indoor air pollution (two variables) - Kitchen (use of the same residential house for cooking or no kitchen 0.15), while Traditional Stove/Firewood; 0.15)

The Forms of energy used for lighting (no electricity; 0.25)

Ownership of Entertainment and Educational Assets - No radio, tape, data-enabled smartphone, TV, or satellite dish (0.20).

The multidimensional Poverty Index (MEPI) as a measure of energy poverty is estimated as:

Energy Poverty Headcount: H

(1) $H = 1/N \sum_{(i=1)}^{q} Ci>k$

were,

N = total number of respondents

Ci = population of subcommunities whose energy poverty score is higher than the cut-off mark of 33%, as defined by the model(Nussbaumer et al., 2012)

K = energy poverty threshold

The energy poverty headcount (H) measures the incidence of energy poverty. It is the percentage of sub-communities whose deprivation score is above the cut-off point. Energy poverty intensity.

(2) $A = \sum_{(i=1)}^{q} Ci(k) / 〖\sum〗_{(i=1)}^{q} Ci$

Where $\sum qi=1Ci \quad (k)$ is the censored weighted deprivation score of the subcommunities. This measures the degree to which the sub-communities are experiencing energy deprivation.

Finally, the Multidimensional Energy Poverty Index (MEPI) is computed from both incidence and intensity of energy poverty as:

(3) MEPI = H * A

We use the Tobit regression model to examine the determinant of sub-communities energy poverty since the values of the endogenous variable lie between 0 and 1.

4. Results and discussion

4.1. Socio-economic characteristics of respondents

Table 1 shows the socio-economic demography of the respondents (household heads) in the surveyed communities. The result indicates that the majority (about 60%) of the respondents are males. It also revealed that 60% of the respondents are between the ages of 30 and 60 years, and a total of 50% of them are unmarried, which indicates a majorly young demography.

Table 1: Socio-economic demography of the respondents within the community

Variables	Frequency (Approx.)	Percentage
Household Head's Age (Years)		
<30	600	30
30–60	1200	60
>60	200	10
Gender		
Male	1100	60
Female	900	40
Marital Status		
Married	500	25
Single	1000	50
Divorced	200	10
Widowed	300	15

Educational Status		
PhD/MSc	90	5
BSc/HND	690	34
NCE/OND	450	23
O/Level	585	29
Non-educated	185	9
Income		
Less than #30,000	525	26
#30,000-#100,000	820	41
Above #100,000	655	33
Main Occupation		
Farmer	85	4
Civil servant	955	48
Trader	750	38
others	210	10

Source: Author's analysis

4.2. Energy access in the communities

The section provides an analysis of the types of energy and utilization by households in the selected communities in the study area as well as the energy sources and impacts on the socio-economic activities of the people.

Types of energy used by households

Table 2 details the types and quantities of energy sources that are available in various households that were interviewed in the communities. The results show that though all the households claimed that they have access to publicly provided electricity, virtually all the respondents also use other energy sources to supplement public electricity use. This is largely due to the high level of unreliability of electricity in the communities as obtained in wider Nigerian society. It is not surprising then that 70% of the households use generator sets, 10% use stoves and candles, 5% firewood, 2.5% inverters, 12.5% solar, and 100% public electricity. The large percentage of the respondents that use the generating set is not surprising as this source has now become the most reliable and highly used energy source in the country.

Table 2: Energy Use in the Communities (%)

Energy sources	Generator	Stove &Candle	Firewood	Inverter	solar	public electricity
Community						
Odogunyan	79	12	5	4	12	106
Baiyeku/Oreta	77	9	7	3	9	108
Erikorodu	66	13	4	3	20	106
IjedeI	76	12	10	2	12	105
Ijede II	70	7	2	4	18	105
Ipakodo	67	15	7	1	9	105
Isiu	87	7	3	4	9	105
Agbala	88	4	5	2	12	105
Ibeshe	82	6	6	5	12	105
Agura	75	16	5	3	15	105
Isele I	55	22	5	3	9	105
Isele II	82	19	4	2	16	105
Igbogbo I	45	12	10	2	17	105
Igbogbo II	65	4	4	2	9	105
Imota I	87	5	9	2	6	105
Imota II	76	12	3	3	23	105
Isele III	46	4	5	1	6	105
Olorunda	85	18	3	2	14	105
Aga/Ijimu	92	3	3	2	22	105
Total	1400	200	100	50	250	2000
%	70	10	5	2.5	12.5	100

Source: Author's analysis

The crux of this paper is to analyze energy poverty in the study area. This analysis is provided in this section. A community is said to be energy-poor if the deprivation exceeds predefined cut-off points. A community is regarded as energy-poor if it has a value greater than 0.33, while they are regarded as non-energy-poor if it is less than 0.33. Table 2 provides an estimation of the level of energy poverty in the communities. It shows that 58 percent of the community was energy-non-poor. Table 2 further indicates that 11wards are energy-non-poor, while 8 sub-communities recorded an energy-poor score depicting that Ikorodu is generally energy-non-poor. An energy-poor community lacks access to more than 33 percent of the essential indicators, as described in the earlier discussion of the MEPI.

4.3. Impacts of energy poverty in the communities

The research investigates the impact of energy poverty on socio-economic activities, and different sources of energy accessible in households. It explores the effects on healthcare services health risks, the impact on the educational system (standard schools), small and medium-sized enterprises (SMEs), farmer yield, and social media usage.

Impact of energy poverty on healthcare services

Table 3 presents information on energy poverty and healthcare facilities. The study considered standard healthcare within the 19 sub-communities. The estimated average energy score for the last five years was calculated using a socio-economic growth rate of 3 percent for the five years (0.97 * value) (United Nations Development Programme, 2004). A total of 68 healthcare facilities were visited within Ikorodu LGA to conduct interviews, 72% of which are within the energy-non-poor wards, while about 28% are located in energy-poor sub-communities. Generally, there are more standard healthcare facilities in energy-non-poor wards than in energy-poor wards. This is an indication that energy availability supports the healthcare system in society, and improves productivity, and household health well-being (Ajayi, 2023; Bouzarovski & Petrova, 2015c)

Table 3: Relationship between healthcare facilities and energy poverty

Community	MEPI Energy Score	Estimated average energy score for the last five years (Computation/Formulae are in the preceding discussion)	Energy Poor or Non-Poor	No. of standard healthcare facility present
Odogunyan	0.31	0.30	Energy Non-Poor	4
Baiyeku/Oreta	0.28	0.27	Energy Non-Poor	4
Erikorodu	0.29	0.28	Energy Non-Poor	3
IjedeI	0.21	0.20	Energy Non-Poor	5
Ijede II	0.19	0.18	Energy Non-Poor	6
Ipakodo	0.24	0.23	Energy Non-Poor	5
Isiu	0.27	0.26	Energy Non-Poor	4
Agbala	0.26	0.25	Energy Non-Poor	2
Ibeshe	0.25	0.24	Energy Non-Poor	5
Agura	0.25	0.24	Energy Non-Poor	5
Isele I	0.23	0.22	Energy Non-Poor	6
Isele II	0.39	0.38	Energy Poor	2
Igbogbo I	0.44	0.43	Energy Poor	2
Igbogbo II	0.42	0.41	Energy Poor	3
Imota I	0.48	0.47	Energy Poor	2
Imota II	0.43	0.42	Energy Poor	3
Isele III	0.38	0.37	Energy Poor	3
Olorunda	0.37	0.36	Energy Poor	2
Aga/Ijimu	0.34	0.33	Energy Poor	2

Impact of energy poverty on schools

Table 4 Presents information about the relationship between energy poverty and learning centers. The study examined the presence of Tertiary, secondary, and primary schools across all the 19 wards in Ikorodu, both public and private institutions. Reports(Table 4) revealed a total of 114 schools were visited, and 72% were present in energy-non-poor communities, while the energy-poor communities only host 28% of such institutions. This indicates that the owners of schools are attracted to locating schools and other training centers in the areas that have more access to energy, also the residents of non-poor energy communities have better economic status to pay for schools compared to energy-poor residents generally, this indicates a high literacy level amongst residents from non-poor energy wards. The results show a higher impact of energy on education centers, which also conform to literature (Ashagidigbi et al., 2020) submission.

Table 4: Relationship between energy poverty and standard schools in the community

Community	MEPI Energy Score	Estimated Energy score average for the last five years	Energy Availability	No. of standard schools (Primary, Secondary or Tertiary) present
Odogunyan	0.31	0.30	Energy Non-Poor	9
Baiyeku/Oreta	0.28	0.27	Energy Non-Poor	7
Erikorodu	0.29	0.28	Energy Non-Poor	6
IjedeI	0.21	0.20	Energy Non-Poor	8
Ijede II	0.19	0.18	Energy Non-Poor	9
Ipakodo	0.24	0.23	Energy Non-Poor	9
Isiu	0.27	0.26	Energy Non-Poor	5
Agbala	0.26	0.25	Energy Non-Poor	6
Ibeshe	0.25	0.24	Energy Non-Poor	8
Agura	0.25	0.24	Energy Non-Poor	7
Isele I	0.23	0.22	Energy Non-Poor	9
Isele II	0.39	0.38	Energy Poor	6
Igbogbo I	0.44	0.43	Energy Poor	4
Igbogbo II	0.42	0.41	Energy Poor	4
Imota I	0.48	0.47	Energy Poor	2
Imota II	0.43	0.42	Energy Poor	2
Isele III	0.38	0.37	Energy Poor	2
Olorunda	0.37	0.36	Energy Poor	5
Aga/Ijimu	0.34	0.33	Energy Poor	6

Impact of energy poverty on agricultural production

Rural communities in developing nations are more exposed to energy poverty (Kaygusuz, 2011). This is attributed to the low incomes of households in rural communities, mostly farmers, compared with those in urban or semi-urban communities, (Akande & Oghenetega, 2022; Bouzarovski & Petrova, 2015a) as well as the specific energy needs of their households (Farming) (Kaygusuz, 2011).

Table 5 presents the average yield per year from respondents within the communities, and energy poverty has no clear effect on the yield of farmers in varying wards. There are varying reports on the influence of energy poverty on agricultural yield, especially in communities; hence, no standard validation can support this outcome (Rao & Pachauri, 2017).

Table 5: Relationship between farmer's productivity and energy poverty

Community	MEPI Energy Score	Estimated Energy score average for the last five years	Energy availability	The average yield from farmers identified per year(tons)
Odogunyan	0.31	0.30	Energy Non-Poor	1100
Baiyeku/Oreta	0.28	0.27	Energy Non-Poor	2400
Erikorodu	0.29	0.28	Energy Non-Poor	2600
IjedeI	0.21	0.20	Energy Non-Poor	2000
Ijede II	0.19	0.18	Energy Non-Poor	3400
Ipakodo	0.24	0.23	Energy Non-Poor	3100
Isiu	0.27	0.26	Energy Non-Poor	2500
Agbala	0.26	0.25	Energy Non-Poor	1700
Ibeshe	0.25	0.24	Energy Non-Poor	5300
Agura	0.25	0.24	Energy Non-Poor	5600

Isele I	0.23	0.22	Energy Non-Poor	4500
Isele II	0.39	0.38	Energy Poor	1800
Igbogbo I	0.44	0.43	Energy Poor	10500
Igbogbo II	0.42	0.41	Energy Poor	2100
Imota I	0.48	0.47	Energy Poor	7800
Imota II	0.43	0.42	Energy Poor	5200
Isele III	0.38	0.37	Energy Poor	4300
Olorunda	0.37	0.36	Energy Poor	5600
Aga/Ijimu	0.34	0.33	Energy Poor	2300

4.4. Impact of energy poverty on social media usage

Table 6 depicts more active hours on social media in energy-non-poor wards than in energy-poor wards. The number of hours one spends on social media directly indicates inclusion, and as understood, energy poverty can reduce social inclusion (Afon, 2007) empirical results indicate that energy poverty hurts Internet use(S. Wang et al., 2022). The Communities are categorized as "Energy Non-Poor," with lower MEPI energy score below 0.30. However, communities like Isele II, Igbogbo I, Igbogbo II, Imota I, Imota II, Isele III, Olorunda, and Aga/Ijimu are classified as "Energy Poor" with higher MEPI scores of 0.30.

Table 6: Relationship between active hours on social media and energy poverty

Community	MEPI Energy Score	Estimated Energy score average for the last five years	Energy Availability	Average No. of hours active on social media per day using electricity
Odogunyan	0.31	0.30	Energy Non-Poor	11
Baiyeku/Oreta	0.28	0.27	Energy Non-Poor	10
Erikorodu	0.29	0.28	Energy Non-Poor	11
IjedeI	0.21	0.20	Energy Non-Poor	9
Ijede II	0.19	0.18	Energy Non-Poor	12
Ipakodo	0.24	0.23	Energy Non-Poor	11
Isiu	0.27	0.26	Energy Non-Poor	9
Agbala	0.26	0.25	Energy Non-Poor	10
Ibeshe	0.25	0.24	Energy Non-Poor	13
Agura	0.25	0.24	Energy Non-Poor	11
Isele I	0.23	0.22	Energy Non-Poor	12
Isele II	0.39	0.38	Energy Poor	5
Igbogbo I	0.44	0.43	Energy Poor	4
Igbogbo II	0.42	0.41	Energy Poor	6
Imota I	0.48	0.47	Energy Poor	4
Imota II	0.43	0.42	Energy Poor	6
Isele III	0.38	0.37	Energy Poor	7
Olorunda	0.37	0.36	Energy Poor	6
Aga/Ijimu	0.34	0.33	Energy Poor	5

Table 7 states the socio-economic variables considered across sub-communities, such as the number of new SMEs, healthcare facilities, schools, agricultural yield, and social media usage, and its relationship with energy. The energy-poor communities tend to have lower scores in variables such as the number of SMEs, healthcare facilities, and educational institutions, this suggests an inverse relationship between MEPI energy scores and the variables, while the energy-non-poor recorded significantly higher scores.

Table 7: Relationship between socio-economic variables and energy poverty

Communit y	MEPI Energy Score	Estimated Energy score average for	Energy Poor or Non-Poor	No new SME per	No. of standard healthcare facility	No. of standard schools (Primary,	The average yield from farmers identified per	Average No. of hours active on

		the last five years		**year**	**present**	**Secondary or tertiary) present**	**year (tons)**	**social media per day using electricity**
Odogunyan	0.31	0.30	Energy Non-Poor	43	4	9	1100	11
Baiyeku/Oreta	0.28	0.27	Energy Non-Poor	51	4	7	2400	10
Erikorodu	0.29	0.28	Energy Non-Poor	49	3	6	2600	11
IjedeI	0.21	0.20	Energy Non-Poor	78	5	8	2000	9
Ijede II	0.19	0.18	Energy Non-Poor	63	6	9	3400	12
Ipakodo	0.24	0.23	Energy Non-Poor	55	5	9	3100	11
Isiu	0.27	0.26	Energy Non-Poor	57	4	5	2500	9
Agbala	0.26	0.25	Energy Non-Poor	59	2	6	1700	10
Ibeshe	0.25	0.24	Energy Non-Poor	52	5	8	5300	13
Agura	0.25	0.24	Energy Non-Poor	58	5	7	5600	11
Isele I	0.23	0.22	Energy Non-Poor	76	6	9	4500	12
Isele II	0.39	0.38	Energy Poor	36	2	6	1800	5
Igbogbo I	0.44	0.43	Energy Poor	31	2	4	10500	4
Igbogbo II	0.42	0.41	Energy Poor	25	3	4	2100	6
Imota I	0.48	0.47	Energy Poor	19	2	2	7800	4
Imota II	0.43	0.42	Energy Poor	24	3	2	5200	6
Isele III	0.38	0.37	Energy Poor	28	3	2	4300	7
Olorunda	0.37	0.36	Energy Poor	26	2	5	5600	6
Aga/Ijimu	0.34	0.33	Energy Poor	23	2	6	2300	5

Tables 8 9, shows a very high correlation coefficient of 0.95967, indicating the high strength of the linear statistical relationship of multidimensional energy poverty with the variables of health, education, SMEs, farming, and social inclusion. It strongly affirms that energy poverty has impacts on the socio-economic conditions of the respondents in the communities. The R square value also indicates a high model fit, further strengthening the accuracy of the results. A standard error of 0.02 shows the high accuracy of our regression analysis. The significance F, 0.000000998, shows a P value far less than 0.05, which indicates that there is a high impact of energy poverty on socio-economic development in the Ikorodu community.

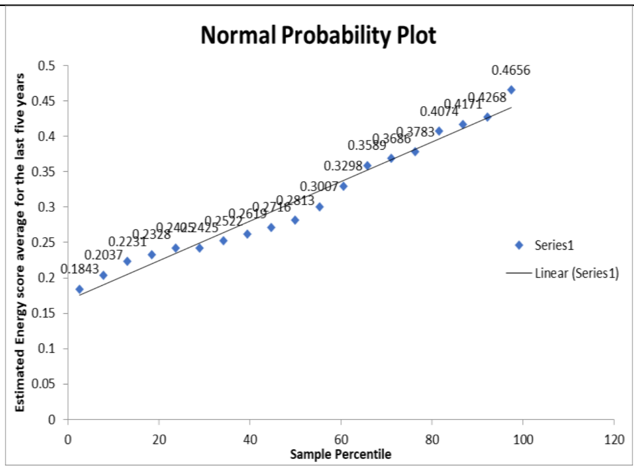

Table 8: Estimated score-Regression analysis

Table 9: Regression analysis

Regression Statistics	
Multiple R	0.959672523
R Square	0.920971351
Adjusted R Square	0.890575717
Standard Error	0.027826015
Observations	19

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0.117302415	0.023460483	30.29946159	9.98038E-07
Residual	13	0.010065733	0.000774287		
Total	18	0.127368147			

Table 10: Analysis

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	0.506361	0.0287641	17.603924	1.9E-10	0.44421968	0.5685	0.44422	0.5685
No new SME per year	-0.002199	0.0006777	-3.245212	0.00639	-0.0036632	-0.0007	-0.0037	-0.0007
No. of standard healthcare facility present	-0.000962	0.0089427	-0.107557	0.91599	-0.02028135	0.0184	-0.0203	0.01836
No. of standard schools (Primary, Secondary or tertiary) present	-0.006559	0.0048546	-1.35115	0.19969	-0.01704711	0.0039	-0.017	0.00393
Estimated average yield from farmers identified per year (tons)	3.93E-06	3.192E-06	1.2322776	0.23967	-2.9624E-06	1E-05	-3E-06	1.1E-05
Average No. of hours active on social media per day using electricity	-0.008475	0.0045375	-1.867767	0.0845	-0.0182778	0.0013	-0.0183	0.00133

5. Conclusion

This study explored the extent of energy poverty within communities and its impact on socioeconomic activities in Ikorodu Local Government Area of Lagos State, Nigeria. A significant number of households still rely on traditional energy sources (such as firewood and stoves) for cooking and on fossil-fuel-powered generators for electricity.

The research findings indicated that approximately 42% of the Ikorodu community experiences energy poverty, while the remaining 58% are categorized as energy non-poor. The study uncovered a strong, positive correlation between energy poverty and critical aspects of socioeconomic development, including education, healthcare, and economic activities. Energy poverty was shown to undermine social inclusion, limit educational attainment at both individual and community levels, reduce overall quality of life and healthcare access, and impede the establishment and growth of businesses. Notably, the study found no conclusive evidence of an impact on agricultural yields among community farmers, likely due to Ikorodu's semi-urban setting, where commercial activities are more prominent than agriculture.

In light of these findings, the study emphasizes the need for government intervention and public awareness campaigns to increase electricity access through renewable energy solutions. It also highlights the necessity of promoting clean, affordable energy alternatives to address energy poverty. Findings reveal that a substantial portion of households still lack access to clean energy, with 70% using generators and 15% relying on traditional methods like firewood, stoves, and candles.

Therefore, it is recommended that the government upgrade energy infrastructure and promote or subsidize clean and renewable energy sources. This approach will help alleviate energy poverty and positively impact households' socioeconomic activities.

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References

Adams, S., Klobodu, E. K. M., & Apio, A. (2018). Renewable and non-renewable energy, regime type and economic growth. *Renewable Energy*, 125, 755–767. https://doi.org/10.1016/j.renene.2018.02.135

Afon, A. O. (2007). Informal sector initiative in the primary sub-system of urban solid waste management in Lagos, Nigeria. *Habitat International*, 31(2), 193–204. https://doi.org/10.1016/j.habitatint.2007.02.007

Ajayi, P. (2023). Energy Poverty and Household Wellbeing in Nigeria. *African Development Review*, 30(4), 410-422

Akande, A. A., & Oghenetega, O. (2022). An Empirical Investigation of Food Security Status in Urban Households in Niger-Delta, Nigeria. *The International Journal of Business & Management*, 10(2). https://doi.org/10.24940/theijbm/2022/v10/i2/bm2202-040

Alkire, S., & Foster, J. (2011). Understandings and misunderstandings of multidimensional poverty measurement. *Journal of Economic Inequality*, 9(2), 289–314. https://doi.org/10.1007/s10888-011-9181-4

Ashagidigbi, W. M., Babatunde, B. A., Ogunniyi, A. I., Olagunju, K. O., & Omotayo, A. O. (2020). Estimation and determinants of multidimensional energy poverty among households in Nigeria. *Sustainability* (Switzerland), 12(18). https://doi.org/10.3390/SU12187332

Bazilian, M., Modi, V., Nussbaumer, P. S. 1991-, & Yumkella, K. K. (2011). *Measuring energy poverty : focusing on what matters*. Oxford Poverty & Human Development Initiative.

Bersisa, M., & Heshmati, A. (2021). A Distributional Analysis of Uni-and Multidimensional Poverty and Inequalities in Ethiopia. *Social Indicators Research*, 155(3), 805–835. https://doi.org/10.1007/s11205-021-02606-w

Bouzarovski, S., & Petrova, S. (2015a). A global perspective on domestic energy deprivation: Overcoming the energy poverty-fuel poverty binary. *Energy Research and Social Science*, 10, 31–40. https://doi.org/10.1016/j.erss.2015.06.007

Day, R., Walker, G., & Simcock, N. (2016). Conceptualising energy use and energy poverty using a capabilities framework. *Energy Policy*, 93, 255–264. https://doi.org/10.1016/j.enpol.2016.03.019

Famewo, A. S., & Uwala, V. A. (2022). Socio-economic Impacts of Rural Energy Poverty on Women and Students in Esa-Oke, Nigeria. *Journal of Sustainability and Environmental Management*, 1(2), 84–93. https://doi.org/10.3126/josem.v1i2.45339

FAO. (2022). *Measuring rural poverty with a multidimensional approach: The Rural Multidimensional Poverty Index*. In Measuring rural poverty with a multidimensional approach: The Rural Multidimensional Poverty Index. FAO. https://doi.org/10.4060/cb8269en

Fungisai Chipango, E. (2021). Constructing, understanding and interpreting energy poverty in Zimbabwe: A postmodern perspective. *Energy Research and Social Science*, 75. https://doi.org/10.1016/j.erss.2021.102026

Gouveia, J. P., Palma, P., & Simoes, S. G. (2019). Energy poverty vulnerability index: A multidimensional tool to identify hotspots for local action. *Energy Reports*, 5, 187–201. https://doi.org/10.1016/j.egyr.2018.12.004

House, Q. E., Nussbaumer, P., Bazilian, M., Modi, V., Yumkella, K. K., & Nussbaumer, Y. (2011). *Oxford Poverty & Human Development Initiative (OPHI)* Oxford Department of International Development OPHI WORKING PAPER NO. 42 Measuring Energy Poverty: Focusing on What Matters. http://ophi.qeh.ox.ac.uk/

Husnain, M. I. ul, Nasrullah, N., Khan, M. A., & Banerjee, S. (2021). Scrutiny of income related drivers of energy poverty: A global perspective. *Energy Policy*, 157. https://doi.org/10.1016/j.enpol.2021.112517

Kanagawa, M., & Nakata, T. (2007). Analysis of the energy access improvement and its socio-economic impacts in rural areas of developing countries. *Ecological Economics*, 62(2), 319–329. https://doi.org/10.1016/j.ecolecon.2006.06.005

Kaygusuz, K. (2011). Energy services and energy poverty for sustainable rural development. *Renewable and Sustainable Energy Reviews*, 15(2), 936–947. https://doi.org/10.1016/j.rser.2010.11.003

Khan, M. A., Tahir, A., Khurshid, N., ul Husnain, M. I., Ahmed, M., & Boughanmi, H. (2020). Economic effects of climate change-induced loss of agricultural production by 2050: A case study of

Pakistan. *Sustainability* (Switzerland), 12(3). https://doi.org/10.3390/su12031216

Kumar, M. (2020). Non-universal nature of energy poverty: Energy services, assessment of needs and consumption evidences from rural Himachal Pradesh. *Energy Policy*, 138. https://doi.org/10.1016/j.enpol.2019.111235

Liang, Q., & Asuka, J. (2022). A multidimensional energy poverty measurement in China - Based on the entropy method. *Energy for Sustainable Development,* 71, 554–567. https://doi.org/10.1016/j.esd.2022.11.005

Nussbaumer, P., Bazilian, M., & Modi, V. (2012a). Measuring energy poverty: Focusing on what matters. *Renewable and Sustainable Energy Reviews,* 16(1), 231–243. https://doi.org/10.1016/j.rser.2011.07.150

Ogwumike, F. O., & Ozughalu, U. M. (2016). Analysis of energy poverty and its implications for sustainable development in Nigeria. *Environment and Development Economics*, 21(3), 273–290. https://doi.org/10.1017/S1355770X15000236

Olang, T. A., Esteban, M., & Gasparatos, A. (2018). Lighting and cooking fuel choices of households in Kisumu City, Kenya: A multidimensional energy poverty perspective. *Energy for Sustainable Development,* 42, 1–13. https://doi.org/10.1016/j.esd.2017.09.006

Ouedraogo, N. S. (2013). Energy consumption and economic growth: Evidence from the economic community of West African States (ECOWAS). *Energy Economics*, 36, 637–647. https://doi.org/10.1016/j.eneco.2012.11.011

Ozughalu, U. M., & Ogwumike, F. O. (2019). Extreme Energy Poverty Incidence and Determinants in Nigeria: A Multidimensional Approach. Social Indicators Research, 142(3), 997–1014. https://doi.org/10.1007/s11205-018-1954-8

Papada, L., & Kaliampakos, D. (2016). Measuring energy poverty in Greece. Energy Policy, 94, 157–165. https://doi.org/10.1016/j.enpol.2016.04.004

Rao, N. D., & Pachauri, S. (2017). Energy access and living standards: Some observations on recent trends. *Environmental Research Letters*, 12(2). https://doi.org/10.1088/1748-9326/aa5b0d

Sadath, A. C., & Acharya, R. H. (2017). Assessing the extent and intensity of energy poverty using Multidimensional Energy Poverty Index: Empirical evidence from households in India. *Energy Policy,* 102, 540–550. https://doi.org/10.1016/j.enpol.2016.12.056

Sarkodie, S. A., & Adams, S. (2020). Electricity access, human development index, governance and income inequality in Sub-Saharan Africa. *Energy Reports,* 6, 455–466. https://doi.org/10.1016/j.egyr.2020.02.009

Scott, O., & Ose, B. (2020). Energy poverty and economic development in Nigeria: Empirical analysis. *KIU Interdisciplinary Journal of Humanities and Social Science, 1(2).* https://ssrn.com/abstract=3676046

Sokołowski, J., Lewandowski, P., & Bouzarovski, S. (2019). *Measuring energy poverty in Poland with the Multidimensional Energy Poverty Index*. https://doi.org/10.13140/RG.2.2.36214.96320

United Nation Report. (2022). *The Sustainable Development Goals Report.*

Villalobos, C., Chávez, C., & Uribe, A. (2021). Energy poverty measures and the identification of the energy poor: A comparison between the utilitarian and capability-based approaches in Chile. *Energy Policy,* 152. https://doi.org/10.1016/j.enpol.2021.112146

Wang, F., Geng, H., Zha, D., & Zhang, C. (2023). Multidimensional Energy Poverty in China: Measurement and Spatio-Temporal Disparities Characteristics. *Social Indicators Research*, 168(1–3), 45–78. https://doi.org/10.1007/s11205-023-03129-2

Wang, S., Cao, A., Wang, G., & Xiao, Y. (2022). The Impact of energy poverty on the digital divide: The mediating effect of depression and Internet perception. *Technology in Society*, 68. https://doi.org/10.1016/j.techsoc.2022.101884

Zhang, D., Li, J., & Han, P. (2019). A multidimensional measure of energy poverty in China and its impacts on health: An empirical study based on the China family panel studies. *Energy Policy*, 131, 72–81. https://doi.org/10.1016/j.enpol.2019.04.037.