

Rural Electrification and Economic Growth: Evidence from the Northern Senatorial District of Cross River State, Nigeria

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Abstract

Access to reliable electricity is a critical driver of rural economic transformation. This study examines the impact of rural electrification on economic growth and development in the Northern Senatorial District of Cross River State, Nigeria. A mixed-method approach, combining household surveys, key informant interviews, and secondary data, was employed to assess the effects of electrification on income generation, enterprise development, education, healthcare delivery, and overall community welfare. The findings indicate that rural electrification significantly improves productivity, stimulates small-scale entrepreneurship, enhances access to essential social services, and promotes inclusive economic development. However, inadequate infrastructure, irregular power supply, and high connection costs continue to constrain the realization of its full benefits. The study concludes that expanding rural electricity access through sustained public investment, supportive policy reforms, and strategic public-private partnerships is essential for accelerating rural economic growth and sustainable development.

Key Words: Rural Electrification, Economic Growth, Energy Access, Infrastructure Development

1. Introduction

Electricity is widely recognized as a fundamental driver of modern economic growth and human development. Access to reliable and affordable energy services underpins productivity, industrialization, education, healthcare delivery, and overall improvements in the standard of living. In developing countries, particularly in sub-Saharan Africa, the absence or inadequacy of electricity remains a critical barrier to economic transformation and social development. According to the International Energy Agency (IEA), millions of households across the region still lack access to electricity, with rural communities disproportionately affected. This energy deficit perpetuates poverty, constrains entrepreneurship, limits access to modern technology, and undermines sustainable development.

Rural electrification has therefore emerged as a central policy tool aimed at bridging the energy access gap and fostering inclusive development. It encompasses the extension of electricity supply to remote and underserved communities through grid and off-grid solutions. Beyond its technical dimensions, rural electrification is increasingly viewed as a catalyst for economic empowerment, enabling small-scale industries, improving agricultural value chains, and

enhancing social services such as schools and hospitals. However, the relationship between rural electrification and economic outcomes is complex and context-specific, influenced by institutional frameworks, affordability, infrastructure quality, and community participation.

In Nigeria, the quest for rural electrification has received significant attention due to the country's vast rural population and the need to stimulate balanced regional development. The government, through agencies such as the Rural Electrification Agency (REA), has initiated programs and partnerships aimed at expanding electricity access. Despite these efforts, many rural areas remain underserved, with limited or unreliable electricity supply. This gap is particularly evident in the Northern Senatorial District of Cross River State, where communities face developmental challenges stemming from inadequate infrastructure and limited access to modern energy.

This study seeks to evaluate the impact of rural electrification on economic growth and development within this district. By examining how electricity access influences income generation, small-scale businesses, agricultural productivity, education, healthcare, and community well-being, the research provides evidence-based insights into the developmental role of energy infrastructure. Furthermore, the study identifies persistent barriers to effective rural electrification and highlights policy implications for enhancing sustainable growth. Ultimately, the findings contribute to the broader discourse on energy and development in sub-Saharan Africa, offering lessons for policymakers, practitioners, and development partners.

Rural electrification is a crucial driver of economic growth and agricultural transformation, particularly in developing countries. Access to reliable electricity in rural areas enhances productivity, supports industrialization, and improves the quality of life. It plays a significant role in modernizing agriculture through mechanization, irrigation, processing, and storage, ultimately leading to increased productivity and economic growth.

In Nigeria, rural electrification has been a major challenge due to inadequate infrastructure, high costs of expansion, and limited investment in off-grid solutions. The Northern Senatorial District of Cross River State, like many rural regions, faces significant electricity shortages. This has hindered the adoption of modern farming techniques, agro-processing, and storage facilities, leading to post-harvest losses and reduced income for farmers.

Agriculture is the main economic activity in the Northern Senatorial District of Cross River State, with many residents engaged in crop production, livestock farming, and small-scale agribusinesses. However, the lack of electricity has led to inefficiencies in farming practices, limited access to markets, and slow economic growth. Without electricity, farmers rely on manual labour, traditional farming methods, and expensive fuel-powered machinery, which reduces productivity and increases production costs.

Rural electrification can enhance agricultural productivity by enabling irrigation, mechanization, and the use of modern storage facilities. Additionally, it can stimulate economic growth by promoting small businesses, increasing employment opportunities, and improving overall living standards. The provision of electricity can lead to the establishment of agro-processing industries, which add value to raw agricultural products, generate income, and reduce poverty.

Despite various government initiatives such as the Rural Electrification Agency (REA) and private sector interventions, many rural areas, including those in Cross River State, still lack sufficient electricity access. This study aims to investigate the effects of rural electrification on agricultural productivity and economic growth in the Northern Senatorial District of Cross River State. It will assess the extent to which electrification influences farming practices, business expansion, and overall economic development in the region

Despite significant investments in rural electrification, many agricultural communities in Cross River State still experience inadequate power supply, which adversely affects productivity (Ibrahim, 2024). The primary problem is that unreliable or absent electricity limits the adoption of mechanized and modern farming techniques, leading to lower crop yields and increased post-harvest losses. Additionally, the high cost of alternative energy solution and poor infrastructure maintenance further exacerbate these issues. The lack of a consistent power supply undermines efforts to improve storage facilities, irrigation systems and market access through digital technologies. This persistent energy gap not only hampers agricultural productivity but also contributes to broader rural poverty and economic stagnation.

In spite of the bold steps taken by the federal government to improve the level of power supply, especially to the rural communities in Nigeria, through its rural electrification strategy and implementation plan, the rate of power supply has remained abysmally low. For instance, Olanrele (2020) reported that the power supply in Nigeria has remained highly insufficient, recording as low as 3,500MW despite its generation capacity of about 7,000MW and that the rural communities are even worse off; enjoying less than 34% of aggregate power supply in Nigeria. Naturally, the estimated electricity needs for developing countries was put at about 1,000MW per one million people (The World Bank Development Indicator 2018). This implies that Nigeria needs an estimated 200,000 MW electricity power supply in view of its estimated population of 200 million people. Therefore, the current low level of power supply, as currently experienced in the country has serious implications for its rural areas, which constitute up to 50 percent of its population, and by extension its agricultural productivity.

Furthermore, electricity's role in ensuring the smooth operation of value chains, only 36 percent of rural Nigerians, most of whom are farmers, have access to grid electricity. Even for those with grid access, power could be available for as little as two hours per day. Rural communities are often distant from existing powerlines, sparsely populated, and demand fewer kilowatts- hours of electricity than denser urban neighbourhoods.

Northern Cross River, like many rural areas in Nigeria, faces significant challenges in access to electricity. The lack of reliable and affordable electricity supply has hindered agricultural productivity and overall economic growth in the region. Most farmers still rely on traditional farming methods due to limited access to modern agricultural technologies such as irrigation systems, mechanized tools, and storage facilities, all of which require electricity. Without adequate power supply, post-harvest losses remain high due to the absence of cold storage facilities and efficient processing methods. Additionally, small-scale agro-industries and businesses struggle to operate optimally, limiting job creation and income opportunities. The absence of rural electrification also discourages investment in value-added agricultural processing, which could enhance productivity and economic prosperity.

Given the region's potential for agricultural growth, addressing the issue of rural electrification is critical to unlocking economic opportunities, improving living standards, and fostering sustainable development. Therefore, this study seeks to examine the impact of rural electrification on agricultural productivity and economic growth in Northern Cross River, identifying challenges and potential policy interventions to enhance rural development.

2. Literature review

2.1 Conceptual review

2.1.1 Agricultural productivity

It consists of all the factors of production such as: labour, capital, farming experiences, availability and management of water and other biological factors. Capital refers to cash and other man-made farm assets that are required to carry out production. Capital is usually accumulated through saving and investment. But, in developing countries where national income is generally low, investment and saving are also low. This explains the low productivity, output and income in developing countries. According to Phillip et al, (2008), the transformation of smallholder agriculture in Nigeria from subsistence to market orientation requires the injection of more capital. This is true because farmers need capital to acquire, machineries and seeds and fertilizers among others. Where financial capital is inadequate farmers resort to borrowing from financial institutions for running of the farms.

2.1.2 Rural electrification

Rural electrification as an investment is also viewed as a potent weapon in raising income level and reducing poverty by contributing to the efficiency of yields, thereby enhancing agricultural productivity (Cook, 2013; Lipscomb et al. 2013; Khandker et al. 2014). It is also capable of integrating dispersed populations in rural areas into the mainstream economy that had otherwise been typically concentrated in urban areas where economic activities thrive best (Cook, 2013). Jimenez (2017) confirmed that rural electrification contributes in a significant manner to the welfare of the populace, with particular emphasis on women and small firms, by leading to a 7% increase in school enrolment, and 25% and 30% growth in employment and income respectively.

2.1.3 Economic growth

Economic growth according to Todaro and Smith (2009) means the steady process through which the productive capability of the economy is increased long term to foster a rise in the levels of national output and income. Economic development can also be defined as consistent improvement in the various aspects of the life of the entire population of a country. This improvement according to Kalu (2001), manifest in the greater ability of the people to solve their problems. Important components of economic growth with regards to Todaro and Smith (2009) are as follows: (i) capital accumulation, which includes a new investment in land, machineries and human resources via health improvements, education and job skills (ii) population growth and thus subsequent growth in labour force (iii) technological progress-new ways of tasks accomplished.

On capital accumulation Todaro and Smith (2009) emphasized that investing in human resources can improve its quality and thereby have the same or even a more powerful effect on production

as an increase in human numbers. They stressed further that formal schooling, vocational and on-the-job training programs, adult skill enhancement and other practices of informal education may all be made effective in augmenting human capital as per direct investment in buildings, machineries and materials. They further saw population growth and the associated upsurge in labour force as a factor capable of stimulating economic boom. As a larger labour force translates to more productive workers and a large overall population upturns the size of the markets. Given the aptitude of the economic system to rivet and productively employ the productive work force.

Also, a third component of economic growth-Technological progress accordingly results from new and improved ways of getting traditional task done such as growing crops, making cloths etc. They highlighted three basic classifications of technological process: natural, labour saving and capital saving. Natural technological progress ensues when higher output levels are realized using the same quantity and combinations of factor inputs. Also, the application of computers, automated systems, high speed electrical drills, tractors and mechanical plough can result in labour saving.

2.2 Theoretical framework

2.2.1 Modernization theory

Modernization theory finds its origin in the ideas of Max Weber, the German sociologist who discussed the role of irrationality and rationality in a traditional society's transition into a modern society (Mayhew, 1985, Dibia, 2006). Weber's approach would later constitute the foundation for the paradigm of modernization developed by Harvard sociologist Talcott Parson. Having translated Weber's writings, Parsons rendered them his interpretations, and sought to develop an approach for poor nations to overcome what he thought impeded their development. Modernization theory was developed in the late 1940s, and it sought to address poverty, especially in 3rd world countries with an evidently non-communist solution that embraced a capitalist model of industrialized development and Western democratic values. In the aftermath of WWII, many Asian, African and Latin American nations, despite some prior exposure to capitalism, remained underdeveloped and poor. Leaders of the West, especially the United States, were exceedingly disturbed by the situation which could become fertile ground for violent revolutions and totalitarian communisms

2.2.2 Endogenous growth theory

Endogenous growth theory or new growth theory was developed in the 1980s, as a response to criticism of the neo classical growth model. The endogenous growth theory holds that policy measures can have an impact on the long-run growth rate of an economy. Endogenous growth economists believe that improvements in productivity can be linked to a faster pace of innovation and extra investment in human capital. Endogenous growth theories describe economic growth which is generated by factors within the production process, for example; economies of scale, increasing returns or induced technological change; as opposed to outside (exogenous) factors such as the increases in population (Gokal & Hanif, 2004). In endogenous growth theory, the growth rate has depended on one variable: the rate of return on capital (Gillman, Harris & Matyas, 2002). The endogenous growth literature has produced two distinct approaches on how

to incorporate human capital into models of economic growth. The first, which is due to Lucas, regards the accumulation of human capital as the engine of growth. The second approach emphasizes the role of the human capital stock in the process of innovation and adoption of new technologies. In the model formulated by Lucas, human capital enters into the production function similarly to the way in which technology does in the Solow model, that is, in labour-augmenting form.

Lucas proposes the following production technology:

$$Y_t = AK_t^\beta (u_t h_t L_t)^{1-\beta} h_{a,t}^\gamma$$

where Y , A , K and L are, once again, output, technology, capital and labour, while u is the fraction of an individual's time allocated to work, h is the skill level or human capital of the representative agent, and h_a is the average human capital in the economy. The level of technology, A , is assumed to be constant (so that it could in principle be dropped from the expression or subsumed within the capital term). Population growth is taken as exogenous. Setting aside the last term on the right-hand side for the moment, the most important assumption of the model concerns the law of motion according to which the human capital variable evolves over time.

And because there are no diminishing returns to the acquisition of skills, human capital can grow without bound, thereby generating endogenous growth. The properties of the steady state in the Lucas model depend on whether there are external effects of human capital, which is the case if $\gamma \neq 0$. In that case, the term h in the production function therefore affects output. And because there are no diminishing returns to the acquisition of skills, human capital can grow without bound, thereby generating endogenous growth.

2.2.3 Big push theory

The Big push theory was developed by Paul Rosenstein-Rodan in 1943 and is a key economic development theory. It argues that underdeveloped economies require large-scale, coordinated investments in multiple sectors to break free from the cycle of poverty and low productivity. The theory suggests that small, isolated investments are insufficient to stimulate significant economic growth—only a “big push” across various sectors can create the necessary momentum for industrialization and development. However, the theory has been criticised on the ground of: (i) being costly and risky: Large-scale investments require huge financial resources, which may not always be available or efficiently used; (ii) implementation challenges: coordinating multiple sectors simultaneously is complex, especially in developing economies with weak institutions; (iii) neglect of small-scale approaches: the theory focuses on large investments, but small-scale, decentralized electrification solutions (like solar mini-grids) might be more sustainable in rural areas.

2.3 Empirical review

The reviewed studies largely agree that reliable electricity supply is crucial for economic productivity, particularly in manufacturing and enterprise performance. Chinedum and Nnadi (2016) found evidence of a long-run relationship between electricity supply and manufacturing

output in Nigeria, although the detailed analysis showed no significant direct relationship between electric energy and manufacturing production. Similarly, Roubaud and Shahbaz (2018) established a causal relationship between electricity consumption and economic growth at both aggregate and industrial levels. At the microeconomic level, Akpan, Essien and Isihak (2013) revealed that rural micro-enterprises relying on generators incurred operating costs up to three times higher than those connected to the national electricity grid, highlighting the adverse effect of erratic power supply on profitability.

Another group of studies emphasized the importance of electricity and infrastructure for agricultural productivity, storage, and agro-industrial development. Olayemi et al. (2012) estimated that 25% of fruits and 40% of vegetables are lost to spoilage during harvest and post-harvest activities due to inadequate storage facilities powered by electricity. In the same vein, Beawuchi et al. (2015) identified inadequate electricity supply, poor irrigation systems, and poor road networks as major constraints to sustainable fruit and vegetable processing in Nigeria. Ozturk (2017) further demonstrated that improvements in agricultural value added, cereal yields, and forest area can reduce the food-energy-water poverty nexus and promote economic growth, although with possible environmental trade-offs.

Other studies focused on policy interventions, renewable energy, and government support for agriculture. Elusakin, Ajide and Diji (2014) found that many off-grid electricity projects in rural Nigeria failed due to poor planning and non-adherence to precautionary measures, recommending proper planning to reduce costs and improve rural productivity. Arango-Aramburo et al. (2019) showed that climate change has increased the demand for renewable energy sources such as solar and wind, despite not causing abrupt declines in hydroelectric capacity. Mahjoub (2018) also reported that government agricultural subsidies positively and significantly influence agricultural exports, with increased public spending leading to higher export volumes, thereby underscoring the role of effective government intervention in enhancing agricultural productivity and economic development.

3. Methodology

3.1 Research Design and Area of the Study

A research design is a plan, strategy where a researcher is either asking question about what is or why it is in order to answer such questions; a researcher needs to investigate the relationship between independent and dependent variables. The study employs survey design which requires the use of questionnaire to collect data that will enable the researcher draw conclusion on the impact of electrification on Agricultural productivity and economic growth in Cross River State. Cross River State is one of the 36 states of the Federal Republic of Nigeria. It is made up of 18 Local Government Areas and consists of 3 Agricultural Zones namely, Calabar, Ikom and Ogoja agricultural zones. According to the National Population Census conducted in 2006, the State has an estimated population of 2888,966 persons (National Population Commission, 2006). The State is located in the Niger Delta Region of Nigeria, and bounded in the North by Benue State, in the South by Akwa Ibom and the Atlantic Ocean, in the East by Cameroon Republic, West by Ebonyi and Abia States. Cross River State lies within longitude 70 501 and 90 281 East of the Greenwich Meridian and Latitude of 50 321 and 40 271, North of the equator (Cross River State Ministry of Lands and Surveys, 2010). The major Rivers in State are the Cross River, Aya River,

Kwa River, Akpa Yafe River and Calabar River. The Cross River which takes off from the Republic of Cameroon passing through the State and empties into the Atlantic Ocean. The Cross-River flows through Etung, Ikom, Obubra, Yakurr, Abi, Biase and Odukpani Local Government Areas. The Aya River flows through Yala, Ogoja and Ikom Local Government Areas and empties into the Cross River. The Kwa River flows through Odukpani, while Akpa Yafe River flows through Akpabuyo and Bakassi Local Government Areas and empties into the Atlantic Ocean. The Calabar River flows into Cross River. For this study the River of interest is the Cross River with its surrounding communities These are rural communities located along the River and those that are within the range of 5 kilometres from the river. The area is characterized by two distinctive seasons- the dry which last from November to the middle of April and the wet which starts from the middle of April to October. The riverside rural communities are endowed with abundant swamp suitable for swamp rice cultivation and dry season farming especially of vegetables. The rural riverside dwellers are engaged in farming, fishing, hunting, tailoring, carpentry, post-harvest processing, etc. The major crops grown include yams, cassava, cocoyam, maize, rice, vegetable, citrus, bush mango, oil palm, cocoa, etc. livestock such as poultry, sheep, goats, etc. are kept in all riverside rural communities which survive by scavenging around the homestead and nearby bush. The riverside rural communities for the study consist of all rural communities along the Cross River and those within a range of 5 kilometers away from the river. This is made up of 78 riverside rural communities with a total population of 511, 604 persons (NPC, 2006).

3.2 Population of the Study

The study has a population of about 400 respondents who are students, owners of businesses (Agriculturalist, Transporters, Tailors, Hairdresser, Barbing salon, Dry cleaning shop etc.) In the state and other citizens who have knowledge on electricity and agricultural activities in Cross River North. The questionnaires will also be administered to realtors and agents in Cross River state across the five Local Government of Northern Senatorial District

3.3 Data Source

In this research work, data will be collected from primary source. This primary data will be collected through field survey basically from owners of houses in Calabar Municipality in Cross River State. Primary data are those data that are collected or gathered from the field in its original state. The methods that will be used in the collection of data include questionnaire and observation. The survey and observational methods of sourcing for primary data will be used to ensure reliability and validity of the study.

3.4 Research Instrument

Based on the nature of this research work, the researcher will employ structured questionnaire as a relevant instrument for primary data collection. The questionnaire will be designed in English Language following the 5-point Likert scale of strongly agreed (SA), agreed (A), disagreed (D) and strongly disagreed (SD). The questionnaire is made up of sections A and B. Section A basically will contain the respondents' biometrics such as age, gender, educational qualifications, years of experience in the business. Section B comprises of questions related to how rural

electrification led to agricultural productivity and economic growth in Northern Cross River State.

3.5 Validity and Analysis Technique

Validity indicates the degree to which a measuring instruments, measures what it is designed to measure. Two levels of validity will be carried out. First, the questionnaire will pass through face validity; checked by supervisor for criticisms and recommendations. Secondly, a pre-test using a sample comprising business owners will be carried out. Reliability of the instrument will be measured through the test-retest method. This has to do with consistency of the measurement instrument.

Data analysis will be undertaken using qualitative as well as quantitative techniques. It is expected that a major segment of the information collected during the survey will be qualitative and may not be easily quantified. Descriptive statistics such as frequencies, percentages etc. will be employed in most of the analyses in summarizing them. The data collected will be analyzed with relevant statistical tool such as the chi-square statistic. Final presentation will take the form of description, tabulation and illustrations. The study will also make use of tables for presentation as appropriate. The basic formula for chi-square statistic is stated thus:

$$X^2 = \sum (Of - Ef)^2$$

Ef

Where;

X^2 = chi-square statistic

$\sum$ = Summation sign

Of = observed frequencies

Ef = Expected frequencies

The degree of freedom for chi-square is computed as $df = (R-1) (C-1)$

Where

df = degree of freedom

C = Column

R = Row

Decision rule

The chi-square (χ^2) test represents the difference between the given frequencies and the expected frequencies obtained. If for instance the calculated value of (χ^2) is greater than the (χ^2) value given in the table, there is association between the variable being measured. Thus, confirming

the alternate hypothesis. But if the calculated value of chi-square (χ^2) is less than χ^2 given in the table, there is no association between the variables in the hypothesis, thus, accepting the null hypothesis. The rejection of the null hypothesis means acceptance of the alternate hypothesis.

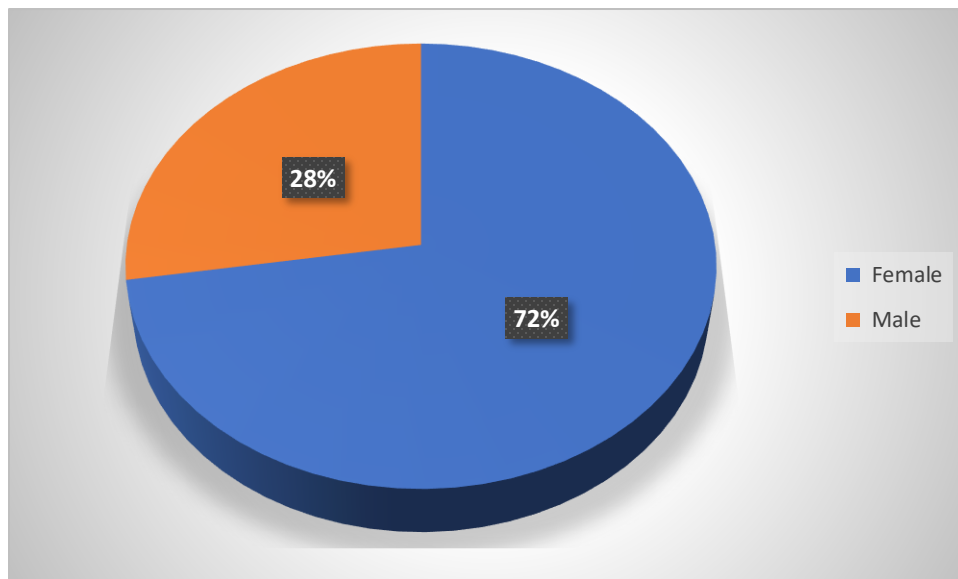
4. Results

The study was made up of different collections of people who were beneficiaries and the demographic data of beneficiaries that were surveyed from the field are presented in the tables and figures below as follows:

Table 4.1: Showing Gender of beneficiaries

Response		Frequency	Percent
Valid	Female	290	72.5
	Male	110	27.5
	Total	400	100.0

Source: Author's field Survey, 2026



The result in table 4.1 and fig. 1 provides information of beneficiaries based on gender. The result showed that 290 beneficiaries representing 72.5 percent are female respondents, while 110 beneficiaries representing 27.5 percent are male that live in Northern Cross River State

Table 4.2: Showing the ages of beneficiaries

Response		Frequency	Percent
Valid	5-10years	80	20
	11-20years	78	19.5
	21-50years	92	23
	50 and above	110	27.5
	Total	400	100

Source: Author's field Survey, 2026

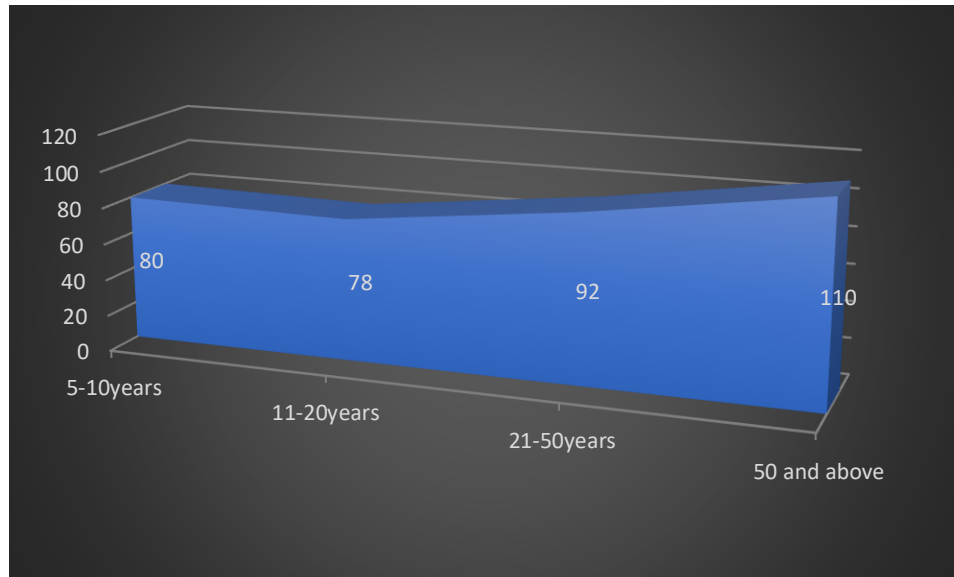


Fig 2: Pie chart of Beneficiaries Responses based on ages

The result in Table 4.2 and figure 2 above is gives an information of beneficiaries based on their ages. The result as given reveals that 80 beneficiaries representing 20 percent are 5-10years, 78 beneficiaries representing 19.5 percent are 11-20 years, 92 beneficiaries representing 23 percent are 21-50 years, while 110 beneficiaries representing 27. 5 percent are 50 years and above.

Table 4.3: Showing beneficiaries based on occupation

Responses	Frequency	Percent
Student	110	27.5
Public servant	90	22.5
Farmer	100	25
Business Person	100	25
Total	400	100

Source: Author's field Survey, 2026

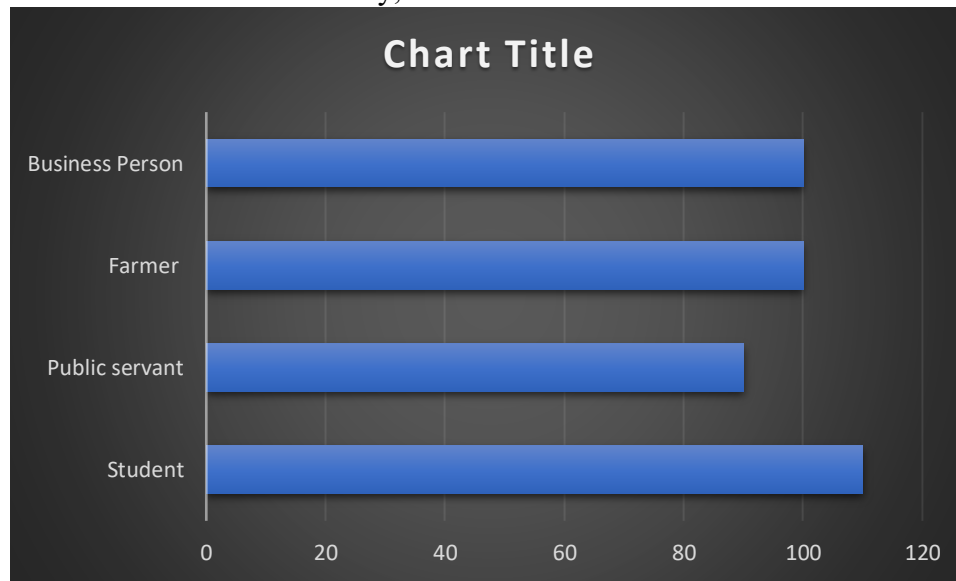


Fig 3: Pie chart of Beneficiaries Responses Based on their Occupation

The result in Table 4.3 and figure 3 above is the information of beneficiaries based on their occupation. The result as presented showed that 110 beneficiaries representing 27.5 percent have been students, and 90 beneficiaries representing 22.5 percent are public servant, 100 beneficiaries representing 25 beneficiaries are farmers and 100 beneficiaries representing 25 percent are business persons in the Cross River State.

Table 4.4: Showing beneficiaries based on their educational level

Response	Frequency	Percent
Valid		
Primary	111	27.5
Secondary	125	31.25
University	164	41.25
Total	400	100

Source: Author's field Survey, 2026

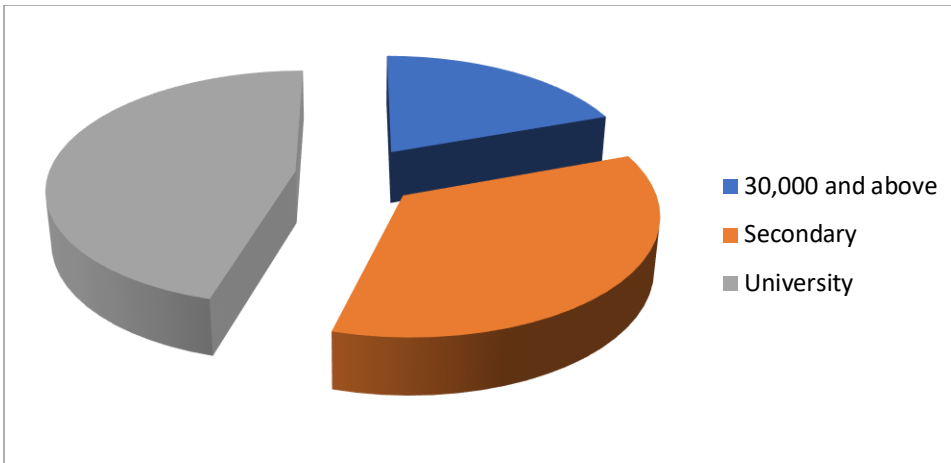


Fig 4: Pie chart of Beneficiaries Responses Based on their educational level.

The result in Table 4.4 and figure 4 above is the information of beneficiaries based on their marital status. The result as presented showed that 111 beneficiaries representing 27.5 percent are in primary school, 125 beneficiaries representing 31.25 percent are in secondary school, and 164 beneficiaries representing 41.25 percent are in live in Northern Cross River State.

Table 4.5: Showing beneficiaries based on the monthly income of beneficiaries

Response	Frequency	Percent
Valid		
5,000-10,000	110	10
11,000 – 20,000	120	7.5
21,000-30,000	100	12.5
30,000 and above	70	37.5
Total	400	100

Source: Author's field Survey, 2026

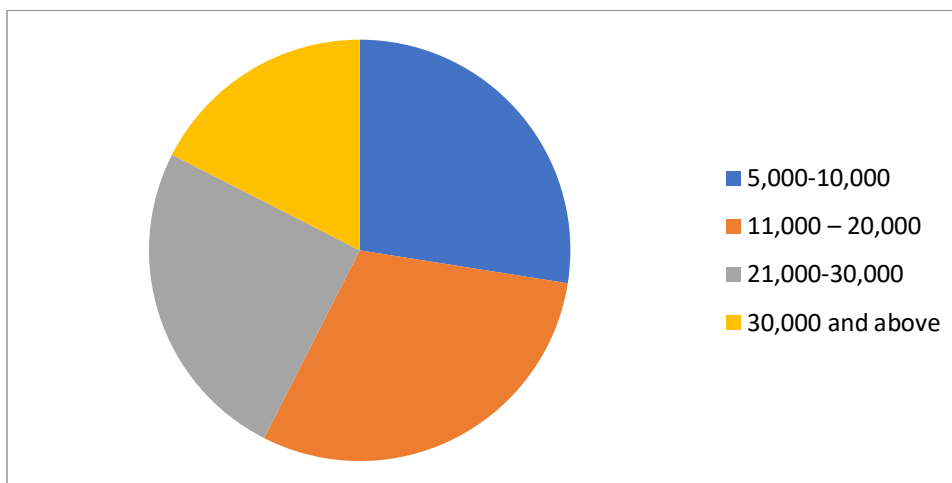


Fig 5: A pie chart showing Beneficiaries Responses based on the monthly income of beneficiaries

The result in Table 4.5 and figure 5 above is the information of beneficiaries based on the monthly income of beneficiaries. The result as presented showed that 110 beneficiaries representing 10 percent earns Less than ₦5000- 10,000, 120 beneficiaries representing 7.5 percent earns ₦11,000- ₦20,000, 100 beneficiaries representing 12.5 percent earns ₦21,000 - ₦30,000 and 70 beneficiaries representing 37.5 percent earns ₦30,0000 and above in Cross River State.

Table 4. 5: Showing how the rural electrification can significantly improve agricultural productivity in Northern Cross River State.

Responses		Frequency	Percent
Valid	Strongly agreed	90	25
	Agreed	117	33.7
	Disagreed	80	23.0
	Strongly disagreed	60	17.2
	Total	347	100

Source: Author's field Survey, 2026

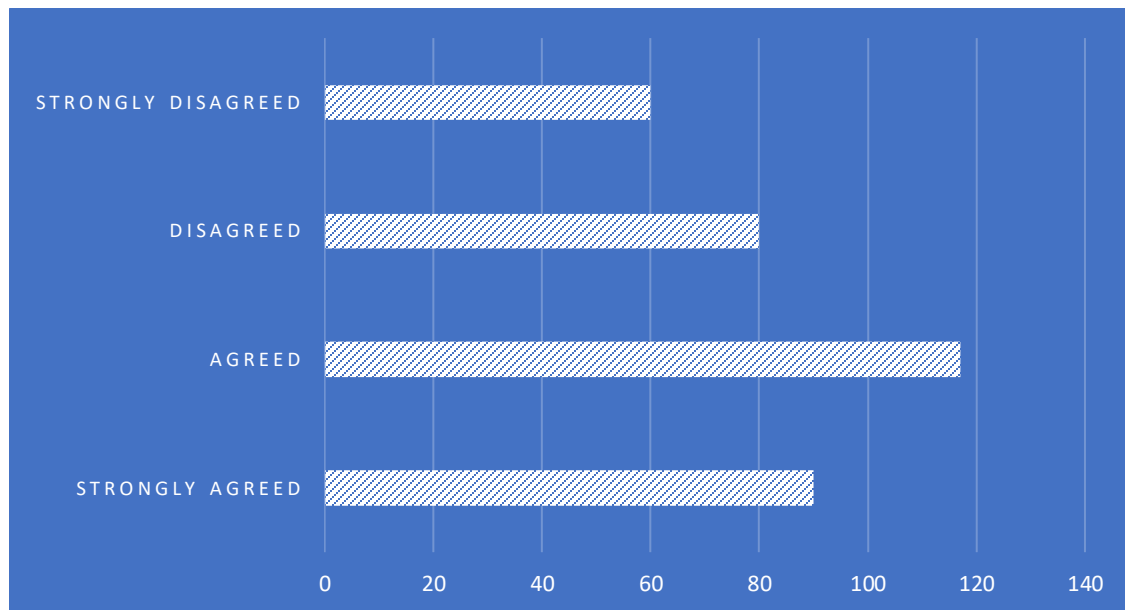


Figure 5: A bar graph showing how access to reliable electricity improves irrigation, storage, and processing of Agricultural products in Northern Cross River State.

Table 4.5 and figure 5 showed that out of 400 questionnaires that were distributed and only 176 were turned in. From the questionnaires, 55 beneficiaries representing 31.25 percent strongly agreed that access to reliable electricity improves irrigation, storage, and processing of Agricultural products in Northern Cross River State, 56 beneficiaries representing 31.8 percent agreed that access to reliable electricity improves irrigation, storage, and processing of Agricultural products in Northern Cross River State, 30 beneficiaries representing 17 percent disagreed that access to reliable electricity improves irrigation, storage, and processing of Agricultural products in Northern Cross River State and 35 beneficiaries representing 19.88

percent strongly agreed that access to reliable electricity improves irrigation, storage, and processing of Agricultural products in Northern Cross River State.

Table 4.6: Indicating that rural electrification encourages the use of modern farming equipment, leading to increased agricultural productivity

Response		Frequency	Percent
Valid	Strongly agreed	112	31.5
	Agreed	101	28.4
	Disagreed	91	25.6
	Strongly disagreed	51	14.3
	Total	355	100

Source: Author's field Survey, 2026

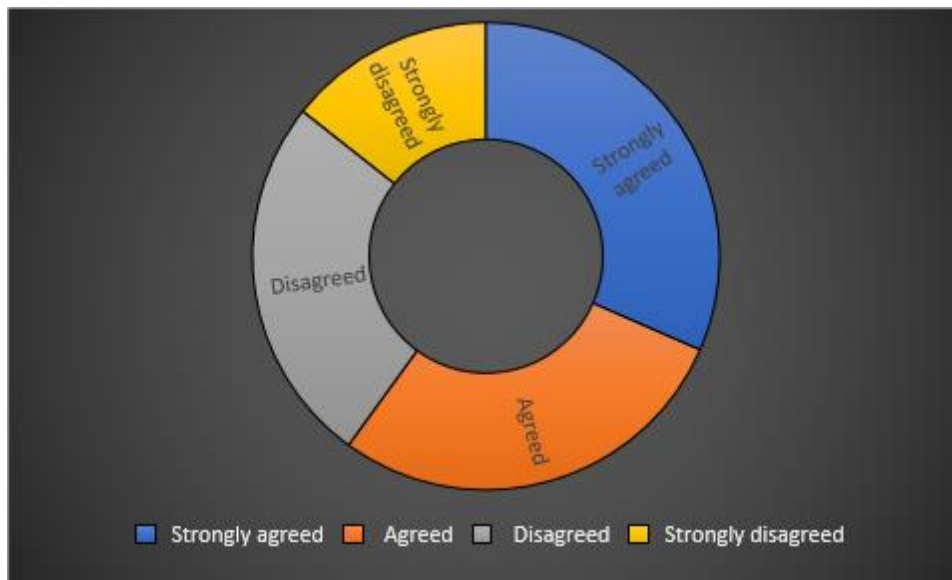


Figure 6: A pie chart showing how rural electrification encourages the use of modern farming equipment, leading to increased agricultural productivity

Table 4.6 and figure 6 showed that out of 400 beneficiaries 355 turned in their questionnaires. From the questionnaires, 112 beneficiaries representing 31.5 percent strongly agreed that rural electrification encourages the use of modern farming equipment, leading to increased agricultural productivity ,101 beneficiaries representing 28.4 percent agreed that rural electrification encourages the use of modern farming equipment, leading to increased agricultural productivity ,91 beneficiaries representing 25.6 percent disagreed that rural electrification encourages the use of modern farming equipment, leading to increased agricultural productivity and 51 beneficiaries representing 14.3 percent strongly disagreed that rural electrification encourages the use of modern farming equipment, leading to increased agricultural productivity.

Table 4.8: Indicating how improved electricity supply in rural areas leads to higher farm output, which contributes to economic growth

Response		Frequency	Percent
Valid	Strongly agreed	95	26.5
	Agreed	100	27.9
	Disagreed	113	31.5
	Strongly disagreed	50	13.9
	Total	358	100

Source: Author's field Survey, 2026

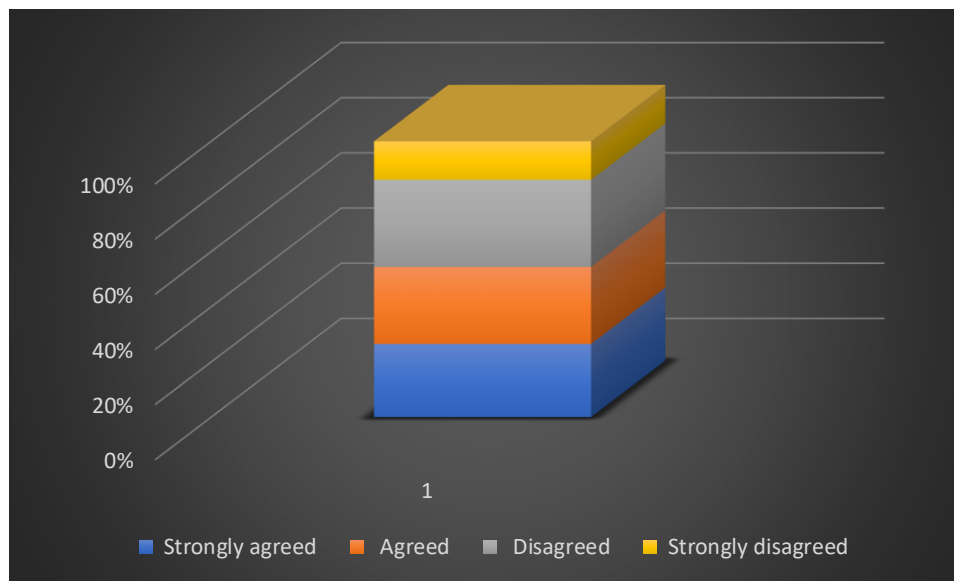


Fig 8: Showing how improved electricity supply in rural areas leads to higher farm output, which contributes to economic growth

Table 4.8 and figure 8 showed that out of 400 respondents, 358 questionnaires were turned in and the result showed that 95 respondents representing 26.5 percent strongly agreed that electricity supply in rural areas leads to higher farm output, which contributes to economic growth, 100 beneficiaries representing 27.9 percent agreed that electricity supply in rural areas leads to higher farm output, which contributes to economic growth, while 113 beneficiaries representing 31.5 percent disagreed that electricity supply in rural areas leads to higher farm output, which contributes to economic growth and 50 beneficiaries representing 13.9 percent strongly disagreed that electricity supply in rural areas leads to higher farm output, which contributes to economic growth in Northern Cross River state.

Table 4.9: Indicating how limited access to electricity is a major reason for post-harvest losses and reduced income for farmers

Responses		Frequency	Percent
Valid	Strongly agreed	140	37.3
	Agreed	115	30.6
	Disagreed	70	18.6
	Strongly disagreed	50	13.3
	Total	375	100

Source: Author's field Survey, 2026

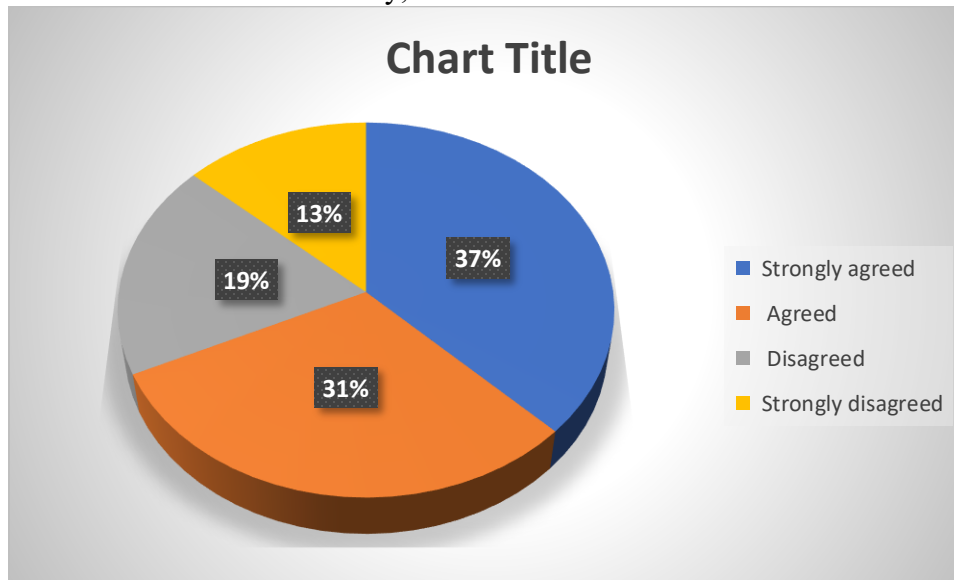


Table 4.9: Showing how limited access to electricity is a major reason for post-harvest losses and reduced income for farmers

Table 4.9 and figure 9 showed that out of 400 respondents, 375 questionnaires were turned in and the result revealed that 140 beneficiaries representing 37.3 strongly agreed that limited access to electricity is a major reason for post-harvest losses and reduced income for farmers, 115 beneficiaries representing 30.6 percent agreed that limited access to electricity is a major reason for post-harvest losses and reduced income for farmers, while 70 beneficiaries representing 18.6 percent disagreed that limited access to electricity is a major reason for post-harvest losses and reduced income for farmers and 50 beneficiaries representing 13.3 strongly disagreed that limited access to electricity is a major reason for post-harvest losses and reduced income for farmers.

TABLE 4.10: A bar graph explaining how government investment in rural electrification is essential for long term agricultural and economic development in Northern Cross River State.

Response		Frequency	Percent
Valid	Strongly agreed	112	31.1
	Agreed	100	27.8
	Disagreed	80	22.2
	Strongly disagreed	67	18.6
	Total	359	100

Source: Author's field Survey, 2026

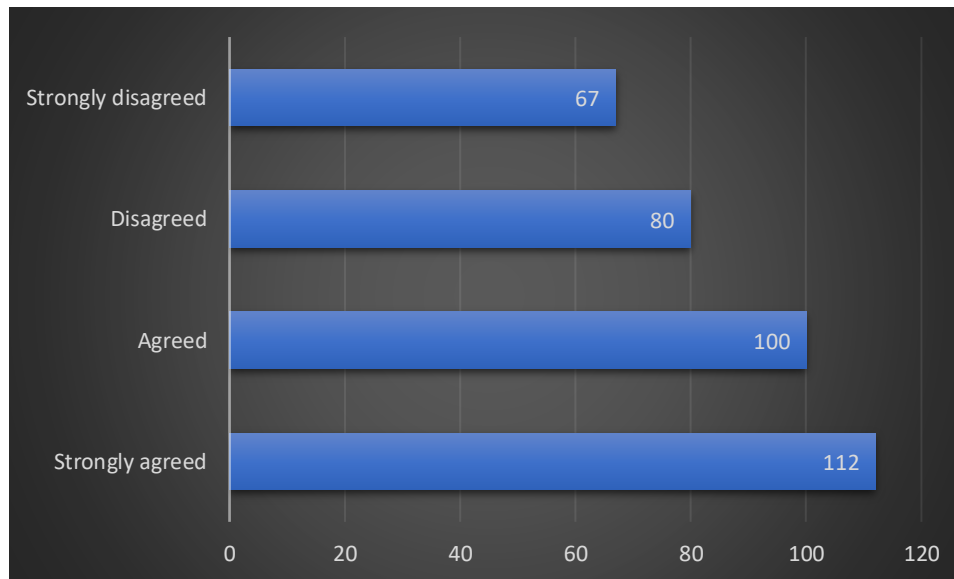


Figure 10: Bar Graph of Beneficiary Responses on how government investment in rural electrification is essential for long term agricultural and economic development in Northern Cross River State.

Table 4.10 and Figure 10 above showed that out of 400 beneficiaries 359 questionnaires were turned in, and the result showed that 112 beneficiaries' representing 31.1 percent strongly agreed that how government investment in rural electrification is essential for long term agricultural and economic development in Northern Cross River State, 100 beneficiaries representing 27.8 percent agreed that government investment in rural electrification is essential for long term agricultural and economic development in Northern Cross River State , while 80 beneficiaries representing 22.2 percent disagreed that government investment in rural electrification is essential for long term agricultural and economic development in Northern Cross River State and 67 beneficiaries representing 18.6 percent strongly disagreed that government investment in rural electrification is essential for long term agricultural and economic development in Northern Cross River State.

SECTION C TABLE 4.11: Showing how rural electricity has significantly improved business operations in rural areas of Northern Cross River State.

Response		Frequency	Percent
Valid	Strongly agreed	120	31.8
	Agreed	101	30.8
	Disagreed	55	16.3
	Strongly disagreed	61	18.1
	Total	337	100

Source: Author's field Survey, 2026

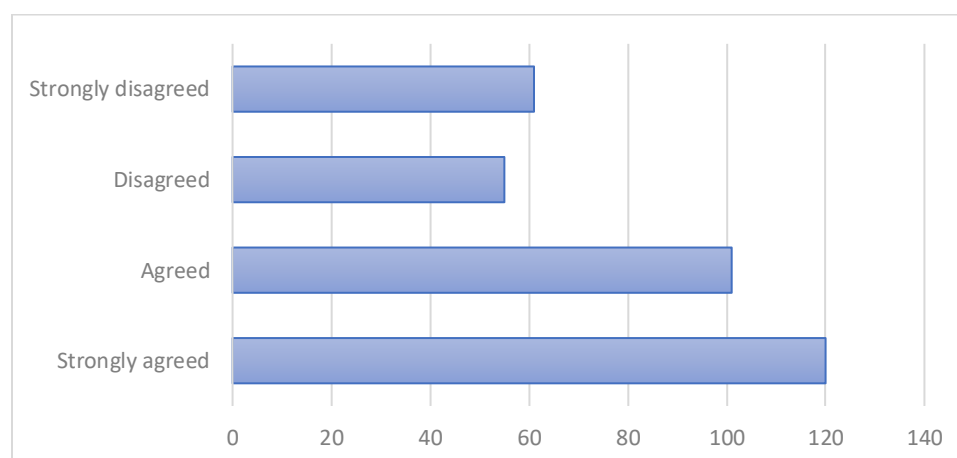


Figure 11: Bar Graph of Beneficiary Responses on how electricity access has significantly improved business operations in rural areas of Northern Cross River State.

Table 4.11 and Figure 11 above showed that out of 400 beneficiaries 337 questionnaires were turned in, and the result showed that 120 beneficiaries' representing 31.8 percent strongly agreed that rural electricity has significantly improved business operations in rural areas of Northern Cross River State, 101 beneficiaries representing 30.8 percent agreed that rural electricity has significantly improved business operations in rural areas of Northern Cross River State, while 55 beneficiaries representing 16.3 percent disagreed that rural electricity has significantly improved business operations in rural areas of Northern Cross River State and 61 beneficiaries representing 18.1 percent strongly disagreed that rural electricity has significantly improved business operations in rural areas of Northern Cross River State.

TABLE 4.12: Showing how lack of electricity remains a major barrier to economic growth

Response		Frequency	Percent
Valid	Strongly agreed	170	43
	Agreed	100	25.3
	Disagreed	70	17.7
	Strongly disagreed	55	13.9
	Total	395	100

Source: Author's field Survey, 2026

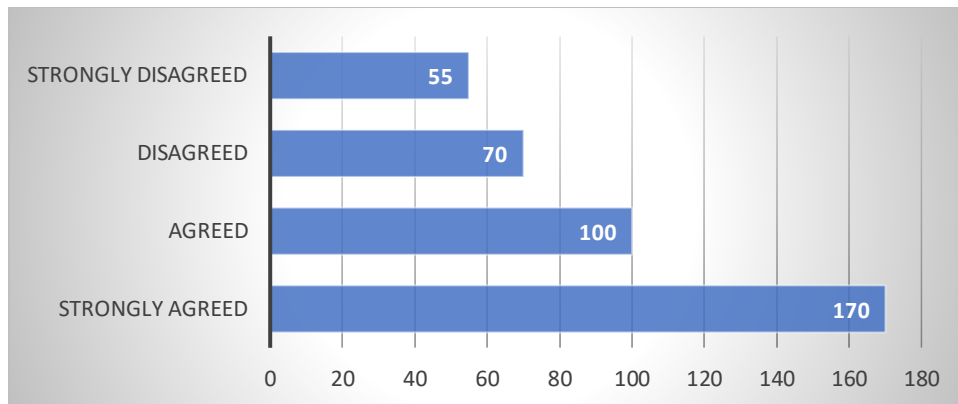


Figure 12: Bar Graph of Beneficiary on how lack of electricity remains a major barrier to economic growth

Table 4.12 and Figure 12 above showed that out of 400 beneficiaries 395 questionnaires were turned in, and the result showed that 170 beneficiaries' representing 43 percent strongly agreed that lack of electricity remains a major barrier to economic growth, 100 beneficiaries representing 23.5 percent agreed that lack of electricity remains a major barrier to economic growth, while 70 beneficiaries representing 17.7 percent disagreed that lack of electricity remains a major barrier to economic growth and 55 beneficiaries representing 15.9 percent strongly disagreed that lack of electricity remains a major barrier to economic growth.

TABLE 4.13: Showing how access to electricity has increased employment opportunities in Northern Cross River State.

Response		Frequency	Percent
Valid	Strongly agreed	110	34.4
	Agreed	112	35.1
	Disagreed	41	12.8
	Strongly disagreed	56	17.5
	Total	319	100

Source: Author's field Survey, 2026

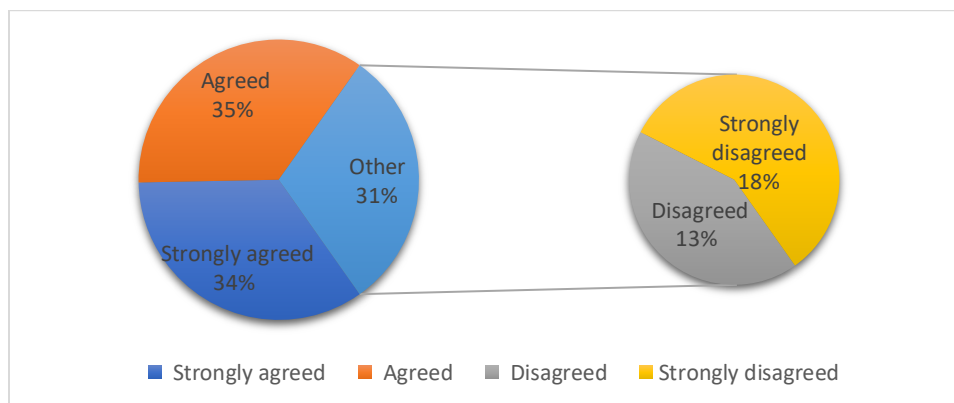


Figure 13: A bar graph showing how low how access to electricity has increased employment opportunities in Northern Cross River State.

Table 4.13 and Figure 13 above showed that out of 400 beneficiaries 319 questionnaires were turned in, and the result showed that 110 beneficiaries' representing 31.4 percent strongly agreed that low how access to electricity has increased employment opportunities in Northern Cross River State, 112 beneficiaries representing 35.1 percent agreed that low how access to electricity has increased employment opportunities in Northern Cross River State , while 41 beneficiaries representing 12.8 percent disagreed that low how access to electricity has increased employment opportunities in Northern Cross River State and 56 beneficiaries representing 17.5 percent strongly disagreed that low how access to electricity has increased employment opportunities in Northern Cross River State.

TABLE 4.14: Showing how electricity access has led to the establishment of new businesses in rural communities of northern Cross River State.

Response		Frequency	Percent
Valid	Strongly agreed	156	44.4
	Agreed	116	33
	Disagreed	45	12.8
	Strongly disagreed	34	9.68
	Total	351	100

Source: Author's field Survey, 2026

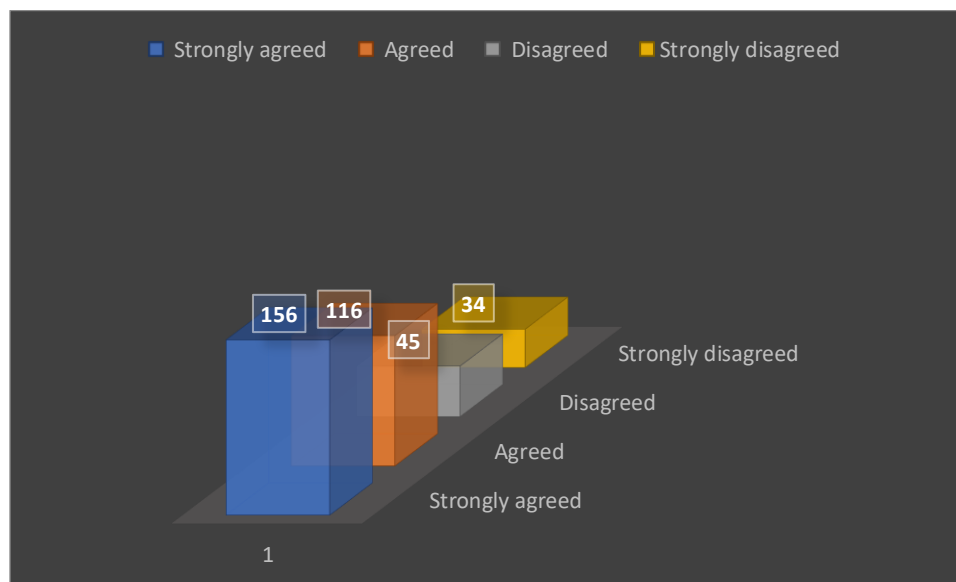


Figure 14: A bar graph showing how electricity access has led to the establishment of new businesses in rural communities of northern Cross River State.

Table 4.14 and Figure 14 above showed that out of 400 beneficiaries 351 questionnaires were turned in, and the result showed that 156 beneficiaries' representing 44.4 percent strongly agreed that electricity access has led to the establishment of new businesses in rural communities of northern Cross River State, 116 beneficiaries representing 33 percent agreed that electricity access has led to the establishment of new businesses in rural communities of northern Cross River State , 116 beneficiaries representing 12.8 percent disagreed that electricity access has led to the establishment of new businesses in rural communities of northern Cross River State. low

and 34 beneficiaries representing 9.68 percent strongly disagreed that electricity access has led to the establishment of new businesses in rural communities of northern Cross River State.

TABLE 4.15: Showing how electricity access has improved education and skills development, contributing to economic growth.

Response		Frequency	Percent
Valid	Strongly agreed	160	51.9
	Agreed	162	52.5
	Disagreed	41	13.3
	Strongly disagreed	45	14.6
	Total	308	100

Source: Author's field Survey, 2026

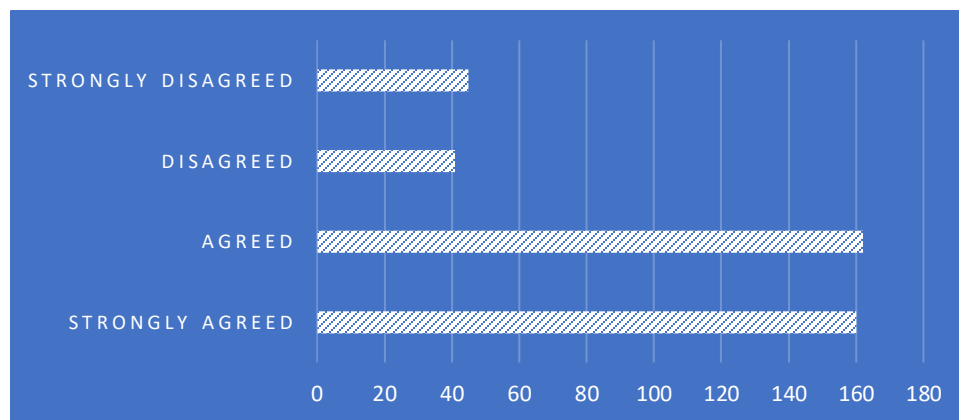


Figure 15: Bar Graph of Beneficiary Responses on how electricity access has improved education and skills development, contributing to economic growth.

Table 4.15 and Figure 15 above showed that out of 400 beneficiaries 308 questionnaires were turned in, and the result showed that 160 beneficiaries' representing 51.9 percent strongly agreed that electricity access has improved education and skills development, contributing to economic growth, 52.5 percent agreed that electricity access has improved education and skills development, contributing to economic growth, while 41 beneficiaries representing 13.1 percent disagreed that electricity access has improved education and skills development, contributing to economic growth and 45 beneficiaries representing 14.6 percent strongly disagreed that electricity access has improved education and skills development, contributing to economic growth.

4.3.1 Analysis of Research Question One

Research Question One: *How has rural electrification boosted agricultural productivity, thereby enhancing economic growth in Northern Cross River State?*

A total of 400 respondents participated in the study. The responses were analysed using descriptive statistics, specifically mean scores and percentages, based on the decision rule:

Strongly Agree (SA) = 3.50–4.00; Agree (A) = 2.50–3.49; Disagree (D) = 1.50–2.49; and Strongly Disagree (SD) = 0.00–1.49.

Table 4.19: Respondents; Perceptions of the Effect of Rural Electrification on Agricultural Productivity (n = 400)

S/N	Statement	SA	A	D	SD	Mean	Decision
1	Rural electrification can significantly improve agricultural productivity in Northern Cross River State.	90 (25.0%)	117 (33.7%)	80 (23.0%)	60 (17.2%)	2.68	Agreed
2	Rural electrification encourages the use of modern farming equipment, leading to increased agricultural productivity.	112 (31.5%)	101 (28.4%)	91 (25.6%)	51 (14.3%)	2.77	Agreed
3	Improved electricity supply in rural areas leads to higher farm output, which contributes to economic growth.	95 (26.5%)	100 (27.9%)	113 (31.5%)	50 (13.9%)	2.67	Agreed
4	Limited access to electricity is a major reason for post-harvest losses and reduced income for farmers.	140 (37.3%)	115 (30.6%)	70 (18.6%)	50 (13.3%)	2.92	Agreed
5	Government investment in rural electrification is essential for long-term agricultural and economic development in Northern Cross River State.	112 (31.1%)	100 (27.8%)	80 (22.2%)	67 (18.6%)	2.82	Agreed

Source: Author's Field Survey, 2026.

The findings in Table 4.19 indicate that respondents generally agreed that rural electrification has a positive influence on agricultural productivity and economic growth in Northern Cross River State. The mean scores for all five statements ranged from 2.67 to 2.92, exceeding the acceptance threshold of 2.50. Specifically, respondents agreed that rural electrification can significantly improve agricultural productivity (Mean = 2.68), encourage the use of modern farming equipment (Mean = 2.77), and increase farm output through improved electricity supply (Mean = 2.67). They also agreed that limited access to electricity contributes to post-harvest losses and reduced farmers' income (Mean = 2.92), while government investment in rural electrification was considered essential for long-term agricultural and economic development (Mean = 2.82).

Test of Hypothesis One

To test the hypothesis, the Chi-square (χ^2) statistical technique was employed because it is suitable for determining the significance of relationships in survey data. The Chi-square statistic was computed using the formula:

$$\chi^2 = \sum \{(F_o - F_e)^2 / F_e\}$$

Where:

F_o = Observed frequency

F_e = Expected frequency

The expected frequency for each cell was calculated using:

$$[F_o = \{\text{Row Total}\} \times \{\text{Column Total}\} \div \text{Grand Total}]$$

The decision rule was as follows:

Reject the null hypothesis (H_0) if the calculated Chi-square value (χ^2_c) is greater than the critical Chi-square value (χ^2_t).

Fail to reject the null hypothesis if χ^2_t is greater than χ^2_c .

At a 5% level of significance and 12 degrees of freedom, the critical Chi-square value is **16.92**.

Table 4.20: Summary of Chi-Square Test Results

Parameter	Value
Calculated Chi-square (χ^2_c)	34.991
Degrees of Freedom (df)	12
Critical Chi-square (χ^2_t) at 0.05	16.92
Decision	Reject H_0

Source: Authors' own computations (2026)

Since the calculated Chi-square value of 34.991 is greater than the critical value of 16.92 ($34.991 > 16.92$), the null hypothesis is rejected. Therefore, the study concludes that rural electrification has a statistically significant impact on agricultural productivity in Northern Cross River State, thereby contributing to economic growth.

4.3.2 Analysis of Research Question Two

Research Question Two: *How has electricity access boosted rural economic activities, thereby enhancing economic growth in Northern Cross River State?*

A total of 400 respondents participated in the study. The same mean score decision rule was applied in analysing the responses.

Table 4.21: Respondents' Perceptions of the Effect of Electricity Access on Rural Economic Activities (n = 400)

S/N	Statement	SA	A	D	SD	Mean	Decision
1	Rural electricity has significantly improved business operations in rural areas of Northern Cross River State.	120 (31.8%)	101 (30.8%)	55 (16.3%)	61 (18.1%)	2.83	Agreed
2	Lack of electricity remains a major barrier to economic growth.	170 (43.0%)	100 (25.3%)	70 (17.7%)	55 (13.9%)	2.97	Agreed
3	Access to electricity has increased employment opportunities in Northern Cross River State.	110 (34.4%)	112 (35.1%)	41 (12.8%)	56 (17.5%)	2.86	Agreed
4	Electricity access has led to the establishment of new businesses in rural communities of Northern Cross River State.	156 (44.4%)	116 (33.0%)	45 (12.8%)	34 (9.68%)	3.12	Agreed
5	Electricity access has improved education and skills development, contributing to economic growth.	160 (51.0%)	55 (52.0%)	45 (13.0%)	31 (14.0%)	3.18	Agreed

Source: Author's Field Survey, 2026.

The results in Table 4.21 show that respondents generally agreed that electricity access has positively influenced rural economic activities in Northern Cross River State. Mean scores ranged from 2.83 to 3.18, all above the acceptance threshold of 2.50. Respondents agreed that rural electricity has improved business operations (Mean = 2.83), increased employment opportunities (Mean = 2.86), facilitated the establishment of new businesses (Mean = 3.12), and enhanced education and skills development (Mean = 3.18). They also agreed that lack of electricity remains a major barrier to economic growth (Mean = 2.97).

Test of Hypothesis Two

The Chi-square test was also applied to determine whether rural electrification has a significant impact on economic growth in Northern Cross River State.

Table 4.22: Summary of Chi-Square Test Results

Parameter	Value
Calculated Chi-square (χ^2_c)	957.170
Degrees of Freedom (df)	12
Critical Chi-square (χ^2_t) at 0.05	16.92
Decision	Reject H_0

Source: Authors' own computations

Since the calculated Chi-square value of 957.170 is greater than the critical value of 16.92 ($957.170 > 16.92$), the null hypothesis is rejected. Consequently, the study concludes that rural

electrification has a statistically significant impact on economic growth in Northern Cross River State through its positive effect on rural economic activities.

5. Conclusion

The study was undertaken to assess the rural electrification on agricultural productivity and economic growth Northern Cross River State. Two objectives were put forward in the study. Two null hypotheses were stated. Both empirical and theoretical literatures were also reviewed. Descriptive statistics such as frequencies, percentages were employed in most of the analyses to aid in summarizing them. Data collected were analysed with relevant statistical tool such as the Chi-square statistic. The outcome of the result from the analysis revealed that rural electrification impacted positively on Agricultural productivity in Northern Cross River State. The result also revealed that rural electrification led to an increase in economic growth in Cross River State.

Rural electrification plays a crucial role in enhancing agricultural productivity and fostering economic growth in Northern Cross River State. The availability of electricity improves irrigation systems, mechanized farming, and post-harvest storage, reducing post-harvest losses and increasing overall farm output. Additionally, electricity supports agro-processing industries, boosting value addition and market competitiveness for farmers. Beyond agriculture, electrification stimulates economic growth by promoting small-scale enterprises, enhancing education and healthcare services, and improving overall living standards.

Rural businesses benefit from better access to power for processing, refrigeration, and communication, leading to job creation and higher incomes. However, challenges such as inadequate infrastructure, high connection costs, and maintenance issues must be addressed to maximize the benefits of rural electrification. Sustainable energy solutions, such as solar and mini-grid systems, can complement conventional electricity supply to ensure reliable access. In conclusion, expanding rural electrification in Northern Cross River State is essential for unlocking the region's agricultural potential and accelerating economic development. Strategic investment in energy infrastructure will not only empower farmers but also drive broader socio-economic transformation in the region. In conclusion, the study recommends the following:

- (i) The State Government should increase its allocation on the power sector to extend electricity grids and develop decentralized renewable energy solutions such as solar mini-grids and biomass plants to power remote agricultural communities.
- (ii) Provide financial support, such as subsidies, tax incentives, and low-interest loans, will encourage private sector investment in rural electrification projects and make electricity more affordable for farmers and agro-industries.
- (iii) Formulate and implement policies that prioritize electricity access for agricultural activities, such as irrigation, processing, and storage, will enhance food security and economic growth in the region.
- (iv) Establishing regular maintenance programs and monitoring mechanisms will ensure the reliability and efficiency of rural electrification projects, preventing frequent power outages and infrastructure failures.

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