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Farmers Awareness and Applicability of Renewable Energy in Ikom Education Zone, Cross River State, Nigeria.

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Introduction:

Global demand for electricity by farmers has increased steadily overtime with Nations striving to meet the demand in order to achieve the food need of the teaming population. However, Nigeria is abysmally struggling to meet the increasing demand with the meager per capita electricity consumption of 151Kwh (Owebor et al, 2021) which is lower than the average per capita electricity demand of 180kwh in sub-Saharan Africa. (Excluding South Africa). To achieve an average electricity consumption, there is need for sustainable energy usage which implies the adoption of renewable energy. Renewable energy according to the United Nations (2025) is energy derived from natural sources that are replenished at a higher rate than they are consumed. Sunlight and wind, for example, are such sources that are constantly being replenished. Renewable energy sources are plentiful and all around us while fossil fuels such as, coal, oil and gas are non-renewable resources that take hundreds of millions of years to form. Fossil fuels, when burned to produce energy, causes harmful greenhouse gas emissions, such as carbon dioxide.

Generating renewable energy creates far lower emissions than burning fossil fuels. Transitioning from fossil fuels, which currently account for the lion's share of emissions, to renewable energy is key to addressing the climate crisis. (United Nations ,2025).

Sources of renewable energy are solar, wind, geothermal, hydropower, ocean and bioenergy. But Solar energy is the most abundant of all energy resources and can even be harnessed in cloudy weather. The rate at which solar energy is intercepted by the Earth is about 10,000 times greater than the rate at which humankind consumes energy. (United Nations, 2025).

Solar technologies can deliver heat, cooling, natural lighting, electricity, and fuels for a host of applications. Solar technologies convert sunlight into electrical energy either through photovoltaic panels or through mirrors that concentrate solar radiation. (United Nations (2025). The application of renewable energy in agriculture includes the use of solar, wind, biomass, and hydropower to power various farm operations like irrigation, heating, and processing. reducing reliance on fossil fuels. These applications help in reducing reliance on fossil fuels, promote sustainability, reduce costs, and can diversify farmer's income but farmers in Ikom education zone seems to suffer some level of mis-understanding about adoption of renewable energy. They may not be aware that renewable energy means the kind of energy derived from sources that are naturally replenishable, sustainable and environmentally friendly. Renewable energy has a lesser or no harmful environmental impacts in contrast to fossil fuels with a high contribution to the degradation of the environment. Fossil fuels release greenhouse gases (such as carbon dioxide) when burned, while renewable energy source produce electricity with significantly low or zero emission. This is crucial for reducing the rate of greenhouse gas emission, which contribute to climate change. An increase in farmer's thirst for renewable energy sources (RES) adoption will decrease cases of environmental degradation, in other words, growth in renewable energy adoption is beneficial and well attached to improved environmental quality (Ugwu, et al 2022, Zhang, 2020).

Integration of renewable energy sources into the global energy landscape represents a pivotal and transformative shift from the unsustainable way societies generate, distribute and consume power to an acceptable and sustainable practices. The increase awareness of environmental concerns coupled with the impacts of climate change, has fast-traced an intensive exploration of renewable energy technologies. This new phase is enhanced by gradual farmer's awareness of the negative impacts of conventional fossil fuel-based energy sources on the environment (Zhang, 2020). Nigeria as a country faces considerable challenges in providing electricity access to its citizens, especially farmers in rural areas. Adoption of renewable energy technologies as a decentralized energy system can help bridge energy access gap, uplifting living standards, supporting small business and fostering rural

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development (Adebanji, 2023). According to Adeleye, (2024) there is a need to enhanced sustainable energy strategy for rapid and significant improvement in the energy sector. A sustainable energy strategy considers all aspects of energy use within a country to ensure a holistic and sustainable long-term plan. This will ensure that, the present energy needs are met without causing harm to the environment in the future. Considering the current global climate change, there is need to source for a comprehensive energy policy that includes renewable, acceptable and applicable energy sources to improved energy efficiency, and well-informed targets for green house emission reduction. The need for a comprehensive energy policy should also include the introduction of incentive and regulations to attract and encourage investment in clean energy technologies (Ozkan,2022, Kennedy, 2018).

Energy and agricultural system are deeply entwined and almost one third of the world's total energy is utilized in agricultural system. The energy used by agricultural system is almost accountable for one third of their greenhouse Gases (Irene & FAO, 2021). Agriculture and energy system are also important for achieving sustainable development goals (SDGs) and they also have a big effect on people and the environment. About 2.5 billion people around the world depend on agriculture as their main sources of income. (Fleming, & Vanclay, 2021). This makes agriculture a key factor in the growth of the world economy. Making sure that reliable, economic and ecological friendly energy is available to farmers for primary production and post-harvest handling as a key part of improving yields earnings, and climate resilience. This is because climate change threaten agriculture and it has become the foremost challenges for sustainable agricultural development (Fleming, & Vanclay, 2021).

Energy is an important resource in agriculture and it is used in different forms for enhancing the productivity of the farm food security, social and economic development (FAO, 2018). Agriculture consumed a lot of energy in various forms, it includes the mechanical, animal and human energy for crop production. In agriculture, two types of energy are used, direct energy and indirect energy. Direct energy is the energy used in various farming activities such as land preparation, irrigation, harvesting, transportation etc (Singh 2021). The energy used in the manufacturing, packaging and distribution of pesticides, farm machinery and fertilizers are referred to as indirect energy (Ozkan 2021). Energy is an absolute necessity for performing various farming operations such as tillage, crop production, irrigation, harvesting and using farm machinery (AL-Mohammed 2021).

The continuous impacts of climate change and cost effectiveness of energy, attract the attention of farmers adopting renewable energy by transferring them into agricultural practices. Renewable energy plays a crucial role in addressing power, heating, cooling and food transportation, provide environmental protection benefit over non-renewable fossil

energy sources like coal and oil (Lui 2018). DC-Croote (2017) consider renewable energy as a response to climate change and a way to reduce pollution in agriculture. Renewable energy has become a true choice for farmers within developing and developed countries to improve their energy structure and achieve green development (Cho, (2019).

According to Powell (2019) irrigation practices, and the forms of pre-planting operation can be Switched from non-renewable to renewable energy technology to reduce carbon emission, cost, and maximize energy efficiently. Powell (2019) reported that farmers adoption of renewable energy on farms can significantly reduce energy costs, and ecological impacts. Rana (2021) also found that renewable energy sources are more financially viable than non-renewable energy sources in Agriculture. The efficient consumption of energy in agriculture will lower the associated environmental hazards, control destruction of natural resources and stimulate sustainable agriculture. A considerable number of references exist concerning the usage of renewable energy by farmers but non refers to its usage by farmers in Ikom education zone of Cross River State.

One therefore wonders whether farmers in Ikom Education zone are aware of renewable energy and whether they apply it in their farms, this is because awareness and applicability are not the same. Adoption or applicability of an innovation at the organizational or farm system has a different task. It is one thing to be aware and more different to induce changes in normal farm practice when organizational decision makers or farmers do not regard changes as necessary. Chang (2020) contended that, individual adopters, in organizations may have trouble understanding, evaluating or selecting suitable innovations to solve specific problems or that the choice of innovation to adopt is frequently complicated by organizational or farm factors (such as culture and values). It has also been found that, a person's social network has a big effect on how quickly they accept a new idea. Fries, (2016) opined that the most important things that keep farmers from adopting innovation to renewable energy are perceived imbalance between opportunities and risks, including incompatibility with daily activities, lack of fit in independent business system, uncertainty about crop yield, lack of information and cost.

Irfan (2021), Ma (2022) also observed that, renewable energy technologies are distinct sources of clean energy that significantly improve farmers quality of life. According to Farzenal & Wang (2022), the agricultural environment is constantly changing and success of a farm businesses depends on the ability of a farmer to adapt to the changing environmental and market conditions. This requires the farmers to work toward sustainable agricultural development, adoption of a renewable energy sources which is cost efficient and environmentally friendly because farming technologies is the key to successful farm business.

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Since developing countries have limited financial resources to invest in new technologies to increase farmers yield and productivity, it is very important for farmers to use the presently available resources efficiently for sustainability. It is therefore noteworthy to investigate the extent of farmers awareness and applicability of renewable energy in Ikom Education zone.

Justification:

The application of conventional fossil fuels such as petrol and diesel on farm equipment has been a long-standing practice due to factors like accessibility, affordability and reliability (Aliyu 2018). A review of the usage of fossil fuel in the study area reveals its long-standing role in supporting agricultural activities, due to limited access to reliable electricity supply. The reliability of fossil fuel stems from its accessibility which are readily available across Nigeria, even the rural remote areas (Salihu (2020).

While the usage of fossil fuel offers certain advantages, including reliability, accessibility, and flexibility in operation, there are notable concerns and controversies surrounding their continued reliance in the agricultural sector. One of the most significant drawbacks is their high operational costs, including fuel expenses, availability, reliability, affordability and maintenance requirement (Aliyu (2018). The fluctuating prices of petrol and diesel has a significant impact on farm operating expenses and profitability especially in Ikom Education zone with limited financial resources.

The cumulative impact of these emission on local air quality, public health and climate change, high cost of purchase of fuel and diesel underscores the urgent need for more sustainable alternative in the management of agricultural activities such as solar energy panels and other renewable energy sources.

Despite Nigeria being among major exporters of fossil fuels, the country faces significant energy challenges, including power shortages, unreliable electricity supply, and high dependency on imported refined fuels. it seems nothing is being done to ameliorate the situation (Adewuyi, 2020). Power shortages, and unreliable electricity supply are common, especially in the rural areas like Ikom Education Zone of Cross River State. This is why this study seeks to examine farmers' awareness and applicability of renewable energy in Ikom Education Zone.

Objectives:

The main purpose of the study is to examine farmers awareness and applicability of renewable energy in Ikom Education Zone. The study specifically seeks to;

1) investigate the level of farmers awareness of renewable energy

2) examine the level of farmers applicability of renewable energy
3) determine the difference between male and female farmers in terms of their awareness of renewable energy
4) determine the difference between male and female farmers in terms of their applicability of renewable energy

Research questions

1) What is the level of farmers' awareness of renewable energy in Ikom Education Zone?
2) What is the level of farmers' applicability of renewable energy in Ikom Education Zone?
3) How does males differ from female farmers in terms of their awareness of renewable energy in Ikom Education Zone?
4) How does males differ from female farmers in terms of their applicability of renewable energy in Ikom Education Zone?

Statement of hypotheses

1. Two hypotheses were formulated to guide the study;
2. There is no significant difference between males and female farmers in terms of their awareness of renewable energy in Ikom Education Zone
3. There is no significant difference between males and female farmers in terms of their applicability of renewable energy in Ikom Education Zone

Methodology

The study adopted a descriptive survey research design because the issue of renewable energy is on-going in the field and survey allows the generalization of results finding on the general population from studying a given sample of the population. The population of the study was made up of registered farmers across the study area which was 5,51O (Cross River Agricultural Development Programme (CADP), 2025). From the population, a sample of 600 respondents was drawn using purposive and simple random sampling techniques. The purposiveness was in line with selected LGAs and communities therein being accessible for investigation while the randomness was in order to give each and every member of the population an equal chance of being selected. Four LGAs and two communities each therein were sampled for the study. The data collection instrument is tagged "Farmers Awareness and Applicability of Renewable Energy Questionnaire" (FAAREQ). It has sections A and B. Section A is designed to obtain data of the respondents' gender while Section B elicited responses concerning the respondents' awareness and applicability of renewable energy with [23 items on a response rubric of strongly agreed (SA), agreed (A), disagreed (D) and strongly disagreed (SD)].

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The instrument was validated by two experts in Measurement and Evaluation in the Department of Educational Management and two experts in the Department of Geography and Sustainable Development Education who ascertained the degree to which the items on the instrument measured what it was expected to measure. The reliability of the instrument was ascertained by conducting a trial test with 40 respondents from communities who were not part of the actual study sample. The obtained data was analyzed using the Cronbach Alpha reliability method. The reliability coefficient for awareness and applicability of renewable energy was 0.77. The data collected for the actual study was analyzed using mean and independent t-test technique and tested at .05 level of significance.

Results and discussion

The results of the study were presented based on the research questions and the hypotheses. Research question one; What is the level of farmers' awareness of renewable energy in Ikom Education Zone? This research question is answered using the calculated mean in table 1

Table 1: Mean and standard deviation score of the level of awareness of renewable energy by farmers in Ikom Education zone. (N=600)

Variable	N	Min	max	Mean	Standard Deviation
Awareness	600	34.00	44.00	39.75	2.83

The result in table 1 shows that, the maximum score for awareness of renewable energy by farmers is 44.00 while the average score is 39.75. This means that the awareness level of farmers in Ikom Education Zone is as high as 90.34%

Research question two; What is the level of farmers' applicability of renewable energy in Ikom Education Zone? This research question is answered using the calculated mean in table 2

Table 2: Mean and standard deviation score of the level of applicability of renewable energy by farmers in Ikom Education zone (N=600)

Variable	N	Min	Max	Mean	Standard Deviation
Applicability	600	11.00	41.00	20.45	8.12

The result in table 2 shows that, the maximum score for applicability by farmers is 41.00 while the average score is 20.45. This means that the applicability level of farmers in Ikom Education Zone is 49.88%.

Research question three;

How does males differ from female farmers in terms of their awareness of renewable energy in Ikom Education Zone? Research question three was transformed to hypothesis one.
There is no significant difference between males and female farmers in terms of their awareness of renewable energy in Ikom Education Zone? Hypothesis one is tested using Independent T-test analysis as shown in table 3

Table 3: Independent t-test analysis of the difference in gender between male and female farmers on their awareness of renewable energy in Ikom Education Zone. (N =600)

Gender	N	Mean	SD	F-value	T-value	Sig
Male	420	40.57	2.32	18.06	12.12	<.001
Female	180	37.83	2.98			

Significant at 0.05 level, df = 2, 598

The result in table 3 shows that, the mean score of males' awareness of renewable energy is 40.57 while that of female farmers is 37.83. The t-value of 12.12 is greater than the acceptable 0.05 significant level. This means that, the F-value of 18.06 is not significant at the 0.05 significant level. Therefore, there is no significant difference between male and females' farmers in their awareness of renewable energy.

Research question

1. How does males differ from female farmers in terms of their applicability of renewable energy in Ikom Education Zone? Research question four was transformed to hypothesis two. There is no significant difference between males and female farmers in terms of their applicability of renewable energy in Ikom Education Zone

Hypothesis four was tested using Independent T-test analysis as shown in table 4.

Table 4: Independent t-test analysis of the difference in gender between male and female farmers on their applicability of renewable energy in Ikom Education Zone. (N =600)

Gender	N	Mean	SD	F-value	T-value	Sig.
Male	420	20.00	8.70			
				12.34	2.08	<.001
Female	180	21.50	6.46			

Significant at 0.05 level, df = 2, 598

The result in table 4 shows that, the mean score of males' applicability of renewable energy is 20.00 while that of female farmers is 21.50. The t-value of 2.079 is greater than the acceptable 0.05 significant level. This means that, the F-value of 12.34 is not significant at the 0.05 level of significance, therefore there is no significant difference between male and females' farmers in their applicability of renewable energy.

Discussion of the findings:

Findings from this study shows that, male and female farmers in Ikom Education Zone do not differ in their level of awareness and applicability of renewable energy. The finding also shows that, farmers in Ikom Education Zone are highly aware of renewable energy but are low in its practical application. This finding is in harmony with Zhang, (2020) that, integration of renewable energy sources into the global energy landscape represents a pivotal and transformative shift from the unsustainable way societies generate, distribute and consume power to an acceptable and sustainable practices. That, increase awareness of environmental concerns coupled with the impacts of climate change, has fast-traced an intensive exploration of renewable energy technologies. This new phase according to Zhang, (2020) is enhanced by gradual farmer's awareness of the negative impacts of conventional fossil fuel-based energy sources on the environment. The finding is also in line with Adewuyi, (2020), that, despite Nigeria being among major exporters of fossil fuels, the country faces significant energy challenges, including power shortages, unreliable electricity supply, and high dependency on imported refined fuels, adding sthat, it seems nothing is being done to ameliorate the situation.

Conclusion:

Farmers are aware of the degrading nature of the use of fossil fuels as a source of energy and the use of renewable energy as a sustainable improvement to energy usage but lack the ability to practice the use of renewable energy especially in their farms. This may be due to initial difficulties of starting a renewable energy plan, initial cost and lack of government incentives.

Recommendations:

Based on the findings and conclusion of the study, the researchers recommend that, there is need to increase farmers education especially in the area of renewable energy. Government incentives and subsides in the provision of renewable energy especially to farmers in the rural area will help to encourage the applicability of renewable energy. By farmers.

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