

OPPORTUNITIES AND CHALLENGES IN THE RENEWABLE ENERGY SOURCES IN FEDERAL CAPITAL TERRITORY, NIGER AND KOGI STATES IN NIGERIA

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Abstract

The purpose of the study was to investigate the challenges and opportunities in the emerging renewable energy sources in Federal Capital Territory (FCT), Niger and Kogi States of Nigeria. Two research questions guided the study. The design used for the study was a survey research design. The simple random sampling technique was used to select a sample for the study which composed of 20 Technical staff from Energy commission of Nigeria who are experts in renewable energy, and 65 lecturers drawn from higher institutions offering Electrical/Electronic technology/engineering in FCT, Niger and Kogi States. The sample was drawn through a simple random sampling technique from a total of four higher institutions (two in Niger, one in Kogi, and one in FCT) and Energy Commission of Nigeria. The instrument for data collection was a structured questionnaire on challenges and opportunities of renewable energy sources which was face validated by three lecturers of electrical/electronic technology in Federal University of Technology, Minna. Data obtained were analyzed using mean, standard deviation, and t-test. The results obtained revealed that renewable energy can generate megawatts of electricity, create thousands of jobs, improve agricultural practices and public health, stimulate industrial development among others. The study also revealed lack of skilled manpower, high cost of investment in renewable energy, inadequate awareness on the potentials or opportunities in renewable energy sources, government's overdependence on non-renewable energy sources such as gas and thermal among others are some of the challenges hindering the exploitation of renewable energy in north-central Nigeria. It was therefore recommended among others that government at various levels should pay more attention to renewable energy sources by allocating more resources to it in their budget.

Keywords: Agriculture, energy, hydro, power, renewable

Introduction

The importance of energy in our everyday life cannot be over-emphasized. For instance, energy is utilized in the agricultural sector for irrigation, food processing and preservation; in the household sector for lighting, heating, refrigeration, and cooking; in the industrial sector for processing raw materials into finished goods; and in the transportation sector to power cars, trucks, trains, airplanes among other uses (Aliyu and Elegba, 1990). Energy contributes enormously to the Gross Domestic Product (GDP) of a nation (Ijeoma, 2012). It is an important contributing feature in developing countries such as Nigeria.

In Nigeria today, most of the energy is from non-renewable sources, namely petroleum, coal, and gas. This has brought about a lot of environmental problems leading to ecosystem degradation. Burning of fossil fuels from generating stations and generating sets in households produce carbon monoxide which pollutes the environment and contributes to global warming (Sesan, 2008). Sulfur dioxide is also produced from burning of these fossil fuels, and this causes acid rain which greatly affects the soil and vegetation (Ijeoma, 2012). Consequent upon this, renewable energy sources has become a viable option for this country. Renewable energy according to Basil (2008) is any energy resource that is naturally regenerated over a short term scale and derived directly from the sun (such as thermal, photochemical and photoelectric), indirectly from the sun (such as wind, hydropower and photosynthetic energy stored in biomass) or from other natural movements and mechanisms of the environment such as geothermal and tidal energy (West, 2013). According to Awogbemi and Komolafe (2011), renewable energy sources are the energy sources that can be replenished or recreated when they are used. They are generally less-polluting and cannot be exhausted. This implies that renewable energy sources are environmental friendly and available, and that they produce little or no negative effect on the ecosystem. Sesan (2008) explained that renewable energy sources, in contrast to fossil fuels, are environmentally friendly, ubiquitous, self-replenishing, infinite, and consequently considered world-wide as the way of the future.

Solar energy as a renewable energy source is obtained from the sun which releases an amazing amount of energy due to the nuclear fusion of hydrogen taking place within its core (Sesan, 2008). Solar panels, called photovoltaic cells are used to convert the Sun's energy into electricity. He further stated that solar radiation is abundant in Nigeria, but the exact exploitable solar resource base currently available in the country is not known. Uzoma *et al* (2011) further stressed that if solar collectors or modules were used to cover 1% of Nigeria's land area, it is possible to generate 1850×10^3 GWh of solar electricity per year; this is over one hundred times the current electricity grid consumption level in the country (Best, 1997). This implies that Nigeria is endowed with abundant sun energy which only needs to be exploited for use as electricity.

Hydropower on the other hand is generated from running water. Dams are built across a lake or river in a valley to trap water. The water flows through tunnels and turns the turbines which produces electricity. Nigeria has an abundant supply of rainfall, dams, rivers and streams distributed all over the country. Sesan (2008) identified that about 30 percent of the nation's grid-connected electricity is generated from large hydropower stations. This utilization represents only 14 percent of the country's total exploitable hydro potential, leaving an untapped 86 percent. According to Aliyu and Elegba (1990), Nigeria possesses potential renewable source of energy along her numerous river systems, a total of 70 micro dams, 126 mini dam and 86 small sites have been identified. All of these sources are left unexploited leading to wastage of abundant resources.

Biomass energy or bio-energy refers to energy derived from the conversion of biomass into liquid or gaseous fuel. Biomass sources generally include wood, charcoal, animal dung, leaves, straw, agricultural residues, sawmill residues and dedicated crops. Ijeoma (2012)

explained that biomass resources of Nigeria can be identified as crops, forage grasses and shrubs, animal wastes and waste arising from forestry, agriculture, municipal and industrial activities, as well as, aquatic biomass. It is estimated that Nigeria can potentially produce about 6.8 million m³ of biogas every day from animal waste only (Nadabo, 2010). This and other biomass resources when exploited and utilized could reduce the power problems faced by small industries.

Other renewable energy sources such as biomass, biogas, wind, water waves, and geothermal have a great potential in Nigeria. Wind energy for instance is available at annual average speeds of about 2.0 m/s at the coastal region and 4.0 m/s at the far northern region of the country (Nadabo, 2010). Study has shown that total exploitable wind energy reserve at 10m height may vary from 8MWh/yr in Yola, Adamawa State to 51MWh/yr in the mountainous areas of Jos, Plateau State and it is as high as 97MWh/yr in Sokoto, Sokoto State (Nadabo, 2010). These are few among the enormous wind energy potentials in Northern Nigeria which when properly exploited will help in reducing the erratic power problem being experienced in Nigeria.

Despite the recognition that renewable energy is an important source of energy in Nigeria, it has attracted neither the reasonable level of investment nor tangible policy commitment (Basil, 2008). Although the Federal and State governments have allocated some incentives for the purpose of exploiting some Renewable Energy sources, the total amount is still insignificant compared to the amount allocated to the conventional energy sector that service less than half of the population. Based on the foregoing, it may be that lack of exploitation of renewable energy in Nigeria is due to some challenges which may have hindered the development of renewable energy sources in Nigeria.

Although renewable energy sources may have been found to be of great importance in solving the problem of power supply experienced around the globe, much have not been done by the government and private organizations to exploit these rich energy sources in Nigeria especially in FCT, Niger and Kogi States located in North-Central part of the country. The study therefore sought to investigate the Challenges and Opportunities in the emerging renewable energy sources in FCT, Niger and Kogi States.

Research Questions

The following research questions guided the study:

- (i) What are the opportunities available in renewable energy sources in FCT, Niger and Kogi States?
- (ii) What are the challenges hindering the exploitation of renewable energy sources in FCT, Niger and Kogi States?

Research Hypothesis

The following null hypothesis was formulated and tested at 0.05 level of significance:

Ho₁ There is no significant difference in the mean responses of Electrical/Electronic lecturers and Renewable energy experts on the opportunities available in renewable energy sources in FCT, Niger and Kogi States

Research Methods

The method of the study is that of survey research. Survey research according to Best (1997) involves assessing behaviors, preferences, perceptions, and opinion of a sample. The study was carried out in north-central States of Niger, Kogi, and FCT, Nigeria. The population of the study consists of 65 lecturers of electrical and electronics in higher institutions where electrical and electronic technology/engineering is offered in Niger, Kogi, and FCT; and 20 technical staff of Energy Commission of Nigeria (ECN), Abuja. The population distribution is as follows; 25 electrical and electronics engineering/technology lecturers in Federal University of Technology, Minna in Niger State, 10 electrical engineering lecturers of Federal Polytechnic Bida in Niger State, 10 lecturers of electrical engineering of Kogi State University, 20 lecturers of electrical engineering in University of Abuja, and 20 technical staff of Energy Commission of Nigeria (ECN) Abuja. Data were collected using a 30-items questionnaire designed to understand the challenges and opportunities of renewable energy sources in Nigeria. The questionnaire was made up of two (2) sections A and B, with Section A containing personal data of the respondent and Section B which was also divided into two sub-sections. The questionnaire was structured using a four point rating scale of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). These ratings have weights of 4, 3, 2, and 1 beginning from the highest to the lowest respectively. Data collected for the study were analyzed using mean and standard deviation. An inferential statistics t-test was also used to test the hypothesis at 0.05 level of significance to compare the mean responses of the two groups. A mean of 2.50 and above was considered agreed (A) while responses with mean below 2.50 were considered disagreed (D).

Results

The response of the various electrical/electronic lecturers and renewable energy experts concerning the abundant renewable energy source within the study area is presented in Table 1.

Table 1: Mean Responses of electrical/electronic lecturers and renewable energy experts on the opportunities available in renewable energy sources in FCT, Niger and KogiStates

S/N	ITEMS	Electrical/electronic Lecturers			Renewable energy experts		
		X	SD	DEC	X	SD	DEC
1	Renewable energy can generate megawatts of electricity	3.39	0.49	A	3.70	0.46	A
2	Renewable energy are more reliable sources of energy than conventional sources	3.61	0.49	A	3.43	0.50	A
3	Renewable energy has the potential to create thousands of jobs in FCT, Niger and KogiStates	3.46	0.49	A	3.53	0.50	A
4	Renewable energy has the potential to improve sustainable economic development in FCT, Niger and KogiStates.	3.32	0.47	A	3.37	0.44	A

5	Renewable energy technologies can improve agricultural practices in FCT, Niger and KogiStates	3.25	0.44	A	3.47	0.50	A
6	Renewable energy has the potential to reduce the cost of electricity generation across the country	3.46	0.50	A	3.70	0.46	A
7	Renewable energy has lower environmental impart than conventional energy technologies	3.51	0.50	A	3.57	0.49	A
8	Renewable energy can stimulate industrial development in FCT, Niger and KogiStates	3.23	0.42	A	3.27	0.44	A
9	Renewable energy can improve public health	3.40	0.49	A	3.30	0.46	A
10	Renewable energy can generate electricity with little or no global warming emissions	3.34	0.48	A	3.27	0.44	A
11	Renewable energy can generate electricity with little cost compared to conventional sources	3.41	0.49	A	3.40	0.49	A
12	Renewable energy can reduce the cost of residential and industrial electricity tariff	3.15	0.36	A	3.43	0.50	A
13	Renewable energy has the potential of eradicating the erratic power problem in FCT, Niger and KogiStates.	3.39	0.49	A	3.27	0.44	A
14	Renewable energy can improve the standard of living in FCT, Niger and KogiStates	3.23	0.42	A	3.53	0.50	A
15	Renewable energy can reduce overdependence on oil and gas as a source of energy in Nigeria	3.46	0.50	A	3.70	0.46	A
	GRAND MEAN & STANDARD DEVIATION	3.38	0.47	A	3.69	0.47	A

Key: \bar{X} = mean, SD= Standard Deviation

The response of the various electrical/electronic lecturers and renewable energy experts concerning the challenges hindering the exploitation of renewable energy sources in FCT, Niger and KogiStates are presented in Table 2.

Table 2: Mean Responses of electrical/electronic lecturers and renewable energy experts on the challenges hindering the exploitation of renewable energy sources in FCT, Niger and KogiStates

S/N	ITEMS	Electrical/electronic Lecturers			Renewable energy Experts		
		\bar{X}	SD	DEC	\bar{X}	SD	DEC
1	Lack of skilled manpower to exploit renewable energy	3.86	0.35	A	3.93	0.24	A
2	Inadequate or Lack of financing and other fiscal incentives by the government for renewable energy uptake	3.22	0.41	A	3.13	0.35	A
3	Lack of indigenous manufacturing capabilities	3.15	0.36	A	3.43	0.50	A
4	Lack of policy and institutional framework to encourage local and foreign investment	3.30	0.46	A	3.47	0.50	A
5	High cost of investment in renewable energy	3.75	0.44	A	3.70	0.46	A
6	High initial capital cost of installation	3.11	0.32	A	3.17	0.37	A
7	Inadequate policy implementation	3.09	0.28	A	3.33	0.47	A
8	Lack of established standard and quality control systems of both locally and imported manufactured technologies	2.31	0.65	D	2.50	0.96	A
9	Inadequate awareness on the potentials or opportunities in renewable energy sources	3.11	0.32	A	3.20	0.40	A
10	Government's overdependence on non-renewable energy sources such as gas and thermal.	3.22	0.41	A	3.70	0.46	A
11	Lack of public understanding on the importance of renewable energy	3.11	0.32	A	3.37	0.51	A
12	High cost of renewable energy materials and technologies	2.78	0.41	A	2.63	0.48	A
13	Lack of financial support for renewable energy projects	3.15	0.36	A	3.47	0.50	A
14	Lack of government understanding of the opportunities in Renewable energy	3.30	0.46	A	3.20	0.40	A
15	Lack of co-ordination and linkage in Renewable energy programmes	2.78	0.41	A	3.33	0.47	A
GRAND MEAN& STANDARD DEVIATION		3.15	0.39	A	3.31	0.48	A

Key: \bar{X} = mean, SD= Standard Deviation

Hypothesis

There is no significant difference in the mean responses of Electrical/Electronic lecturers and Renewable energy experts on the opportunities available in renewable energy sources in FCT, Niger and KogiStates

The response of the various electrical/electronic lecturers and renewable energy experts on the opportunities available in renewable energy sources in FCT, Niger and KogiStates presented on t-test in Table 3.

Table 3: t-test analysis of mean responses of Electrical/Electronic lecturers and Renewable energy experts on the opportunities available in renewable energy sources in FCT, Niger and KogiStates

Status of Respondents	N	\bar{X}	SD	DF	t-cal	Decision
Electrical/Electronic Lecturers	140	3.38	0.47	168	-0.91	Not Significant
Renewable Energy Experts	30	3.69	0.47			

Discussion

Table 1 presents the various abundant renewable energy source within the study area of FCT, Niger and KogiStates and also indicate the enormous renewable energy opportunities available in FCT, Niger and KogiStates. Findings show that renewable energy can generate megawatts of electricity, create thousands of jobs, improve agricultural practices, improve public health, reduce the cost of domestic and industrial electricity tariff, eradicate the problem of power supply and stimulate industrial development in north-central area of Nigeria. This is not surprising giving the abundant and unexploited renewable energy sources available in Nigeria especially in northern Nigeria. Sesan (2008) stressed that Nigeria is endowed with significant and abundant quantities of each of renewable energy sources such as solar photovoltaic, solar thermal, wind, small hydropower and biomass. Furthermore, given the present problem of employment generation in Nigeria, adequate exploitation of renewable energy sources in the country can lead to increase in renewable energy projects which will in turn generate more employment opportunities. In addition, improvement in power supply as a result of investment in renewable energy may also enhance agricultural and health practices in the country.

The results from Table 2 reveal that the respondents agreed with all the items regarding the challenges hindering the exploitation of renewable energy sources in FCT, Niger and KogiStates and the findings revealed the challenges hindering the exploitation of renewable energy sources in north-central Nigeria. Some of these challenges include lack of skilled manpower, inadequate or lack of financing and other fiscal incentives by the government for renewable energy uptake, lack of indigenous manufacturing capabilities, and lack of policy and institutional framework to encourage local and foreign investment. Others include high cost of investment in renewable energy, inadequate awareness on the potentials or opportunities in renewable energy sources, government's overdependence on non-renewable energy sources such as gas and fuel among others. Consequently, it is noted that there is enormous renewable energy resource potential in Nigeria, but current use of renewable energy is quite low due to these challenges that are militating against the implementation of renewable energy exploitation projects in the country. For instance, Ijeoma (2012) stressed that the success of Renewable Energy technologies has been limited

by a combination of factors or challenges such as lack of manpower and appropriate policy framework. Similarly, Awogbemi and Komolafe (2011) mentioned that Nigeria is endowed with renewable energy sources but they are still not being exploited due to some challenges which are partly to ignorance and partly to high cost of the conversion technologies involved. Furthermore, Nadabo (2010) explained that despite the abundant resources of renewable energy in Nigeria there are quite a lot of factors that affect and hinder the use of renewable energy sources in Nigeria; these have made the use of renewable energy in Nigeria to be stagnant. Therefore, there is need for government and stakeholders in the energy sector to curb these challenges in order to make renewable energy to be exploitable thereby solving the erratic power problem experienced in the country especially in north-central Nigeria.

The analysis in Table 3 reveals that the t-cal value is less than the t-Table value. Therefore, the null hypothesis was accepted regarding the opportunities available in renewable energy sources in FCT, Niger and KogiStates. Findings of the hypothesis show that there is no significant difference in the mean ratings of the respondents regarding the opportunities available in renewable energy sources in FCT, Niger and KogiStates. This means that the respondents share the same opinion on the opportunities available in renewable energy sources in FCT, Niger and KogiStates in North-Central Nigeria.

Conclusions

Based on the findings of the study, it is concluded that there are opportunities that abound in renewable energy sources in FCT, Niger and KogiStates in North-central Nigeria. Renewable energy have the potential of generating megawatts of electricity, creating thousands of jobs, improving sustainable economic development, reducing the cost of electricity in North-central Nigeria and the country as a whole. Despite these opportunities that abound in renewable energy, renewable energy sources exploitation is still challenged by lack of skilled man power, lack of financial and other fiscal incentives by the government for renewable energy projects uptake, high cost of investment in renewable energy, high initial capital cost of installation among others. Nevertheless, if the available renewable energy sources in north-central Nigeria are fully exploited, the region will be able to meet her energy needs and power failure will become a thing of the past.

Recommendations

Based on the findings of the study, the following recommendations were made:

- (i) Government at various levels should provide adequate policy framework and enabling environment for renewable energy to flourish in Nigeria.
- (ii) Private sector should be encouraged by the government to invest and engage in the development of renewable energy.
- (iii) Universities and other research institutions should be provided with adequate fund to carry out more researches on suitable conversion technologies for the country.
- (iv) Government should partner with international organizations like International Monetary Fund (IMF) and World Bank to help finance some of the Renewable Energy Projects.

References

- Aliyu, U. O. & Elegba, S. B. (1990). prospects for small hydropower development for rural applications in Nigeria. *Nigerian Journal of Renewable Energy*, 1, 74-86.
- Awogbemi, O. & Komolafe. C. A. (2011). Potential for sustainable renewable energy development in Nigeria. *Pacific Journal of Science and Technology*, 12(1), 161-169.
- Basil, S. (2008). *Opportunities in renewable energy*. Retrieved on 1st June, 2013 from www.treia.org
- Best, J. W. (1997). *Research in education*. New Jersey: Prentice Hall.
- Ijeoma, V. A. (2012). *Renewable energy potentials in Nigeria*. Portugal: Conference Proceeding at 32nd Annual Meeting of the International Association for Impact Assessment.
- Nadabo, S. L. (2010). *Renewable energy as a solution to nigerian energy crisis*. Final Research Thesis at University of Applied Science Vaasan. (Unpublished M. Sc. Thesis).
- Sesan, T. (2008). *Status of renewable energy policy and implementation in Nigeria*. University of Nottingham, United Kingdom (Unpublished M. Sc. Thesis).
- Uzoma, C. C., Nnaji, C. E., Ibeto, C. N., Okpara, C. G., Nwoke, O.O., Obi, I.O. Unachukwu, G. O. & Oparaku, O. U. (2011). Renewable energy penetration in Nigeria: A study of the South-East zone. *Continental Journal of Environmental Sciences*, 5(1), 1 – 5.
- West, L. (2013). *Top seven renewable energy sources*. Retrieved from www.environment.about.com on 20th June, 2013.