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Adaptation of Solar Photovoltaic Technology in Bache State, Nigeria: Problems and Prospects

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Abstract: *Rapid technological advancement in the economically quick growing countries such as India, China Malaysia and their contemporaries are indeed beyond reasonable doubt related to their efficient and reliable sources of electricity. Nigeria, popularly called "the giant of Africa" has for decades strived to meet its power demand through various development plans, but all ended to no avail. The enduring and pandemic power scarcity in Nigeria has on the other hand annoyed and forcibly prompted its citizens to opt for gasoline generators which are usually imported from the aforementioned countries. Besides the cost of fuelling and maintenance, these generators are proven to be the cause of many noxious causalities, unplanned deaths and air pollution. The active hydro-power stations that are available in the country presently can no longer satisfy its gigantic power need. In pursuit to meet the demand in view, Nigeria must voraciously go for alternatives from the horizon of power sources. From amongst these, solar energy has appeared to be highly affordable and more promising. However, solar technology is gaining patronage in the country, the innovators and manufacturers of this technology should ardently need to know how their innovation impacts on the lives of the users. Reports of this type of influence should definitely guide and direct the manufacturers in improving the quality of their products and also boost their competition in the international markets. This research aimed at finding out the adaptation of solar technology in Nigeria and how it impacts on the lives of its citizens. The study was a descriptive survey which collected qualitative data from 40 respondents through structured questionnaire tagged "Adaptation of Solar Energy Technology Questionnaire" (ASETQ). The data collected was analyzed by SPSS version 20 to determine the mean and standard deviation of the responses. From the analysis, it was found that the solar technology has a direct bearing to Nigerians' leisure and comfort. Though, they recognized the technology as panacea to the incessant power failure, the cost and economy has actually thrashed the more possibilities of solar equipment ownership. In addition, the technology was found to relate to safer environment, vaccines preservation, improving computer studies, invigorating irrigation and to greater extent boosting rural water supply. Based on the findings made, some recommendations were therefore given; cost of solar equipment should be reduced, soft loans for the purchase of the solar equipment to be made easily accessible and a course of study "solar technology" to be introduced in Nigeria's secondary and tertiary institutions of learning are among others.*

Key words: *Solar technology, alternative energy, innovation*

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I. Introduction

The United Nations Sustainable Development Goal 7 may remain illusory unless all the teething impediments to its achievement are absolutely eradicated with all possible forces or else 40 % of the world population will continue to be using archaic way generating energy and consequently expose themselves to pollution related diseases (Wu, 2015). To facilitate the achievement of this goal therefore, international communities should cooperate and endeavor through all tenable ways to make sure that the clean and renewable energy resources are affordable to all and sundry. (United Nations Development Programmed, 2017). Clean and renewable energy according to Agbongiarhuoyi (2017) is that natural endowment that comes from the sources which spontaneously replenish themselves on human timescale. Specifically, these endowments are sunlight, wind, rain, tides, wave and geothermal heat (Sambo & Bala, 2017). From this description, it appears that such types of energy are cost effective in entirety and seemingly suitable for African continent as a result of their abundance and variety. In spite of these opportunities, the continent cannot tap and harness the treasures earnestly due to some hindrances which according to Sambo and Bala (2012) include technical know-how, corruption, awareness and others Among the energy innovations so far, solar photovoltaic technology turns to gain greater recognition and integration into electricity policies of many nations (World Energy Council, 2012). Despite the fact that solar energy technology is valuable today, its level of exploitation is globally less than 1 %. In this manner generally, Germany is in the lead then followed by China, Japan, Italy and USA respectively

(World Energy Council, 2012). Three technologies are adopted today for harnessing solar energy; solar photovoltaic (PV), concentrated solar power (CSP) and solar water heating system (Danish, 2014). PV in its own way operates when silicon cells in the panel trap sunlight, convert them and create electric field through thin layer which thereafter elicit electricity to flows. CSP in their respective mode uses multi-junction cells and concentrated lenses instead of silicon cells in the generation of electric current (Solar Energy Technology Office, 2013).

The Federal Government of Nigeria's initiative to boost local business and attract international investment may not be successful with present power capacity of 7,000 MW. To achieve the said target actually, the capacity of the power generation should be expanded to around 50 MW (Premium Times, 2016). In pursuit to this, The Nigeria's Honourable Minister of Power, Works and Housing Mr. Babatunde Fashola has disclosed the roadmap for attainment of sufficient and reliable power supply as follows; 3,050 MW-hydro, 1,200 MW-coal combustion, 380MW- solar and10MW-windmill (Premium Times, 2017). Though, this is a giant step for fixing nation's power problem, but, sustainability of such developments occasionally suffers deliberate sabotages such as rampages and wrecks by agitators, thefts and to some extent, crisis related ethno- religious origin (This Day, 2016).

In spite of above development, the nation is yet endowed with adequate sunlight which when prudently harnessed will satisfy its power demands and hopefully align it across the ways towards achieving Sustainable Development Goals by 2030 (This Day, 2016) In connection to this, Sambo and Bala (2012) reported that, Nigeria can produce 600,000 MW through solar technology by giving up only 1 % of its land mass. By interpretation, the country has all what to take it to be power sufficiency if effective planning policies and enough funding will be put at a right place. Further, Akinbora, Adejumobi, and Makinde (2012) explain that Nigeria is strategically positioned on sunlight latitude with total annual mean sunshine of $3.5kwhm^{-2}day^{-1}$ at the sea shore to about $7kwhm^{-2}day^{-1}$ along the desert fringes in the far North.

Inability of the country to diversify its power generation through alternative sources will be like dragging itself to the knee in terms of economic development. The current population of Nigeria is about 182 million (National Population Commission, 2017) and close to 70 % out of this colossal number live in rural and sub-rural areas most of which are not connected to national grid. (Akinbora, Adejumobi, & Makinde, 2012). The consequence of this scenario is total dependence on biomass as source of energy and also purchase of gasoline generators. Smokes from biomass combustion and generators are indeed serious threat to environmental degradation and health well-being (Sambo & Bala, 2012). In another vein, the cost of purchasing, fuelling and maintenance of such generators as a result of inadequate power supply costs the country about 1.56 trillion naira in addition to the countless causality related to its operation (Boda, 2011). Today, people are significantly turning to the use of PV for the purpose of complementing and supplementing the perennial power gap. Perhaps, this patronage could be connected to many benefits attached to PV efficiency. In is against this background that this study aimed to investigate adaptation of solar PV technology in relation to its value and problems in Bauchi State, Nigeria.

Purpose of the Study

main purpose of this study was to investigate the adaptation of solar photovoltaic technology in Bauchi State, Nigeria: Prospect and problems. Specifically, it sought to find:

1. People's view about the relevance of solar PV technology to their well-being.
2. People's view about the value they attached to solar PV technology.
3. People's view about the impact of solar PV technology on environment.

Research Questions

Three research questions were formulated to guide the research. They are as follows:

1. What is the people's view about the relevance of solar PV technology to their well-being
2. What is the people's view about the value they attached to solar PV technology
3. What is the people's view about the impact of solar PV technology on environment

II. Methodology

The design of the study was descriptive survey which was carried out in Bauchi State, Nigeria. The sample size comprised of 37 respondents which were drawn through systematic random sampling at the area of study. The instrument for data collection was 27- item Adaptation of Solar Photovoltaic Technology Questionnaire (ASPTQ). The data collected was analyzed by using SPSS Version 20 to determine mean and standard deviation of each item in the questionnaire. The decision point for considering a response to an item as either positive or negative was 2.50.

Table 1: Respondents' View on the Adaptation Solar PV Technology

S/N	Item Description	Mean	Standard deviation	Decision
	Relevance to Comfort/Leisure			
1.	Solar energy is used in lighting homes.	3.41	0.96	Positive
2.	Solar energy is used in watching TVs.	2.50	1.35	Positive
3.	Solar energy is used in listening music.	3.00	1.23	Positive
4.	Solar energy is used in boiling water.	2.05	1.29	Negative
5.	Solar energy is used in preserving food items.	1.97	1.32	Negative
	Affordability			
6.	Solar equipment are expensive.	3.46	0.90	Positive
7.	Solar spare parts are available in the local market.	1.91	1.16	Negative
8.	Solar equipment are cheap in local markets.	1.68	1.18	Negative
9.	Solar equipment are not available in local markets.	2.40	1.38	Negative
10.	Installation of solar equipment is too expensive	3.16	1.61	Positive
	Encouragement			
11.	Government encourages me to install of solar set.	2.14	1.20	Negative
12.	Colleagues encourage me to install solar equipment	2.30	1.37	Negative
13.	I am encouraged to install solar for its efficiency.	2.40	1.62	Negative
14.	I am encouraged to install solar for its low price	2.10	1.21	Negative
15.	Less money is spent in maintenance of solar equipment	2.00	1.31	Negative
	Dependability			
16.	I am saved from paying high power bill through solar	2.49	1.46	Negative
17.	Solar equipment are less hazardous	2.40	1.54	Negative
18.	I am saved from frequent power failure through solar	2.70	1.26	Positive
19.	Solar equipment don't pose problems always	2.83	1.36	Positive
	Environmentally Friendly			
20.	Solar installations are noise free.	3.02	1.24	Positive
21.	Solar installation are smoke free	2.95	1.15	Positive
22.	Solar installations are always tidy.	2.73	1.38	Positive
	Impact on Life			
23	Solar equipment are used in vaccine preservation	2.43	1.57	Negative
24.	Solar equipment enhance irrigation	2.84	1.36	Positive
25.	Solar equipment improve computer studies.	3.11	1.13	Positive
26.	Solar equipment boost rural water supply	3.08	1,12	Positive
27.	Solar equipment improve security	1.32	1.49	Negative

Table 1 shows mean and standard deviation for all the items in each dimension of ASPTQ. Though, the respondents' view about PV technology was generally favourable, it was observed that they were not positively encouraged with the way government and the general community attached worth to the PV technology. The mean and standard values for all the items ranged from1.68 to 3.46 and 1.03 to 0.90 respectively.

Table 2: Mean and Standard Deviation of the Respondents' view on the Adaptation of Solar PV Technology

S/N	Dimension	Mean	Standard Deviation	Deviation
1.	Relevance to Leisure/Comfort	2.51	1.23	Positive
2.	Affordability	2.52	1.12	Positive
3.	Encouragement	2.18	1.13	Negative
4.	Dependability	2.61	1.41	Positive
5.	Environmentally Friendly	2.90	1.25	Positive
6.	Impact on life	2.79	1.35	Positive

Table 2 presents the mean and standard deviation of all the dimensions of ASPTQ. From the table, it is observed that the dimension "Environmentally Friendly" bear the highest mean then followed by Impact of live, Dependability, Affordability and Relevance to Leisure/Comfort respectively

III. Discussion

Solar photovoltaic energy today gains patronage in many parts of the world. The process of generating this type of energy is absolutely clean, noise less and friendly. Widespread of solar energy technology across the globe will enormously facilitate the attainment of SDGs – 7 in a very near feature. As a result of this, our remaining forest treasures will be salvaged from the unnecessary biomass exploitation, in addition to saving millions of life that are lost annually from primitive generation of energy (Wu, 2012).Climate change as a result of human activities has of course risen the global overall temperature. The effect of this anomaly is as a matter of fact is most severely felt in tropical countries such as Nigeria. Since, the nature of power supply in most developing countries is not steady and a large portion of their localities are not connected to national grid, the situation is indeed unbearable. With advent and wide spread of solar technology, the life of many people will very soon be transformed to comfort especially after strenuous day work (Eronini, 2014). The benefits of solar

technology today is crossing beyond the circle of comfort to business enterprise, health, education, irrigation, security and folds (Ohunakin, Adaramola, Oyewola & Fagbenle, 2014)

IV. Conclusion

From the data analysis, it was found that the people of Bauchi State, Nigeria have positive view about the adaption of solar photovoltaic technology.

V. Recommendations

Based on the result found from the data analysis, the following recommendations are therefore are given:

1. Owners of small scale entrepreneurships should be encouraged to install PV facilities to boost their business.
2. People should be encouraged to have solar PV facilities through soft loan.
3. A course of study "Solar Technology" should be introduced in Nigeria's secondary and tertiary institution of learning.
4. Government and able citizens should invest immensely into solar technology enterprise.
5. Citizens should be trained on the skills of instillation and servicing solar facilities

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