Utilization of Solar Power by Rural Households in Ikole Local Government Area of Ekiti State, Nigeria

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Received: 28-SEP-2023; Reviewed: 17-OCT-2023; Accepted: 07-NOV-2023
http://doi.org/10.46792/fuoyejet.v8i4.1114

ORIGINAL RESEARCH

Abstract - The study investigated solar power utilization amongst rural households in Ikole Local Government Area, Ekiti State. Specifically, it investigated the level of awareness; evaluated perception towards solar power, and identified the constraints to solar power utilization. A two-stage sampling procedure was used. The first stage involved a random selection of six rural communities. Twenty rural household heads were selected from the rural communities making one hundred and twenty respondents in the second stage. Awareness of usage of solar power to charge phones (90.8 %) and for household for lightening (90 %) ranked 1st and 2nd while the utilization of solar power for charging of phones (mean = 4.81), lightening of the house (mean = 4.58), lightening of the shop/office facilities (mean = 3.91), ranked 1st, 2nd and 3rd respectively. The respondents had a positive perception towards solar power utilization in terms of its reliability (x = 4.76), saving fuel costs (x = 4.76) and no payment for electricity bills (x=4.72) among others. 'Requires sunny weather to work best' (mean= 4.70) and 'It is not reliable in raining season' (mean = 4.29) were the strongest constraints to its utilization. A significant relationship existed between perception about solar power and utilization of the same at $p \leq 0.05$. Solar power is moderately utilized among rural dwellers to enhance their living standard. It is recommended that Government, NGOs, and other stakeholders should provide solar powered lightening infrastructures for public utility and also make it inexpensive for to low-income rural dwellers through subsidized, instalment payments.

Keywords- Energy, perception, power, solar, rural

1 INTRODUCTION

Increasing urban and rural population has created a demand that is beyond supply for power and as a result a good number of suburban and rural areas are not even connected to the national grid. The use and utilization of solar power could be a panacea to ameliorating this deficit. (Mohammed et al., 2013). Shaaban and Petinrin (2014), also affirmed that the country is suffering from high shortage of power and that solar power can be of importance in solving this problem and in improving the lives of residents of rural and suburban areas.

Baurzhan and Jenkins (2016); and Monyei et al. (2017), reported that out of about 1.2 billion people living without access to stable electricity, 50 per cent of them reside in Sub-saharan Africa. Nigeria, the giant of Africa has about 100 million citizens living without access to stable source of power (Akinyele *et al.,* 2017; Yakubu & Ifeanyi-Nwaoha, 2017). The provision of essential services and infrastructure in the urban and suburban areas for human needs like water supply, health facilities, cooking, communication requires energy supply. The rural population especially require energy for improvement of rural life and for food security through irrigation, agro-processing, fertilization, irrigation and land preparation. (FAO, 2016).

Fundamental to the development and growth of a nation's economy is its power supply. Therefore, energy supply is of paramount importance in sustaining the wheel of technological development of a nation Ayodele and Ogunjuyigbe (2015); Rafindad (2016), and Akuru et al. (2017) established that a consistent power supply is an essential requirement for economic development, creation of job, poverty reduction, industrialization, manufacturing, commerce, infrastructural development and security. Anumaka (2012) stated that power is playing a great role in the world of our time as its developmental growth depends largely on abundant energy.

The utilization of solar energy has become an increasing phenomenon in Nigeria over the years. This becomes essential and unavoidable because of the inconsistent and epileptic nature of electric power supply from other non-renewable sources. Aside from the age long use of solar energy for sun drying of agricultural produce, solar power has found other important uses over the years in many parts of the nation. Solar power has to do with the translation of the energy of the sun into electricity using photovoltaics cell (PVC) directly or by the use of concentrated solar power, or a fusion or merger of the two. Photovoltaic cells through photovoltaic effect are capable of translating light into electric current. The Photovoltaic system is a technology that is acknowledged by the Food and Agriculture Organisation, FAO, as one that is meeting the needs of the world at household levels and is also making a great impact in generating income and enhancing agricultural productivity (FAO, 2016).

Some of the places where solar PV have been used include households, agricultural productivity, off-farm productive uses (rural and cottage industry, commercial services and small business development), social and community services, and other productive activities,

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Section A- AGRICULTURAL ENGINEERING & RELATED SCIENCES
Can be cited as:
Ajala A. O., Alabi O. O., Adebimpe T. A., and Ademola R. O. (2023). "Utilization of solar power by rural households in Ikole local government area of Ekiti state, Nigeria", FUOYE Journal of Engineering and Technology (FUOYEJET), 8(4), 415-419. http://doi.org/10.46792/fuoyejet.v8i4.1114

namely: billboards/advertising etc. Solar energy is known as one of the most useful choices among the renewable energy sources. It is pollution free, abounding, and free (Fang and Song, 2018). Consequent upon this, this study examined the awareness of solar power among rural households; evaluated the rural household perception towards solar power; assessed the level of utilization of solar power and identified the constraints to solar power utilization among rural households. The hypothesis of this study is as follows:

H_{o1}: There is no significant relationship between the perception of rural household heads towards solar power and its utilization.

2 METHODOLOGY

2.1 STUDY AREA

The study was carried out in Ikole Local Government area (LGA) in Ekiti State, Nigeria. It has 16 communities and is the third largest of the sixteen LGAs in the state. Its coordinates are 7°40′N5°15′E. All rural households in the LGA are the population of the study.

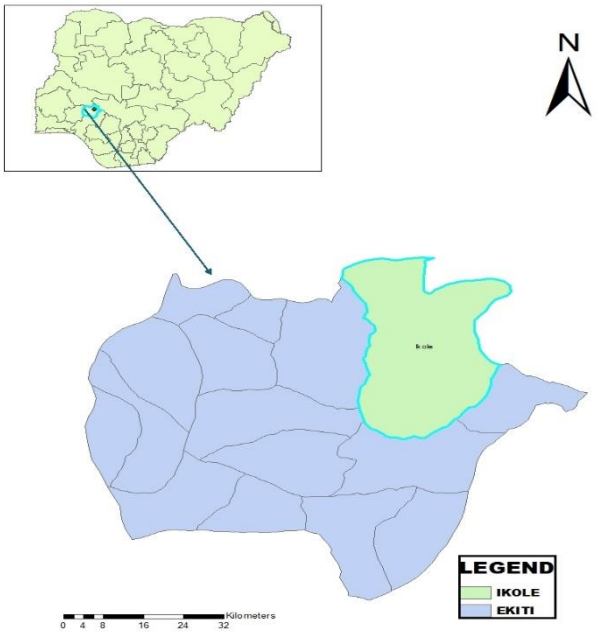

Fig. 1: Map of Ekiti State showing Ikole Local Government Area

2.2 SAMPLE SELECTION

The first of a two-stage sampling procedure involved a random selection of six rural communities from the LGA based on their level of rurality. Twenty rural households from the rural communities were selected in the second stage, making one hundred and twenty respondents. Data collection was done through structured interview schedule and questionnaire. The dependent variable of the study was utilization of solar power. The respondents were given a list of statements of usage and were asked to indicate their level of utilization appropriately as; highly utilized 5, moderately utilized 4, utilized 3, partially utilized, 2 and not utilized 1 point. The total score was categorized into three: high, low and medium and 3.0 was the decision mean.

3 RESULT AND DISCUSSION

3.1 THE LEVEL OF AWARENESS OF THE USE OF SOLAR POWER IN RURAL HOUSEHOLDS

Table 1 shows all the respondents in the study area were aware that solar power can be used to charge phones and can be used for lightening of the house while 90.8 and 90 per cent of the respondents were aware that solar power can be used to power electrical appliances and for lightening of shop/office facility respectively ranking 3rd and 4th. Also, street lightening (90%), lightening of pen (79.2.0%), pumping of borehole (77.5%), refrigeration of farm produce (62.5%) ranking 5th, 6th, and 7th respectively. Klepacka *et al*, (2018) and Nwalule and Mzuza (2022) reported a high level of awareness of solar power among rural households.

Table 1. Distribution of respondents according to awareness of the uses of solar power.

S/N	Uses	Awareness %	Frequency	Unaware %	Frequency	Rank
1	For charging phone.	100.0%	120	0.0%	0	1st
2	For lightening of the house.	100.0%	120	0.0%	0	2nd
3	To power electrical appliances.	90.8%	109	9.2%	11	3rd
4	For lightening of the shop/ office facility.	90.0%	108	10.0%	12	3rd
5	For street lightening.	90.0%	108	10.0%	12	5th
6	For lightening of the pen.	79.2.0%	95	20.8%	25	6th
7	To pump borehole water.	77.5%	93	22.5%	27	7th

Source: Field survey, 2022.

3.2 LEVEL OF UTILIZATION OF SOLAR POWER

Data in Table 2 revealed the utilization of solar power by rural household as follows: for charging of phones (mean = 4.81), refrigerating vaccines in rural health care systems (mean = 4.70), lightening of the house (mean = 4.58), lightening of the shop/office facilities (mean = 3.91), ranking 1st, 2nd 3rd and 4th respectively. The result showed that solar power is moderately utilized in the study area. This is in agreement with Oyedepo (2014) that solar power makes business premises more identified at night and reduces crime rate in Nigerian rural areas and with the studies of Haque *et al.* (2013) who reported that solar power is a good substitute for kerosene in Bangladesh and that of Nwalule and Mzuza (2022) also reported that 52 percent of the respondents in their study area in Malawi used solar power for lighting.

http://doi.org/10.46792/fuoyejet.v8i4.1114 http://journal.engineering.fuoye.edu.ng/

Table 2. Distribution of respondents according to level of utilization of Solar power

Uses	Highly Utilized		Utilized		Moderately Utilized		Partially Utilized		Not Utilized		Mean	Level
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%		
charging of phones	111	92.5	4	3.3	5	4.2	-	-	-	-	4.81	High
refrigeration in rural health care systems (vaccine)	103	85.8	8	6.7	3	2.5	2	1.7	4	3.3	4.70	High
lightening of the house	95	79.2	3	2.5	9	7.5	3	2.5	8	6.7	4.58	High
lightening of the shop/office facilities	72	60	11	9.2	12	10.0	3	2.5	22	18.3	3.91	High
To power electrical appliances such as radio, fan	64	53.3	14	11.7	17	14.2	5	4.2	18	15.0	3.45	High
street lightening	29	24.2	25	20.8	12	10.0	10	8.3	44	36.7	2.77	High
powering feed mill machines	4	3.3	12	10.0	1	0.8	5	4.2	98	81.7	1.31	Low
To pump borehole water	19	15.8	24	20.0	19	15.8	7	5.8	55	45.8	2.47	Low
lightening of the pen	15	12.5	5	4.2	15	12.5	7	5.8	78	65.0	2.02	Low
refrigeration of farm produce	16	13.3	13	10.8	9	7.5	3	2.5	79	65.8	2.00	Low
chick brooding	8	6.7	16	13.3	12	10.0	3	2.5	81	67.5	1.86	Low
crop drying	4	3.3	10	8.3	3	2.5	8	6.7	95	79.2	1.44	Low
dairy production	-	-	10	8.3	1	0.8	3	2.5	106	88.3	1.22	Low
egg incubation	-	-	8	6.7	1	0.8	3	2.5	108	90.0	1.13	Low
Grand mean											2.70	

Source: Field survey, 2022

3.3 Perception towards Solar Power

Table 3 shows the favourable perception of the respondents towards solar power utilization in terms of its reliability (x=4.8), saving fuel costs (x=4.7) and paying of electricity bills, (x=4.4) not producing unpleasant noise, (x=4.7), and its eco-friendly, (x=4.6). Zarma *et al.* (2017) reported that solar power is gaining increasing relevance in terms of its utilization in Nigeria. This is undoubtedly because power deprived rural dwellers have positive perception towards solar power utilization. Also, Klepacka *et al.* (2018) reported that rural households in Poland have positive attitude towards solar power because it is clean, accessible and cost saving. They have relatively unfavourable perception towards solar power in terms of Not effective in rainy season (x=3.9), No energy production at night(x=3.6) and cost of installation not affordable(x=3.8). These implies that the respondents in the study area were positively disposed towards solar power utilization. This finding aligns with Akinboro *et al.* (2012) and Oji *et al*. (2012) that the initial cost of installation which was high was a general constraint to solar power usage compared to the cost of connecting to the national electricity grid.

http://doi.org/10.46792/fuoyejet.v8i4.1114 http://journal.engineering.fuoye.edu.ng/

Table 3. Distribution of rural household heads based on their perception towards solar power

	Perception Statement	Strongly Agree		Agree		Undecided	Disagree		Strongly Disagree	Mean	Decision
		Freq	%	Freq	%	Freq %	Freq	%	Freq %		
1.	Energy from Solar power is reliable	72	60	29	24.2	14 11.7	3	2.5	1 1.6	4.8	Favourable
2.	It does not need fuel or kerosene to power.	98	81.7	15	2.5	7 5.8	-	-	- -	4.7	Favourable
3.	It does not produce unpleasant noise as generator does	95	79.2	17	14.2	8 6.7	-	-	- -	4.7	Favourable
4.	It is the best alternative to the unreliable electricity	89	74.2	24	20	6 5.0	1	8	- -	4.6	Favourable
5.	Solar power is a long-lasting investment.	87	72.5	19	15.8	14 11.7	-	-	- -	4.6	Favourable
6.	It is environment ally friendly	85	70.8	24	20.0	10 8.3	1	8	- -	4.6	Favourable
7.	It saves money on electricity bill	82	68.3	23	19.2	8 6.7	6	5.0	1 8	4.4	Favourable
8.	Solar power is not very effective in raining season	63	52.5	42	35.0	11 9.2	2	1.7	2 1.7	3.9	Unfavourable
9.	No energy production at night	58	48.3	40	33.3	20 16.7	-	-	2 1.7	3.6	Unfavourable
10.	The strength of solar power is not as powerful as electricity	54	45.0	43	35.8	18 15.0	3	2.5	2 1.7	3.4	Unavourable
11.	The cost of installing solar power is not affordable.	45	37.5	37	30.8	16 13.3	13	10.8	9 7.5	3.8	Unfavourable
	Grand Mean:									**4.1**	

Source: Field survey, 2023

3.4 Constraints to Solar Power Utilization Amongst Rural Household

Table 4 shows the constraints to solar power utilization by rural households in the study area. The constraints ranking first is 'Requires sunny weather to work best' (mean= 4.70) followed by 'It is not reliable in raining season' (mean= 4.29). High cost of installation (mean= 4.01, rank=3rd), Installation is difficult (mean= 3.69, rank= 4th), among others. It can be interpreted that the weather condition has great impact on the utilization of solar power. Hence, this buttresses the findings of Oyedepo (2014) that the efficiency of solar power at night and during the raining season is not as high as during the sunny season. Also, Nwalule and Mzuza (2022) reported that 55 percent of the respondents in his study area in Malawi affirmed that low production during winter is a constraint to solar power utilization.

Table 4. Distributions of respondents according to the constraints to the utilization of Solar power

S/N	Constraints	Mean	SD	Decision	Rank
1.	Requires sunny weather to work best	4.70	0.56	Very High	1st
2.	It is not reliable in raining season	4.29	0.86	High	2nd
3.	High cost of installation	4.01	1.08	High	3rd
4.	Difficulty in installation	3.69	1.07	High	4th
5.	It cannot be moved easily	3.03	1.33	Moderate	5th
6.	Inadequate credit facilities	2.97	1.36	Moderate	6th
7.	Inadequate knowledge	2.86	1.39	Moderate	7th

Source: Field Survey, 2022

Table 5. Regression analysis of relationship between perception towards solar power and utilization

	Standardised coefficients Beta	t-value	p-value
(Constant)		6.636**	0.00
Utilisation of solar power.	2.09	2.487*	0.01

Source: Field survey, 2022

r=0.83, r^2=0.68, ** significant at 0.01% level, * significant at 0.0 5% level

3.5 Test of Hypothesis

The result in Table 5 showed that there is a significant relationship between respondents' perception of solar power and their utilization of the same at 0.01% and 0.05% respectively. Therefore, the hypothesis is rejected This may not be unconnected with the positive perception and high level of utilization of solar power in the study area as supported by the findings of Zarma *et al.* (2017).

4 Conclusion and Recommendation

Results of this study shows that rural households are aware of and have favourable perception to solar power but could not utilise it well enough to enhance their standard of living as the cost of installation is a major constraint. It is recommended that NGOs, and other stakeholders should provide solar powered lightening infrastructures for public utility and make solar power available and affordable to rural dwellers through subsidized, instalment payments. Enlightened community stakeholders, suppliers and beneficiaries should conduct trainings and re-trainings programmes to enhance awareness and skill acquisition on solar power.

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