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Socio-Economic effects of renewable energy on rural communities: a case study of Danjawa village, Sokoto state, Nigeria

Usman I Dabai[1], Muhammad T Dansabo[2]
Department of Sociology, Usmanu Danfodiyo University, Sokoto, Nigeria

Abstract
The paper examined the socio-economic effects of renewable energy on rural community of Danjawa village of Sokoto state, Nigeria. A structured questionnaire was administered to forty-five randomly selected heads of households and in-depth interview was conducted for twelve women in the village. The results show improvement in education, access to water, commerce and health. Restriction on use of high voltage electrical appliances like refrigerator, heater etc is one of the constraints of the project. However, all the respondents indicated their willingness to contribute resources for the sustenance of the project. Based on the findings, the researcher recommends that the project management should ask the villagers to contribute certain amount of money either weekly, monthly or annually for the sustenance of the project, the project management should also improve the capacity of wind and solar photovoltaic plant so that the beneficiaries can make use of other electrical appliances like refrigerator, water heater, electric iron, electric stove etc.

Keywords: renewable energy, socio-economic, sustainable development, poverty

Introduction

Since the 1950's, rural electrification has been promoted by enthusiasts as being the driving force behind the development of rural areas. But while the majority of programs have focused on the expansion of the national grid networks, alternative Renewable Energy supply options have received little coverage, with even less merit being attributed to pre-electrification programs using decentralized renewable energy networks (IEA, 2002) [2]

Electricity, the most efficient and cleanest form of modern energy, is a critical component of economic development (Pokarel, 2007). An efficient provision of electricity can improve the socio-economic conditions and technological aspects of a nation that ultimately improves the living standards of the people (Sihag *et'al*; 2004; Kanagawa and Nakata, 2008) [9, 3].

Globally, more than two billion people still lack access to electricity and rely on traditional biomass such as firewood, agricultural residues, charcoal, and animal dung for cooking, heating and lighting in their homes (IEA, 2002; WDR, 2010) [2], [15]. Using these insufficient technologies, according to IEA, 2002 [2]; Peters *et'al*; 2009 [7], basic energy needs can hardly be met and this contributes to maintaining the cycle of poverty in developing countries.

Nigeria is an energy resource rich country, endowed with abundance of renewable energy (RE) resources, providing her with electric grid capacity to develop an effective national energy plan (Vincent –Akpu,2012) [12]. However, Nigeria is yet to exploit these huge available energy potentials with less environmental and climate impacts. The national energy supply is almost entirely dependent on fossil fuel and firewood. These two are being depleted due to failure to harness other energy resources. Currently, solar, wind and biomass are in abundance all year round in Nigeria but are largely untapped (Vincent –Akpu, 2012) [12]. For energy to be renewed, its harvesting, conversion and use would occur in a sustainable manner and any negative effect on the people and natural environment would be avoided. Following these backgrounds, the paper examined the socio-economic effects of renewable energy in rural community of Danjawa in Wamako Local Government Area of Sokoto State. By virtue of its location, the village has appropriate geographical resources that allow the deployment of renewable energy system combining the use of photovoltaic, wind turbines, solar thermal and biogas technologies. This is to leave out fossil fuels that pollute the environment, and deploy systems using solar photovoltaic, wind, solar thermal and biogas technologies to provide the basic energy requirements of the village. An integrated renewable energy system was installed in the village which has a 10kw photovoltaic plant with necessary battery storage system as well as 1.2kw individual photovoltaic powered street lights, 3kw wind turbine. For the solar thermal technology, 500 liter header/riser type solar water was installed in addition to 100kg solar dryers. 10 cubic meter fixed dome biogas digester provides cooking gas for two household near the installation, as part of the project, a water borehole was rehabilitated for the village and made functional using photovoltaic power system. The 15kw integrated system comprising these technologies was implemented optimally for specific applications such as lighting, water heating, solar water-pumping and cooking purposes; there is also provision for the households in the village to power their basic appliances such as TVs, fans, radios, handset charger etc. with the electricity generated. The aim of this study is to assess

the effects of renewable energy technology in Danjawa rural community.

The specific objectives of the study include:
1. To identify additional sources of income acquired by the beneficiaries through the use of renewable energy system,
2. To ascertain the amount of money saved by the beneficiaries for using the integrated renewable energy system.
3. To ascertain the beneficiaries' willingness to contribute to the sustenance of the project.

Methodology

This describes the methodology that was employed in conducting the study. It includes study population, sampling technique, methods of data collection, techniques of data analysis and the ethical issues that were considered in conducting the study.

The population of the study consisted of residents of Danjawa village of Wamakko local government of Sokoto which has a total population of about one thousand people (1000) comprising of both male and female and with fifty households

All the heads of fifty households were selected to constitute the sample size of fifty (50) respondents. Questionnaires were administered to either the head of each household or their representatives. The justification is that Danjawa village is a patriarchal society where the male heads of households are considered very important and carry important information regarding their households and the entire community. The village also have four wards (4), from each ward, three (3) women were selected which amount to total of twelve (12) respondents that were interviewed. The justification is that women are the ones that were constantly using firewood as it was the predominant source of energy for cooking, lighting, heating and other domestic uses in the village. They, therefore, have important information regarding the use of both traditional and renewable sources of energy and their effects in the village. The justification for using twelve women is that it's not easy to have access to married women (house wives) in the village even with the use of research assistant who are women. Moreover, in qualitative study there is no limit as to number of people to be respondents for interview.

Two methods of data collection were employed in conducting the study; namely, quantitative and qualitative methods. On the quantitative method, the researcher collected data through the use of structured questionnaire which consisted of four (4) sections: section one (1) socio-demographic structure (gender, age, occupation, etc), section two (2) sources of energy before and after the project (firewood, renewable energy, bush lamp and kerosene, etc), section three (2) socio-economic (education, health, annual income, etc), section four (4) sustainability of the project (willingness to contribute money, labor, etc)

On the qualitative aspect of the study, cluster sampling was used to select wards. The village has four wards (Unguwar gabas, shiyar fulani, Unguwar liman and Kaurar-bella). Each ward has twelve households with the exception of Kaurar-bella which has fourteen households. Three house-wives from each ward were selected through systematic sampling technique. This was done by selecting every 6^{th} respondent from each ward but first respondent from each ward was selected through simple random technique, making up the total of twelve (12) respondents that were interviewed using In-depth Interview (IDI) technique. The data collected through this method was used to enrich the study because some information was not gotten through quantitative method, for example, information on sources of energy for cooking, heating and lighting before the village electrification, effect of using firewood in kitchens with no windows, amount of money saved per day for not using kerosene, etc.

Descriptive statistics (involving the use of tables, frequencies, percentages) were employed to analyze the quantitative data. The qualitative data was analyzed using content analysis, which was presented in a narrative form (prose style). The data presentation was done through the use of Statistical Packages for Social Sciences (SPSS).

Ethical Consideration

The purpose of the study was explained to the respondents and the assurance of the confidentiality of all the information supplied was guaranteed. The respondents were made to know that the information gotten from them was to be used for academic purpose alone.

Presentation of Results

Forty-five (45) questionnaires were self-administered while effort to access the other five (5) was unsuccessful. This was as a result of their unwillingness to respond to the questions. Therefore, the analysis was based on the forty-five (45) administered questionnaires

Table 1: Socio-Demographic characteristics of the respondents

Variables	Categories	Frequency	Percentage
Gender	Male	45	100%
	Female	0	0%
	Total	45	100%
Age	20-30	4	8.89%
	31-40	25	55.56%
	41-50	6	13.33%
	51-60	2	4.44%
	60 and above	8	17.78%
	Total	45	100%
Occupation	Farming	38	84.44%
	Trading	7	15.56%
	Others (specify)	0	0%
	Total	45	100%

Note: Field survey, 2014.

Results from the study shows that majority of the heads of household benefiting from the project (55.56%) belongs to the age group of 30-40 years with those in the age categories of 50-60 having the least proportion (4.44%), none of the respondents mention other occupation apart from farming and trading. See Table 1 above.

Majority of the respondents were observed to have farming as their major occupation (84.44%), while 15.56% were observed to have trading as their major occupation.

Hours spent in Islamic schools in the night before and after the project.

Results from the study shows that children in the village spent 2-3 hours studying in the night before the project, but after the renewable energy supply, majority of the respondents (77.78%) agreed that children spend 5-6 hours in Islamic schools in the night, while the remaining (22.22%) of the respondents agreed that children spent 4-5 hours studying in Islamic schools in the night. The housewives interviewed also indicated that number of hours spent in Islamic schools studying in the night have increased to a certain extent. One of the interviewees narrated that:

Regarding the hours spent in Islamic school, my child stays for 3-4 hours studying with other children in the village, but before the project they usually spent two hours, sometimes even less than that (housewife).

Another respondent reported that:

… even on Thursdays and Fridays when the children don't normally go to school, my child and his friends usually read under the solar street light in the night (housewife).

All the interviewees said that their children no longer go to bush to fetch firewood for lighting, heating and cooking. The implication of this is that it could increase school attendance.

Sources of energy before the village electrification.

Results from the study show respondents' views on sources of energy for lighting, heating and cooking before the village electrification. Regarding lighting, the data reveals that twenty one (21) respondents (46.67%) were using firewood, twenty (20) respondents (44.44%) were using bush lamp and four (4) respondents (8.89%) were using rechargeable lamp. As regards cooking, the data reveals that all the respondents (100%) were using firewood and kerosene. Similarly, all the respondents (100%) were using firewood and kerosene for heating water.

Table 2: Sources of Energy after the Village Electrification.

Variables	Sources	Frequency	Percentage
Lighting	Firewood.	5	11.11%
	Bush lamp.	-	-
	Rechargeable lamps.	-	-
	Solar power	40	88.89%
	Total	45	100%
Cooking	Firewood & kerosene	40	88.89%
	Improved cooking stoves.	5	11.11%
	Others	-	-
	Total	45	100%
Heating	Firewood & kerosene.	35	77.78%
	Improved cooking stoves.	10	22.22%
	Others	-	-
	Total	45	100%

Note: Field survey, 2014.

Results from the study show that forty respondents (88.89%) are now using solar system for lighting in their homes and school, while the remaining five (5) respondents (11.11%) are still using firewood as their source of lighting. Forty (40) respondents (88.89%) and thirty five (35) respondents (77.78%) were using firewood for both cooking and heating respectively in their houses; the remaining five (5) respondents (11.11%) and ten (10) respondents (22.22%) are now using improved cooking stoves for both cooking and heating respectively in their homes (Table 2).

Even the In-depth Interview (IDI) conducted with some of the housewives on sources of energy before and after the village electrification revealed similar result.

One of the interviewees narrated that: You know in the past we relied totally on firewood and bush lamps for lighting our houses and schools, but with this project, we no longer have to go to bush to fetch firewood, there is always light at night (housewife).

She further said that: Regarding source of light for cooking and heating, we still use firewood, even though we have been provided with improved cooking stoves but they are not enough for us as some of our houses have not gotten a single one (housewife).

Another respondent narrated that: Before the electrification of the village, I used firewood for cooking and heating, my kitchen does not even have windows and sometimes I cooked in my room using firewood, more especially during raining season (housewife).

Table 3: Amount of money saved per day for not using kerosene lanterns.

Saving (naira)	Frequency	Percentage
20-30	5	11.11%
31-40	30	66.67%
41-50	8	17.78%
51-60	2	4.44%
Total	45	100%

Note: Field Survey, 2014.

Information on the amount of money saved per day by benefiting households is presented in table 3. Most of the respondents (66.67%) were observed to be saving N31-40 each day which is about N3600 – N4800 per annum for not using kerosene for cooking, heating and lighting their rooms in the night, while two (2) respondents (4.44%) are saving 51-60 naira per day. Invariably, the same amount was said to be spent before introduction of the renewable energy project in the village. This is because solar power cost little or nothing at all; therefore the amount of money that is supposed to be used for kerosene is now being saved.

Income generation through renewable energy supply

When the respondents were asked whether they have increased sources of income through renewable energy supplied in the village, out of the twelve (12) respondents, eight (8) argued that they do not have additional source of income rather they do save additional income for not buying kerosene every day for lighting

cooking and heating, while the remaining four said they have additional source of income. One of them narrated that:

I have invested money in business of recharging hand-set for my child, he collect the batteries in the day time and charges them at night when the solar energy is on (housewife).

The implication of this is that, small amount of money the villagers can save for not using kerosene and the one generated from recharging of hand-set can be used to cater for other domestic needs

Sustainability of the Project.

When the heads of household were asked in the self-administered questionnaire whether they are willing to contribute money, physical labor and materials for the sustenance of the project whenever the need arises, they all indicated their willingness to do so. They also expressed their willingness to pay charges similar to those charged by the Power Holding Company of Nigeria (PHCN).

However, one of the respondents indicated that, sometimes light does not reach morning and they are prohibited from using electrical appliances like water heater, electric iron, refrigerator, electric cooker, etc. Another respondent indicated that sometimes they experience low currents especially when the sun is not so bright.

Discussion

The Effects of the Project on Islamic Education

Electricity can directly influence the education level in the rural community, (Zahnd and Kimber, 2009). All the heads of households and women who were interviewed indicated that numbers of hours spent in Islamic schools studying have increased to a certain degree. The implication of this is that it could bring about improvement in the level of education in the village. In past years, children had to spend most of their productive time collecting firewood or use insufficient traditional kerosene lamps as a means of illumination to study at night; this creates an unfavorable environment for study. But renewable energy system provide light which is more efficient and brighter than what they had before, thus school attendance has increased because children no longer have to go to bush and fetch firewood.

Renewable Energy and Its Effects on Rural Communities

Village electrification improved the indoor atmosphere significantly. Traditional cooking stoves are now replaced with improved cooking stoves.

It is obvious that if a rural community has reliable access to basic lighting services, it can have a major impact on the environment. Poor rural communities heavily rely on firewood, which is a free resource, as the only cost of firewood collection is physical effort and time (Katuwal and Bahara, 2009) [4]. This is true of Danjawa village as almost all the respondents interviewed reported that before the village electrification they heavily relied on firewood as their predominant source of energy for lighting, cooking and heating. Over exploitation of firewood for household purposes (cooking, heating and lighting) leads to the degradation of natural forests that ultimately results in scarcity of local resources (Mahat, 2004) [5]. Another disadvantage of the use of traditional biomass in rural areas is that people are susceptible to indoor air pollution (mainly vision and respiratory illness) due to poorly ventilated kitchens (Katuwal and Bohara, 2009) [4]. All the women interviewed revealed that before the village electrification and provision of improved cooking stoves in the village they cooked in local kitchens, some with just a window, some even said their kitchens had no windows while others revealed that they used to cook in their rooms.

In the past, kerosene and firewood were used for cooking, heating and lighting in the households, often supplemented by agricultural residues and animal dung. Village houses were made of flat muddy roofs with stones and wood beams. Moreover, the traditional open fire kitchens were shared for most of the daily activities and social gathering. The use of biomass as energy in rudimentary cook-stoves releases carbon dioxide and products of incomplete combustion including mixture of gases (carbon monoxide, nitrogen compounds and methane) (IEA, 2002; Warwick and Doig, 2004) [2, 14].

Income Generation Through Renewable Energy Power Supply

The economic literature has studied the role that energy plays in economic development and it seems it can be accepted that a positive relationship exists between energy and economic development. Ebohon (1996) has obtained a simultaneous causal relationship between energy and economic development for Tanzania and Nigeria. Majority of the respondents interviewed indicated that they do not acquire additional source of income through the use of renewable energy power supply. However, four (4) of the respondents indicated that they have additional source of income through business of recharging hand-set batteries in the village. Moreover all of them indicated saving some money for using PV power instead of kerosene.

Sustainability of the Project

All of the heads of households and women interviewed indicated their willingness to make sacrifices and contributions for the project to be sustained. This is in line with the studies conducted in Kwalkwalawa village where the villagers indicated their interest to contribute for the maintenance of the solar photovoltaic plant installed in the village (Umaru, Yahya and Atiku, 1998) [11]. Involvement in community development has been said to be one of the main enduring and flourishing heritage of traditional societies in Africa and Nigeria in particular. It has been the indigenous mechanism developed and employed by the people to take cooperative actions in satisfying their needs (Umaru, Yahya and Atiku, 1998) [11].

Even before the introduction and application of the theory of development planning and studies, many rural communities in Nigeria had learnt to pool their resources together and provide both functional and physical facilities for themselves (Ugal, 1992) [10]. 30% to 40% of the finance for rural development projects as access roads, postal agencies in most cases was provided through communal efforts, government and private agencies provided for the rest of the funding for these projects (Ugal, 1992) [10]. In a study conducted on health care delivery in Senegal, Vogel (1988) also reported that people are willing to pay for health care, particularly if they perceived improvement in the quality.

Conclusion

This study found that renewable energy has a significant effect on the consumption of firewood in rural households. It was

revealed that Danjawa children have lesser propensity to go for wood collection because their homes are now connected to the photovoltaic power plant.

Similarly, because of the electric light connected to their homes, children have more time to study during night time.

The prohibition on the use of some electrical appliances like refrigerator is one of the major problems of the project as expressed by the respondents. This has deprived them of most of the benefits associated with the use of electric power.

The study also found that the light does not reach morning time and sometimes there are low currents especially when the sun is not so bright.

Thus, this study comes to conclude that renewable energy has positive impact on socio-economic conditions of the rural communities.

Recommendations

Based on the above findings, the following recommendations are offered:

For the maximum potential of the project to be realized, the project management should improve the capacity of wind and solar photovoltaic plant so that the beneficiaries will have 24hours of power supply without any restriction on the use of electrical appliances like refrigerators, water heater, electric iron, e.t.c.

Secondly, the villagers should be asked to contribute small amount of money monthly for the sustenance of the project. Thirdly, the project management should find ways of storing more energy in the plants so that even on non-sunny-days the villagers can have light and ensure full current of the solar energy supply.

References

1. Gurung A. Socio-economic impact of a micro-hydro power plant on rural livelihoods. Scientific research and essays. 2011; 6(19):3964-3972.
2. IEA. International Energy Agency, World Energy Outlook, 2002, 365-393.
3. Kanagawa M, Nakata T. Assessment of access to electricity and socio-economic impacts in rural areas of developing countries. *Energy Policy*. 2008; 36 (6):2016-2029
4. Katuwal H, Bahara AK. Biogas a promising renewable technology and its impact on rural households in Nepal. *Renew. Sust. Energy. Dev*. 2009; 13 (9):2668-2674.
5. Mahat I. Implementation of alternative energy technologies
6. in Nepal: towards the achievement of sustainable livelihoods. *Energ. Sust. Dev*. 2004; 8(2):9-16.
7. Peters JG, Harsdorff M, Ziegler F. Rural electrification: Accelerating impacts with complementary services. *Energ. Sust. Dev*. 2009; 13(1):38-42.
8. Pokharel S promotional issues on alternative energy technologies in Nepal. *Energ. Policy*. 2003; 31(4):307-318.
9. Sihag AR, Misra N, Sharma V. Impact of power sector reform on the poor: case studies of south and south-east Asia. *Energ. Sust. Dev*. 2004; 8(4):54-73.
10. Ugal GA. Role of non-governmental grass-roots agencies in rural development the experience of Cross-river State Proc. Conf. on rural development strategies in Nigeria, 1992, 220-229.
11. Umaru BF, Yahya HN, Atiku AT. Socio-economic impact of solar photovoltaic power on inhabitants of Kwalkwalawa village of Sokoto State. Nigerian journal of renewable energy. 1998; 6(1&2):27-30.
12. Vincent-Akpu I. Renewable energy potentials in Nigeria. Conference proceedings, centro de congress da Alfandega, porto-Portugal (www.iaia.org), 2012.
13. Vogel R. Cost recovery in healthcare sector: selected country studies in West-Africa. World Bank technical paper, Washington D.C. 1998; 82:177-1980
14. Warwick H, Diog A. Smoke-the killer the kitchen indoor air pollution in developing countries. ITDG publishing, London, UK, 2004.
15. WDR. Development and Climate Change. World Development Report [chapter 7], 2010, 288-312.