ISSN: 2455 - 9172

EIJO Journal of Engineering, Technology And Innovative Research (EIJO–JETIR)

Einstein International Journal Organization (EIJO)

Available Online at: www.eijo.in

Volume – 2, Issue – 2, March - April 2017, Page No. : 66 - 71

Remote Village Electrification through Renewable energy sources

Banothu Mohan

Dept of Electrical Engineering

Research Scholar, OPJS University, Churu, Rajasthan, India

Abstract

This paper deals with the study of rural electrification scenario through Photo Voltaic cell systems of Sagar island which is isolated from main land mass of West Bengal state by river Hugli (width of river ~3Km). Photovoltaic (P.V) put in place by the West Bengal Renewable Energy Development Agency (WBREDA) have clearly brought benefits to many of the residents of Sagar island.. The highly-touted community management system governing the projects has been successful at instilling local pride and overcoming the traditionally thorny problem of tariff no collection. There are ten solar-powered stations which installed in between 1996 to 2006 at different remote sides of the Island. Kamalpur is the village where solar-powered station first installed in 1996 with power generation capacity of 26 (kW). After two years (1998) another solar-powered station was installed in the village of Mritunjoynagar with the same capacity as the previous project. In 1999 three solar-powered stations installed, namely Khasmahal, Gayenbazar, and Mahendraganj solar projects with capacity of 25(kW) each. Natendrapur and Uttar Haradhanpur solar-power stations developed in 2000 having 28.5 & 32.5 (kW) power generation capacity. In 2001, only one solar-powered station is installed at Mandirtala, with power generate capacity of 28.5 (kW). Koylapara & Rudranagar Hospital solar-power stations are installed in 2006.Their power generate capacity was 120 & 20 (kW) respectively.

Keywords: Renewable Energy, Solar Radiation, Density

1. Introduction

Energy is a driving force to foster economic, social and health condition. Energy effect all the dimensions and supporting pillars of sustainability (IEA, 2001; Sharma, 2007). All of these supporting pillars namely Environment, Social and Economic should go hand in hand without compromising on its ability for the future generation to satisfy their own need. According to section 6 of the electricity act 2003, the Government of India decided to electricity all villages that were not yet electrified. It is thought that conventional as well as renewable energy will be used to achieve this objective, renewable energy sources would be used in a decentralized manner where conventional grid connectivity is not possible. The application of decentralized renewable energy for electricity provision and rural electrification has shown mixed result. Sagar Island in the district of south 24 parganas in West Bengal state, is electrified through renewable energy sources like solar photo voltaic (SPV) energy. It is proposed to optimize the solar-powered plants of this remote isolated island with a proposition to grid integration in near future. But this proposition to connect the isolated remote renewable power plants to the conventional power grid is a challenge in the Indian scenario. Average annual solar radiation is about 1600 kWh/m2 on horizontal surface. In a year average 250 sunny days and 55 overcast days observed in the study area. The annual average solar radiation on horizontal surface is about 4.91 kWh/m2/day. The Electricity act 2003 (EA03)

marked an increase in urgency attached to the problem at the national level, codifying the requirement to supply electricity to all villages. To implement the law , the government launched the Rajiv Gandhi Grameen Vidyutikaran Yojana initiative in 2005, with the aim of achieving universal electrification by 2012.In theory, electricity produced under the Rajiv Gandhi scheme is supposed to cover operational costs (except for households below the poverty line). The Rajiv Gandhi guidelines also emphasize distributed generation options in cases where grid extension is not feasible, with individual states required to submit proposals to the Ministry of Non – conventional Energy sources (MNES). MNES envisions a major role for renewable sources in meeting the 2012 electricity requirement (Banerjee 2006). WBREDA became interested in Sagar Island in 1994, and has since both photovoltaic systems to electricity much of the island. The program began with the installation of individual solar lighting systems, which now provide electricity for more than 2000 families (Ashden 2003).There are now ten solar photovoltaic power plants carrying a total capacity of ≥ 300 kW and powering ≥ 2000 families for six hours a day (Ashden,2003). Study area:

Sagar Island (also known as Ganga Sagar) lies on the continental shelf of Bay of Bengal about 150 km (80 nautical miles) south of Kolkata, in West Bengal. The area of the island is about 251.59 sq km with 43 villages and a population of over 180408 with population density of 717 / sq km. The latitude of the study area is $21^{o}\ 37^{/}$ N to $21^{0}52^{/}$ N and the longitude of the study area is $88^{0}02^{/}$ E to $88^{0}11^{/}$E. The Island has scatter Mangrove swamp, waterways and small rivers. The island is a famous Hindu pilgrimage. Every year on the day of Maker sankranti (middle of January thousand of Hindus gather to take a holy dip at the confluence of Ganga and offer puja in Kapil Muni Temple. The Sunderland along the Bay of Bengal has through quaternary (began about 2 million Years ago and extends to the present) sediments deposited mainly by the mighty river Ganges, Brahmaputra, Meghna and their numerous distributaries. The building up of this estuarine area is not complete. The mangrove dominated delta is a complex ecosystem comprising one of the three largest single tracts of mangrove forests of the world. The Sunderland floor varies from 0.9m to 2.11 m above sea level. Sagar Island such an area, which despite its tremendous economic potentiality is lagging behind in comparison with many other areas which are in geo-economic, geo-environmental and geo-hydrological in same region. This study will emphasize on finding out the reasons behind the backwardness, identifying the areas of potentials and highlighting the prospects therein.

2. Data Base & Research Methodology

Methodology for data collection is divided into two segments. Secondary and primary sources. Secondary sources mainly consist of literature survey, peer reviewed articles and research papers and government published documents. Data from the state department of Renewable Energy (WBREDA), United Nations Development Programme has been used. Primary data sources consist of 10 % household survey of total households following random sampling method. The inputs from the conducted interviews and feedback received from Questionnaire survey were analyzed against the actual data collected and the literature review.

2. The Criteria For Village Electrification of Isolated Island

The criteria for village electrification are as : (a) identification of parameters such as : (i) Economic : cost of product , maintenance and operating cost , prevailing subsidy, tax benefits, benefits due to absence / lesser amount of social / scarcity /opportunity cost etc- all in annualized quantities. (ii) Social: Energy habit of the customer, social custom,

aesthetic value of the product customers goodwill for reasons such as lowering of pollution by use of these "green system", political goodwill/ propaganda, population density & accessibility of the location, grid connectivity, etc. (iii) Environmental : Availability of solar radiation and other environmental conditions that would significantly affect the performance of the SPV system in consideration. (iv) Supply of time: A: 24 hours supply, B: fixed time supply, C: Any time supply.

3. Demand Assessment

It was found in almost all locations, people use kerosene for lighting purposes and the kerosene consumption varies from 4 liters to 7 liters/month per household. The access to electricity is one of their priorities and most of the households are interested to take the service connections. It was estimated that demand per household would be approaching 30 units per month with duration of supply for at least 8 hours. It was found that people needs electricity for two hours (4am to 6 am) for domestic purposes and 6 hours (6 pm to 12 pm) in the evening.

4. Findings & Analysis

West Bengal Renewable Developments agency (WBREDA) in eastern part of India is trying to electricity remote isolated villages of this Sagar isolated island through renewable energies. The underlying issue for this grid connectivity is that rural India will not get 40 % electricity to 50 % of time at the end of 13 th plan. Hence, to make 24 hours reliable system of rural India, Renewable Energy Systems must be optimized in the off-grid smart distribution system.

The island suffers from chronic storage of electrical energy due to non availability of grid quality paper. The rivers are tidal in nature and sometimes become about 1 to 4 km wide. Therefore this island is totally isolated from the main island. It was extremely difficult to extend transmission lines from main land to this island resulting in technical limitations and prohibitive cost. In 2010 this process was started, and now it is under process to give the adequate electricity in this island. People depend on the expensive and often erratic supply of kerosene for their lighting needs. There are a few small diesel generator sets supplying electricity to the markets of some villages, but the diesel delivery mechanism is not adequate. West Bengal Renewable Energy Development Agency (WBREDA), in association with Ministry of Non –conventional Energy Sources, Government of India, has taken several initiatives since 1994 to meet the electrical energy needs for the people living in the island.

Table 1: Village level electrification status of Sagar Island (2011), West Bengal, India.

Villages	Population (2011)	Households (2011)	Households availing grid electricity (%)	households availing solar electricity (%)	households without electricity (%)
Kamalpur	6601	1341	27.84	55.67	16.49
Mrityunjaynagar	3142	700	0.00	72.92	27.08
Manasadwip	6206	1213	17.58	57.14	25.27
Chemaguri	6560	1444	22.58	46.24	31.18
Mahendraganja	4554	889	6.58	59.21	34.21
Natendrapur	1179	236	29.41	47.06	23.53
Haradhanpur	9001	1733	0.00	70.23	29.77
Mandirtala	6141	1354	17.95	46.15	35.90
Kaylapara	3496	722	6.56	78.69	14.75
Rudranagar	7126	1423	36.94	40.54	22.52

Table 2: Electricity production in Sagar Island before 1996.

Electricity type	Capacity of power generation	Households benefited	Duration of supply	Year of installatio
Diesel	Variables	650	4 hour day^{-1}	Before 1994
Solar home system	30-70 W hour^{-1}	5000	6 hour day^{-1}	1994
WBSED (Grid)	356 Kw	1600	6 hour day^{-1}	1996

6. Actual Status of Electrification through PV System

There are ten solar-power stations in the study area which were installed in various locations in remote villages in between the year of 1996 to 2006. Kamalpur was the first solar-power station, installed in 1996 with power generation capacity of 26 (kW). About 55.67 % of households are connected with solar electricity in this village. However, 27.84 % households are consuming grid electricity. Rest of the households has no electricity and deepened on kerosene for lighting in night. After two years Mritunjoynagar solar-powered station has installed (1998) with the aforementioned power generation capacity and 72.92% households are enjoying solar electric facility. Unfortunately, there is no facility of grid electricity in this village. Hence, 27.08 % households are using kerosene to get the light. In 1999 three solar-powered stations are installed, which are Khasmahal, Gayenbazar, and mahendraganj respectively with power generate capacity of 25 (kW) each. About, 57.14 %,46.24 % and 59.21 % households of these villages are availing solar electricity to get sufficient light in night and

Table 3: Capacity and year of installation of selected photovoltaic plants at Sagar Island

Villages	Capacity (KW)	Year of instalation
Kamalpur	26	1996
Mritunjoynagar	26	1998
Manasadwip	25	1999
Chemaguri	25	1999
Mahendraganj	25	1999
Natendrapur	28.5	2000
Haradhanpur	32.5	2000
Mandirtala	28.5	2001
Koylapara	120	2006
Rudranagar	20	2006

17.58 %, 22.58 %, and 6.58 % households consuming grid electricity. Rest of the ouseholds is using kerosene to get light. Natendrapur and Uttar haradhanpur solar-powered stations are developed in 2000 with the power generate capacity of 28.5 & 32.5 (kW) respectively. 47.06 % households are using solar-power in Natendrapur though, 29.41 % households are using grid electricity. On the other hand 70.23 % households are getting solar electricity in Uttar Haradhanpur. Grid electricity is absent in this village. In 2001 one solar-power station was installed at Mandirtala with power generation capacity of 28.5 (kW). Only, 46.15 % households are using solar-power and 17.95 % house hold is being benefited by grid electricity this village. 35.90 % households are using kerosene. Last of all Koylapara & Rudranagar Hospital solar-power stations are installed in 2006. Their power generate capacity are 120 & 20 (kW) respectively. Of them solar-powered projects koylapara has the maximum

power generated capacity (120 kW) and Rudranagar Hospital has the minimum capacity (20 kW). 78.69 % households are enjoying solar-powered electricity in koylapara. Only 6.56 % are using grid electricity here.40.54 % households are consuming solar-powered electricity in Rudranagar. Grid electricity-generating power station is available In this village a result grid electricity status is maximum, which is 36.94 % of total households. (Source WBREDA 2007).

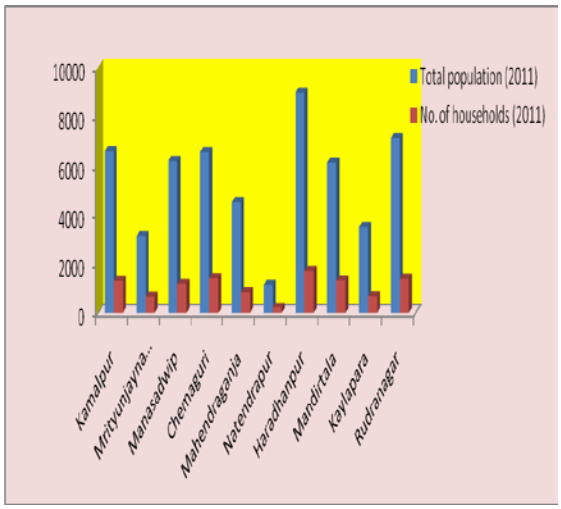

Figure 1: House hold electric facility status (2011).

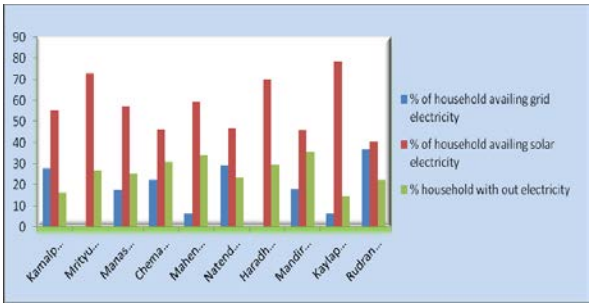

Figure 2: house hold and total population of selected villages in Sagar island.(Census 2001).

7. Conclusion

Sagar Island consists of 43 villages of which only ten villages is being benefitted by solar electricity. Rest of villages and the villagers remain dark in night. Though, a limited no of households are using solar-powered electricity in private mode. Hence, insufficient electric facility is the major problem in this island which is one of the hurdles for the villagers to operate modern machineries. Thus, a large number of people engaged in primary activity, especially in traditional agriculture system. Medium or large scale industries are totally absent in this study area because of power insufficiency. Though, 100 % grid electrification process is continuing in the entire island. After completion the process islanders must be benefited and the socio-economic development must be faster than before.

8. References

[1]. Ash den Awards, (2003): "Sagar Island- Solar Island "Retrieved from World Wide Web.: www.ashdenawards.org/winers/wbreda

[2]. Bannered, R. (2006): Comparison for Options for Distributed Generation in India, Energy policy 34, pp 101-111.

[3]. Bhattacharyya, S.C, (2006). Energy access problem of the poor in India, Is rural electrification a remedy? Energy Policy 34, pp 3387-3397

[4]. Bureau of Applied Economics & Statistics, Government of West Bengal. 2003. District Statistical Handbook.

[5]. Chakrabarti Snighdha, Chakra arty Subhendhu, 2002. Rural Electrification Programme with solar energy in remote region – a case study in an island. Energy policy 30,(2002), pp 33-42.

[6]. Malhotra, p. (2006) – Management of Community Based energy Interventions in Rural Areas of India, Issues and perspective pp 33-45.

[7]. Mitra Indradip (2005). A study on Solar Photovoltaic based mini –grid systems for Rural Electrification. Journal of the Solar Energy Society of India 15 (1), pp 25-35.

[8]. Nouni, M. R., Mullick, S.C,. And Kandpal, T.C,. (2006), Photovoltaic Projects for decentralized power supply in India: A financial evaluation Energy policy 34 , pp 3727-3738.

[9]. Sastry , E.V.R., (2002).- The Photovoltaic Program in India, Ministry of Non- conventional Energy Sources, Government of India, Annual Report 2001-2002.

[10]. The Energy and Resources Institute, (2005) Integrated electricity supply master plan for off-grid Sundarban Islands. Project Report No -2005 RT 23.