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INSTALLATION OF OFF-GRID RENEWABLE ENERGY SYSTEMS IN INDIA: A GEOGRAPHICAL ANALYSIS

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ABSTRACT:

The conventional energy resources are become limited due to increasing demand with increasing population and industrialization. Increasing population and improper management of energy sources lead to over exploitation of the natural resources, cause scarcity of the conventional resources, environmental degradation and energy crises. So it is necessary to utilize non conventional or renewable energy sources for generating the energy for sustainable development of the nation. By keeping this view the study aims to analyze the installation of Off-grid renewable energy systems like Biogas plants, Water Pumping Wind Mills, Solar Photovoltaic Pumps, Street Light Systems, Home Lighting Systems and Solar Cookers in India. The present investigation is based on secondary data published by Govt. of India in Energy Statistics. The comparative study of the Installation of Off-grid Renewable energy systems in India is studied for the period of 2009-10 and 2011-12.

Key words: Natural resources, Industrialization, Renewable energy, Environmental Degradation

INTRODUCTION:

The resources play a significant role in the overall development of the nation. The increasing population and industrialization suffer the crucial problem of power resources and causes the energy crises. The conventional power resources become limited to provide the increasing demand of the increasing industrialization. The agricultural and domestic areas of the India also suffer the energy or power sources. Energy is the basic natural input without which the existence of mankind is quite impossible. To a common man, it is a commodity (like gasoline, gas or electricity), to an industrialist it is the heat required to power his gigantic machinery; to an economist it is key ingredient for economic prosperity (Das, 1990). It means the entire progress of the country is mainly based on the energy. But the unequal distribution of natural resources and the power sources threaten the functioning of the economy. Mainly the countries like India which economy is based on agricultural sector suffer various problems in its development. The lack of energy sources is one of the major factors become obstacle in the agriculture development. Most of the villages in remote areas also suffer from problem of electrification in India. In view of the energy crisis and its impact on the economy the fuel policy committee set up by the government of India has strongly recommended popularization of Bio gas and other non conventional energy sources as an alternative (Shukla and Chowdhry, 1992).

By considering all these things and scarcity of the conventional or non renewable resources needed to turn over to installation of off grid/ decentralized renewable energy system/ devices for overall development of the rural and remote areas. These non conventional or the renewable energy systems solve various difficulties of the human beings. So here an attempt is made to analyze the distribution and installation of off grid energy system / devices like Bio gas, Water Pumping Wind Mills, SPV Pumps, Street Lighting System and Home Lighting System, etc.

THE REGION:

India is the seventh largest and second most populous country in the world. The region is lying between the 8° 4' 28" North to 37° 17' 53" North latitudes and 68° 7' 33" East to 97° 24' 47" East Longitude. It covers an area of 32,87,264 sq. kms. which is 2.4 per cent of the total world area supports roughly 16 per cent of the world population. Out of total land masses of India 43.3 per cent of ate area is covered by plains, about 27.7 percent by plateaus, 18.6 per cent by hills and about 10.7 per cent by mountains. Most of the rainfall of the country is received from the south west monsoon which lasts from June to September. The north east monsoon is usually active from October to February. The average rainfall (1130mm.) has considerable variations in space and time and accordingly the flow of water in the river of central and the south India depends upon the monsoon rainfall. The other source is the snow. The Ganga, Brahamputra, Narmada, Tapi in the Northern part. While Mahadevi, Godavari, Krishna, Cauvery and Pennar etc. flows from west to east into the Bay of Bengal in Southern part. Broadly the country has Monsoon climate. The temperature ranges between 10° C to 37° C. it increases from north to south and isotherms run across India nearly parallel to the latitude.

OBJECTIVES:

- 1. To study the implementation and volume change in off grid power system / Devices in India
- 2. To study the regional imbalances in Installation of Off-grid / Decentralized Renewable Energy Systems / Devices in India

DATA BASE AND METHODOLOGY:

This study is mainly based on secondary data where state is considered as a real unit. The related data has been abstracted through Energy Statistics for the period of 2009-10 and 2011-12, published by Central Statistics office, Ministry of Statistics and Programme Implementation Government of India. The share of percentage and volume of change of renewable energy systems are tabulated for analyzing implementation of the off grid renewable energy systems. The results are represented by the tables, Graphs, Diagrams and maps. The proportion in percentage for the period of 2009-10 and 2011-12 is also calculated for comparative study of regional imbalances in the installation of off grid renewable energy systems / devices in India.

ANALYSIS:

The growth of installation of selected off-grid/ decentralized renewable system / devices is not satisfactory. It is observed that, about 5663161 total no. of energy system / devices are installed in the year of 2009-10 which is decreased by 1.38 per cent with the volume of change of +-10.03 per cent. The number of Biogas plants was 4253624 in the year 2009-10 and increased up to 4455182 in the year of 2011-12. The contribution of Street lighting system has contributed about 797344 devices in 2009-10 which is decreased by 28.41 per cent in the year 2011-12 and noted 226506 devices. The numbers of Home lighting system/devices in the year 2009-10 are 603307 and increased up to 892974 no. of devices. The growth of water pumping wind mills and SPV pumps is not satisfactory (Table 1)

	Year's				Volume of
	2009-10		2011-12		Change
Energy System					For year of
	No. of Devices	Share of %	No. of Devices	Share of %	2009-10 and2011-12
Biogas Plants	4253624	75.11	4455182	79.77	4.66
Water Pumping Wind Mills	1352	0.02	1352	0.02	0.00
SPV Pumps	7334	0.13	8792	0.16	0.03
Street Lighting System	797344	14.08	226506	4.06	-10.03
Home Lighting System	603307	10.65	892974	15.99	5.34
Total	5663161	100.00	5584806	100.00	+ - 10.03

Table 1: Installation of Off grid / Decentralized Renewable EnergySystems / Devices

Source: Data Compiled by the researcher from Energy Statistics 2011, 2013

It is observed that, Biogas plant is the system that has greatest contribution followed by street lighting system and home lighting system which has contributed by 75 per cent, 14 percent and 11 percent respectively in the year of 2009-10 (Fig. 1 A). The rate of installation of biogas has contributed about 80 per cent followed by home lighting system by 16 per cent and street lighting system by 4 percent. It is noted that the share of street lighting system is decreased by 10.03 per cent in the year of 2011-12(Fig. 1 B). The share of water pumping wind mills and SPV pumps are negligible in both the period.



Source: Compiled by the researcher, Base: Energy Statistics 2011, 2013

A) Proportion of Biogas Plants:

The installation of biogas plants in the year 2009-10 was 4253624 plants where as it went up to 4455182 plants during the year 2011-12. The highest installation of biogas plants observed in Maharashtra has 780527 plants where as lowest installation observed in Chhattisgarh has 97 plants only. This pattern is changed in 2011-12 and observed that, the installation of bio gas plant is increased and went up to 824203 plants, where as Chandigarh has remain constant to the previous situation.

During the year 2009-10 the very high proportion is observed in Maharashtra where as High proportion in Andhra Pradesh. The moderate proportion of Bio gas plants observed in Uttar Pradesh is followed by Karnataka, Gujarat, West Bengal, Madhya Pradesh Orissa and Tamil Nadu (Fig 2 A). The low proportion of installation of Biogas plants is observed in Kerala is followed by Bihar, Punjab, Assam, Rajasthan and Haryana where as very low proportion is observed in North eastern and Northern states, Jharkhand and Chhattisgarh.

During 2011-12 the proportion of biogas plants in very high and high categories are constant to the previous year. The moderate proportion of biogas plants observed in Karnataka is followed by Utter Pradesh, Gujarat, West Bengal, Madhya Pradesh and Orissa (Fig 2 B). The low proportion noted in Tamil Nadu is followed by Punjab, Kerala, Bihar, Rajasthan etc. whereas very low proportion is observed in North eastern and eastern states of the India with Chhattisgarh and Jharkhand.



Fig. 2 A

Proportion of Biogas Plants in India



Fig. 2 B

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B) Proportion of Water Pumping Wind Mills:

India ranks fifth in the wind energy with installed capacity of 10891 MW (Meisen, 2010). The national project aims at drawing water from underground wells, bores etc. for irrigation purpose. Wind energy system once installed does not require any energy inputs like Diesel and kerosene (Mahajan, 1991). The installation of water pumping wind mills in 2007-08 was 1352 devices. The highest installation of devices / systems observed in Gujarat is 879 devices where as lowest installation of devises observed in Chhattisgarh is only 1 device. This situation has also remained constant in the year 2011-12.

It is observed that the high proportion of water pumping wind mills is observed in Gujarat where as moderate proportion in Rajasthan of western part of the India. The low proportion of such devices / system observed in Kerala is followed by Tamil Nadu, Bihar, Karnataka, Maharashtra, Andhra Pradesh, Assam, Andaman Nicobar and Chhattisgarh in 2009-10. The northern and central part of the India along with the eastern and north eastern states is away from these system devices (Fig. 3 A).

In the year 2011-12 only Kerala has upgraded from low proportion to moderate proportion and other condition is similar to the previous year. (Fig.3 B). The Jharkhand and Sikkim, Dadar & Nagar Haveli, Daman and Div, Lakshadweep has not in practice of SPV pump systems.



Proportion of Water Pumping Wind Mills in India

Fig. 3 A



Fig. 3 B

Dr. Vijay D. Gaikwad

C) Proportion of SPV Pumps:

Solar energy is an important, clean, cheap and abundantly renewable energy (Singh, 2009). India promises to become one of the world's largest photovoltaic energy markets. The country has the best solar resources in the world with 260 -300 clear sunny days per year, on the other hand, it is confronted with continues electricity shortages (Meisen, 2010). The installation of SVP pump system in India in the year 2009-10 is 7334 devices which are increased up to 8792 devices in the year 2011-12. The highest installation of devices are observed in Punjab are 1850 devices where as Nagaland has installed very few i.e. only 3 devices in the year 2009-10. This situation is somewhat content in 2011-12.

The very high proportion of installation of SPV pumps in India observed in Punjab is followed by high installation in Tamil Nadu, Kerala and Utter Pradesh. The moderate proportion of installation is observed in Andhra Pradesh, Karnataka and Haryana in 2009-10. The Western states like Rajasthan, Gujarat and Maharashtra, Central states like Madhya Pradesh, Chhattisgarh come in low proportion where as the Northern and North eastern states show very low proportion of installation of SPV pumps in India (Fig. 4 A). In the year 2011-12 the very high proportion is observed in Punjab where as high proportion is observed in Rajasthan. The moderate proportion observed in southern states like Tamil Nadu is followed by Kerala, Andhra Pradesh Karnataka and Utter Pradesh and Haryana in the northern part of India (Fig 4 B). The Chhattisgarh, Maharashtra, Tripura, Bihar and Delhi where as Madhya Pradesh in central, Gujarat in West have noted low proportion. The northern states and north eastern and eastern states have observed very low proportion of SPV pumps in India.



Proportion of SPV Pumps in India



Fig. 4 B

Fig. 4 A

D) Proportion of Street Lighting System:

The installed proportion of street lighting system in India for the period 2009-10 was 797344 devices/ systems. The highest installation is observed in Haryana about 71646 systems where as lowest no. of systems of about 1027 are observed in Goa in 2009-10. In the year 2011-12 the total no. of installed systems are 226506 in India out of which highest no. of devices observed in Uttar Pradesh are 1000406 devices where as lowest in Assam are only 98 devices. The high proportion of installation of street lighting system for the period 2009-10 observed in Haryana was followed by Maharashtra, at west, Uttaranchal, Utter Pradesh and Bihar at North East, and Kerala at Southern part of India (Fig. 5 A). The moderate proportion observed in Andhra Pradesh is followed by Gujarat, Jammu Kashmir, Meghalaya, Himachal Pradesh, Punjab, Tamil Nadu, Orissa and Jharkhand in Eastern and South eastern part of the India. The low proportion of street lighting system observed in Karnataka is followed by Nagaland, Andaman Nicobar, Mizoram, Delhi Rajasthan etc.

Proportion of Street Lighting System in India



Fig. 5 A

Fig. 5 B

In the year 2011-12 Utter Pradesh leading in installation of street lighting systems has contributed very high proportion followed by Haryana of high proportion of street lighting system (Fig. 5 B). The moderate proportion observed in West Bengal is followed by Uttaranchal, Maharashtra, Himachal Pradesh, Madhya Pradesh, Rajasthan, Tamil Nadu etc. The low proportion is observed in Gujarat in western part of India, Kerala in southern part, and Chhattisgarh, Jharkhand and Eastern states of India.

Vol.2 No.1

E. Proportion of Home Lighting System:

The high installation of home lighting system was 603307 devices in the year 2009-10 which went up to 892974 devices in 2011-12. During the year 2009-10 the highest no. of devices installed in west Bengal are about 111090 systems where as lowest no, of devices in Chhattisgarh are only 275 devices. In 2011-12 the Uttar Pradesh has noted 185388 devices as highest no of installation where as Chandigarh has only 275 devices.

The very high proportion of home lighting system observed in West Bengal is followed by Uttar Pradesh and Uttaranchal where as high proportion is observed in Rajasthan during 2009-10 (Fig 6 A). The moderate proportion of home lighting system is observed only in Kerala where as low in Haryana, Karnataka, Tripura, Jammu and Kashmir, Himachal Pradesh, Gujarat, Punjab, Meghalaya, Chhattisgarh and Arunachal Pradesh. The very low proportion is observed in central and southern part and north eastern part of India.



Proportion of Home Lighting System in India

Fig. 6 A

Fig. 6 B

In the year 2011-12 Utter Pradesh and West Bengal have noted very high proportion followed by Rajasthan and Uttaranchal of high Proportion and Haryana of Moderate proportion of home lighting systems. The low proportion of this system is observed in Jammu and Kashmir, Himachal Pradesh and Arunachal Pradesh of Northern part, Gujarat at western part and Karnataka and Kerala at south western part of India. The Maharashtra at western, Madhya Pradesh, Punjab and all eastern states and south eastern part has denoted very low proportion of home lighting systems (Fig 6 B).

FINDINGS AND SUGGESTIONS:

The geographical condition of India supports to the installation of renewable energy system devises. Being a country of rural sector our economy is mainly based on agricultural activity which suffers various types of problems and energy is one of them. Mainly the remote and the inaccessible areas of the region are attracted the installation of the off grid energy system/ devices.

It is observed that Bio gas is the main significant off grid energy system accepted by the farmers of the country. The cattle population of the country helps to practice such energy system in India. The bio gas provides gas to the domestic purpose, gas for lighting the lamps and also provides organic fertilizer as by-product for the agricultural practices.

The wind power is another source for drawing water from underground, wells and tube wells for the irrigation purpose. But it is observed that the physiographic condition required for the installation of water pumping wind mills is not available everywhere in the country. So the physiographic limitations for this method is main cause of the development of the water pumping wind mills in India.

The growth of the street light system in the region is decreased suddenly because of the lack of maintenance and security. The progress of home lighting system is also insignificant. The climatic condition of the country and the temperature range between 10° C to 37° C helps to the installation of the SPV pumps in all the states in large quantity but only Punjab is leading for installation of such SPV pumps.

The use of the off grid energy system devices are reducing the expenditure on grid interaction. It also helps to sustain the natural resources and protects the natural environment. Once the windmills are installed for the water pumping it does not require other means of natural resources and automatically reduces the expenditure.

But the awareness among the people for installation of such off grid energy system devices is needed to be strengthened. It is also needed to increase social and environmental awareness among the people for adoption of these techniques.

The use of these energy devices will be the concrete solution on load shading in agricultural, domestic purposes and also for village lighting systems.

The participation of NGOs big farmers and individual owners leads to promote for installation of such system devices for agricultural, domestic, home lighting and also street lighting systems.

It is suggested to make compulsory to include the planning of installation Hone lighting and the SPV pump system for final proposal to the construction of building to an individual and also to developers for construction of buildings.

It is also suggested to the peoples of rural community for construction of the biogas for generating gas for domestic purpose and utilization of the same gas for lighting the lamps in the home.

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