ROLE OF SOLAR ENERGY IN DEVELOPING SMART VILLAGES OF INDIA

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Abstract

There is dire need for designing and building smart villages in India as it is an agricultural country. Renewable energy like solar, wind and biogas have tremendous potential to develop the villages with sustainability. The application of solar pump for irrigation in farm of Gujarat state has been selected for case study. Solar energy can be used for irrigation purpose in farms of villages. In farms we can also have solar tractors, solar drip irrigation, solar lights, solar dryers etc. Solar Power acts like risk insurance by diversifying the source of farmer's income. Food crops are very prone to natural calamities, pests and irregular monsoon etc. It is observed that the rural population is suffering more for living than urban one which forces rural population to migrate to urban or semi urban areas. Smart village project can act as a buffer against the unsustainable growth of mega cities with expanding slums.

Keywords: drip irrigation, irregular monsoon, solar pump, solar tractor

INTRODUCTION

In India alone there are 6,00,000 villages out of which around 1,25,000 are backward. Nearly 800million people leave in villages of India. Indian government is taking uplifting of smart villages is taking special care for uplifting the rural and economically poorer regions. [1]. It has been correctly said by Mahatma Gandhi that "India lives in villages". Where agriculture is the main source of income. According to the planning commission of India, According to the Erstwhile Planning Commission of India, a place with a maximum population of 15,000 can be considered as a village. All such areas which cannot be considered as urban areas are considered as rural areas. Number of villages in India are increased to 6,40,867. This rural area has population of nearly 68% [2].It is observed that the rural population is suffering more for living than urban one which forces rural population to migrate to urban or semi urban areas. Smart village project can act as a buffer against the unsustainable growth of mega cities with expanding slums. To solve this problem, the center has selected 60 villages of three districts of Madhya Pradesh namely Rajgarh, Sehore and Satna to be developed under smart city project. In this smart village development, each village will be getting Rs. 25crores [3].

I. Objectives of Smart Villages

The objectives for development of the smart villages will be [4].

- Adoption of drought tolerant seeds of field and fodder
- Agro-forestry
- Establishment of fodder banks
- Water conservation techniques
- Energy management technologies by use of alternative energies
- Provision of climate change information etc.

I. MAIN SECTORS OF SMART VILLAGES

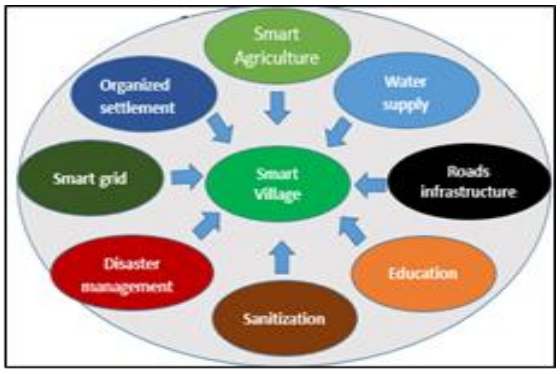

Fig. 1. *Main sectors of smart village*

Figure 1 shows the main sectors of smart village which are mainly as smart agriculture, water supply, roads infra-structure, education etc. Solar energy is considered to be the main source of renewable energy. It can cover many areas of research such as cooking, drying, desalination and power generation etc.

The availability of off grid electric power can be used for lighting, pumping, refrigeration, sanitation, education and communication. In addition, the availability of off-grid electrical power for decent lighting, pumping, refrigeration, sanitation, education, communication, audio-visual and entertainment facilities, will enhance rural life and development [5].Electricity from photovoltaic module is now accessible to millions of people living in villages. For energy demand less than 5 kilowatt hours per day solar lighting based on LED is proven to better alternative to kerosene lamp. Even diesel driven genset can be used with PV system in hybrid combination. Model Mera Gao has built micro grid by centrally located solar power combined with battery backup for the time of inadequate ration. [6]. Within a period of two years, Mera Gao has been able to provide electricity to 500 off-grid villages, providing 65,000 people with lighting and mobile-phone charging facilities [7].

A. Status of Village Electrification

The growth in agriculture in India has been moderate in the past decade and we have shifted from being a food importer to food exporter. According to Jha et al.[8]. "There have been some structural shifts in terms of composition of output with increasing trends towards commercialization and diversification of agriculture." Tractor consumes very high energy and are highly accentual as required for farm operations as well as for transportation and running irrigation pumps.

These trends are expected to continue affecting the development of more than 6,00,000 villages in India where nearly 70% of the population lives, many of whom have slender access to fossil energy and few resources to buy it[9].

99.25% of villages of India were electrified at the end of March 2017. Arunachal was the only state in India which was lagging behind the race of village electrification as only 76.63% of villages were electrified.

B. Solar Roof Top

It is one of the best alternative to use solar roof top for smart villages. Solar panel generates DC power. When this DC power is converted into AC power, nearly 15% of power produced is lost (for pico- systems). A solar panel of area 0.75m2 can generate 125W. Which can be used for lights, television, cell phone charging, and a refrigerator. When all these appliance can run with DC power the losses will be reduced to 7% from 45% in case of AC. Using 48V DC will reduce further power consumption and as a result it will reduce the cost. Ashok Jhunjhnwala and his team has designed "Solar-DC-Inverterless", which can be monitored by Bluetooth.

Use of Brushless DC motor fan, Cell Phone Charger Socket, LED tube light, Remote control for fan and LED tube light can further reduce the power losses. As a result of this, DC appliances can cost quarter that of the AC appliances [10]. Table 1 shows the list DC appliances which can be used for power saving.

Table 1: *LIST OF DC APPLIANCES*

Sr. No.	DC appliances	Power Requirement
1	LED bulb	5W
2	DC cooler	80W
3	Color TV	30W
4	DC Mixer	75W

A. Solar Based Sustainable Irrigation

TABLE 2: *COSTING OF SOLAR AND DIESEL PUMP*

	Capital cost (Rs.)	Net Present Maintenance cost (Rs.)	Net Present Fuel Cost (Rs.)	Total (Rs.)
SPV Pump	200000	3072	0	203072
Diesel Pump	25000	12289	278993	316282

Electrical Pumps: Farmers do not rely on electrical pumps due to odd hours of supply, they require high consumptive subsidies for the state and there is difficulties in load management. There is possibility of excessive ground water depletion.

b) Diesel pumps: Difficulties in regular diesel supply, they require high consumptive subsidies and also polluting environment by the CO2 emission.

Solar Pump: They act as a positive alternative, environment friendly and reduces inequity in access to irrigation [10].

Table 2 shows the comparison between solar pump and Diesel pump. It can be seen that the investment for SPV pump and diesel pump is Rs. 2,03,072 and Rs.3,16,262 respectively. solar power by itself acts like risk insurance by diversifying the sources of farmers' incomes. Food crops are very prone to natural calamities, pests and irregularity of monsoons [11].

It reduces the farmers' sole dependence on incomes from food crops and reduces the risk factor in earnings. Solar Power acts like risk insurance by diversifying the source of farmer's income. Food crops are very prone to natural calamities, pests and irregular monsoon etc.

[12].Dhundi Saur Urja Utpadak Shakahari Mandali (DSUUM) in Gujarat is the first solar irrigation cooperative in the world where farmers are selling surplus solar power to Discom by connecting solar pumps to grid (IWMI)[13].

D. Solar Cooking and Drying

Drying is one of the major food processing operations. The main objective of drying is to remove free water from fruits and vegetable to the extent, where micro-organisms do not survive, so that dried fruits and vegetables can be stored for longer period without rotting and deterioration in the quality of the product. Not only this but many agricultural, horticultural, and industrial products including chemical and pharmaceutical are dried for various purposes like safe storage, easy handling, value addition, further processing and quality improvement Solar drier removes moisture of the product and hence prevents it from getting decomposed. It not only saves energy but also saves lot of time, occupies less area, improves quality of the product, makes the process more efficient and protects environment also. The main motivation for this work is to design a two-in-one solar cooker cum dryer, which is portable, easy to handle, befitting for a domestic usage and pollution free as well. Such dryers are highly essential in monsoon season when conventional open drying is not possible [14-18]. Smita Joshi et.al has shown calculation for roof top building of 1 kW under smart solar house. The prize of solar panel is reducing at very fast rate. With government subsidies Smart roof top of 1 kW capacity costs approximately Rs.37,000 only. Smart tractor prototype and solar aircraft prototype were developed which can be used for multiple applications by the farmers [19-23].

CONCLUSIONS

It is very much clear that these above mentioned technology is currently beyond the reach of all off-grid villages but the concept of smart village for poor farmer with the use of renewable energy sources can become a boon to village people and can improve the economic condition of the nation which has agriculture as the main profession. Solar pump can be the better option compared to the diesel pump as it is environment friendly and cost effective in longer run. Smart roof top is the best alternative as due to the government subsidies the payback period becomes less than 1.5 years. Use of solar tractors can be motivated by the government which can reduce the use of conventional fuel like diesel. Solar Power acts like risk insurance by diversifying the source of farmer's income. Food crops are very one to natural calamities, pests and irregular monsoon etc.

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