

Solar Energy Application in Indian Irrigation System

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ABSTRACT

The electricity deficit and high diesel costs influence the pumping needs of urban water supply and irrigation; hence, the use of solar power for water pumping is a viable alternative to traditional water pumping systems dependent on grid power and diesel. In recent decades, attention has been given to clean and renewable energies from the vast majority of countries' priorities in the environmental and economic sectors. Agricultural sector is backbone of Indian economy as population increases demand of water also increases. Extract and transfer of water to agriculture and drinking is equals high-energy consumption. One of the best solutions is to use of an abundant and almost free solar energy to supply energy in all sectors, especially the irrigation sector. In the growth period of crops, when irrigation is often required, there are a high of solar radiation comes from the sun. This study shows that in India, like many other developing countries, the weakness of using this important source, the program of converting solar energy, and photovoltaic pumping systems use. This paper summarizes solar energy development and its application in the irrigation system and comparing them with the conventional diesel pumps. The expected results of this paper are to encourage the politicians, statesmen, and professionals to planning and policy-making the use of the green energy industry in the water sector that could pump water to the villages and agriculture and jump in the energy sector to the economic and Sustainable development.

1. Keyword : - *Solar pumping system, Solar Panel, agricultural area, solar photovoltaic array etc....*

1. INTRODUCTION

It is well known fact that Indian economy is one of the leading economies over the world. Among the various sectors in the Indian economy, agricultural sector provides the largest contribution to develop the nation. In order to achieve extreme manpower utilization and highest return in a given postulated it is required to promote different engineering methods which are recently used in today's global market [1]. Since there is a snowballing in usage of energy, the nonstop decrease in prevailing sources of fossil fuels and the rising issues in relation to the environment pollution, we have been pushed to discover renewable energy sources like solar energy, wind energy, etc. [2]. Solar energy is one of the greatest plentiful resources of energy in this universe. Besides being a solution to today's energy problem, Solar power also acts as a pollution free form of energy. Photovoltaic generation is an effective method for consuming the solar energy [3]. The solar energy projects in most of the developing countries of the world are diverse, such as rural power supply, communication services, water pumping, street lighting, cooling and heating of residential and commercial spaces, heating of water etc. that protected the environment [4]. Handling with the current situation of energy problems in India, irrigation system using solar power can be opted for farmers to manage their agricultural works. It is a finest technique to produce the energy in an eco-friendly manner after a primary investment [5]. One of the most significant usages of solar energy is providing drinking water for small communities which has the around thousand members [6]. The World Bank estimates the number of people who live in remote rural areas and do not have safe drinking water in developing countries about one billion people [7].

According to the distant villages of the nationwide grid, supplying energy and drinking water to the rural population is very difficult and costly. For this reason, the policy of exploiting local energy sources, such as solar energy, has been recognized for many years as a useful solution. One can mention the benefits of using local energy, improving health and well-being, boosting agriculture through irrigation, access to safe drinking water and providing residential lighting and reducing urban migration. At present, more than 160,000 villages worldwide are based on solar energy [8]. Among the many uses of solar energy, photovoltaic pumping systems have been widely welcomed in the last two decades. According to World Bank reports, up to 1993, ten thousand photovoltaic pumps were installed and operated worldwide, and by the year 1998, there were 60,000 photovoltaic pumping systems [9]. Solar water pumps are very efficient in areas where the expansion of the power grid is not feasible. Even in areas where the connection to the national grid is possible, the use of photovoltaic pumps is preferable for several reasons [10]. Solar pumps can be used in numerous capacities according to the necessity of water [11]. Today, the implementation and exploitation of photovoltaic pumps system in developing countries are growing faster than in developed countries. The reasons for this are as follows. restrictions on the distribution of the power grid, money restrictions for the import of oil and The Government's commitment towards rural population, providing electricity, health, and educational programs that have been guaranteed by international organizations [12]. Therefore, Governments in developing countries have decided to invest in the production of photovoltaic pumps system. Most of these studies began in 1979 and continue to this day [13]. The cost-effective economics of the photovoltaic pumps were fixed in comparison with the diesel pumps. In addition, during the survey of the inhabitants of the region, great reliability, and supply of water volume required by photovoltaic pumps were confirmed. Studies of photovoltaic pumps system in India confirm the economic justification and social benefits of these systems [14].

2. SOLAR PUMPING SYSTEM

Photovoltaic is being used for pumping for an extensive kind of processes, especially for water irrigation in agricultural area. It can be also used in refrigeration of fruits and vegetables, fencing, cattle lighting and insects controlling. The techniques which are being used in the PV system is applicable to only those activities that have need of slight power input. They are inappropriate when it comes to large power consuming areas like rice mills and high powered agricultural processing [15]. In current situation, under the hot sun, farmers find difficult to irrigate their plants to maintain their crops green. They suffer because they have no appropriate idea about obtainability of the power. The solar pumping system offers an idea to solve this problem. Generally, the solar pumping system has the following main parts: Electric solar panels pump controller, submersible pump, converter, storage tank and rechargeable battery. The illustration of solar pumping system is shown in figure 1.

2.1 Solar Panel

Solar panels are manufactured with solar cells which comprises of semiconductor materials. The main purpose of solar panels is to change solar power into DC electrical power. The rating of the load determines the number of cells needed and their size. The higher amount of electric power can be produced with the help of collecting solar cells. However, the solar panel should be placed accurately at precise angles towards the sun rays. The size of the pump is being decided in accordance with the photovoltaic cells. The solar submersible pumping system need to be operated along with a PV array of capability with the value ranging between 250 to 550 watt peak, and are being calculated through several typical test. Numerous modules in series & parallel can be utilized to acquire the adequate PV power output. When the PV modules are involved in typical test conditions, it should have a minimum of 74- watt peak.

2.2 The Submersible Pump

The submersible pump is often placed in a stainless steel case, which is located in a well pit at the joint of the open channel and the natural stream course. The pump controller is used to pump water towards the water tank within a specific time period using the control unit. The size of the solar pumps is determined by the total depth of the well and the longitudinal and local losses of the piping system in pumping from the well and the required water flow.

2.3 Solar charge Controller

A charge controller is very significant electrical device in any solar-power system. It allows correct charging voltages to the batteries. The main purpose of charge controller is to regulate the current as well as voltage from

the solar panel. It also used for charging the battery and protect the battery from over and undercharging conditions.

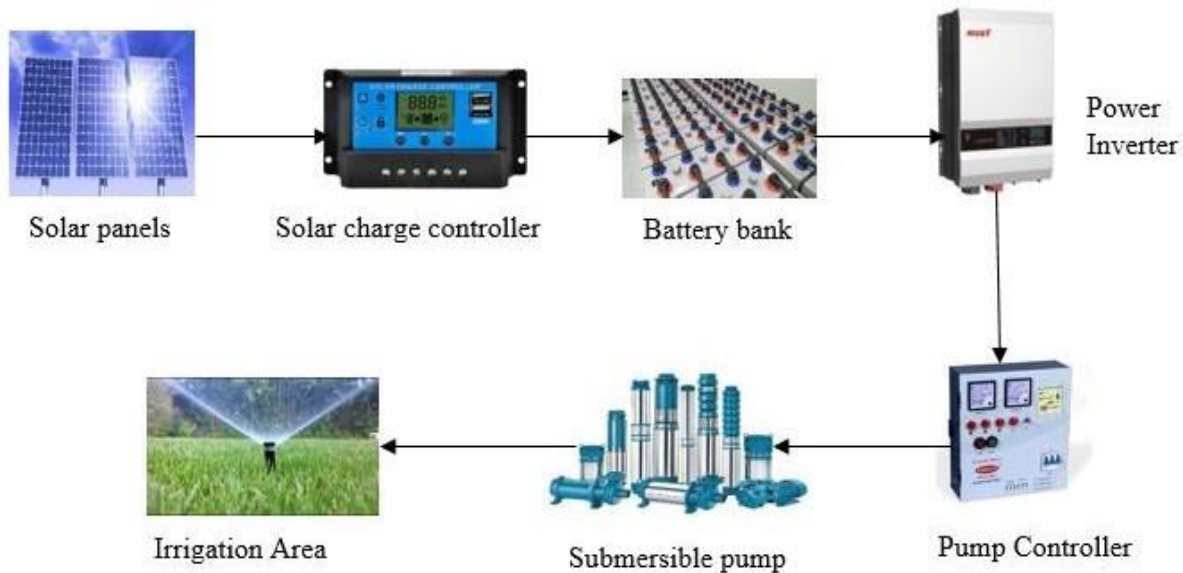


Fig -1: Solar pumping system

2.4 Battery

The battery is generally used for store current that is formed by the PV panel and delivered to the equivalent loads. The batteries requirement may be varied according to load requirement. The photovoltaic system being large, needs the solar panel as its component in order to produce and deliver the electricity in rural and urban area's applications. The electric current produced by the photovoltaic panels is direct current (D.C). The voltages of these plates varying according to the variation of temperature and solar radiation. Solar cells are available in three types of monocrystals, polycrystals, and morphs. The pump controller adjusts the power exchanged between the solar panels and the pump. This controller protects the pump against current fluctuations and provides conditions for permanent output. In addition, if the pump is dry, the pump controller can automatically shut down the system, also the pump can be shut down by installing a floating switch connected to the controller when filling the tank. Control circuit permits the battery to charge. A converter circuit transforms DC supply from the battery to AC supply and it gives power to the water pump which is sunken into the well. Before discharging the water into the agricultural arena, the water is drove into an overhead tank for keeping save the water provisionally. The storage mechanism in the solar water pump system can be either water storage method or power storage method. The storage water method most economical way to save water and the most reliable method. Of course, the system can save the power for using the pump during cloudy days and at night with battery embedding. Although this method has high reliability, it also requires higher costs and more maintenance than the first method.

3. A REVIEW: USAGE OF SOLAR ENERGY IN AGRICULTURAL AREA

Water pumps in most essential application in agricultural sector, the use of solar energy for lifting the water is a best option for agricultural development and efficient use of available water resources. There are various stages to implement the solar water pump to the irrigation system, and are as follows, (i) Determine the quantity of water requirement which includes climatic analysis. (ii) Calculate the power requirement for pumping water. (iii) Estimate the rate of energy production and climatic adaptation. The aim of the study was to estimate the rate of energy production and climate adaptation [24-36]. Water requirement for irrigation, which is completed by use CROPWAT8.0 software for two types' crops one is winter wheat it planting time in November and harvest time in July. So during the design stages of the required flow drip irrigation system 33.3m³/h (25.9lit/s) and 7.5 hours and duration of irrigation in two turns. 27-meter system and the dynamic head static head are estimated to be 5 meters. The pump should be selected as the height of 32 metros of water [15].

4. DESIGN OF SOLAR PHOTOVOLTAIC ARRAY

The solar photovoltaic array consists of several photovoltaic solar modules size basically to satisfy the energy needs of pumps has been designed. The connection of the PV modules in series and parallel, depending on the voltage and time required are made. The solar array installed in this field Fixed type can be either track one. The tracking system will considerably improve the efficiency although it adds an additional cost of tracking equipment. 40 to 60% of the photovoltaic panels of the overall system costs. The power output of the PV array with respect to the difference in the location of the solar radiation and atmospheric factors, different temperatures, so the appropriate size according to the required page is very important and the process is difficult. The size of the PV array can be done regarding the need to lift the daily required an amount of hydraulic energy of water HE, Average daily radiation on photovoltaic array E and the daily subsystem efficiency. This method makes the system more accurate and reliable.

Table -1: Electrical characteristics of a multicrystalline solar panel.

Electrical characteristics	Values
Maximum power (Pmax)	170 W
Voltage at maximum power point (Vmax)	35.4 V
Current at maximum power point (Imax)	4.8 A
Short circuit current (Isc)	5 A
Open circuit voltage (Voc)	44.2 V
Temperature coefficient of short circuit current (Isc)	0.065± 0.015 (%/°C)
Temperature coefficient of open circuit voltage (Vop)	-160± 20mV
Temperature coefficient of power	-0.5± 0.05 (%/°C)
NOCT (°C)	47 2

4.1 Solar water pump comparing with diesel water pump

In this section, a detailed analysis carried out between solar water pump and diesel water pump is the perspective of cost and reliability. Diesel water pumps, are usually cost effective at the initial time, though when it comes to operation and maintenance, they are costly. Unlikely, the solar water pumps are having maximum initial cost and little for operation and maintenance. In consistency, it is more liable to make use of solar water pumps rather than using diesel water pumps. From the environmental point of view, diesel driven water pump is produce various gases which change climate as well as health hazards. This is made possible where diesel water pump gets rusted when it is actually not in use, but solar pumps may survive for years, even if it is not used properly. The preliminary cost of the solar water pump is frequently unapproachable to the project executors to expanse their funds as extreme as possible to grasp the highest number of receivers with the use of a low primary optimum cost.

5. CONCLUSIONS

The solar power is suitable for agricultural applications such that electrical fencing, threshing, aeration, grinding, irrigation, purification etc. Nowadays the farmers from India are generally using the solar energy in the water sectors especially in irrigation sectors for their agricultural farms. However, farmers are thinking the solar water pump systems initial cost is higher than diesel water pump system but never thought generation and maintenance costs of both systems. One of the most importing things is the solar water pump system PV array can be used for electricity generation when the irrigation is not a requirement. Solar water pumping systems can easily meet the irrigation

water requirement for landholding system marginal farmers. Due to facing regularly increasing fuel cost, pump sets is being deployed every year in India. Solar water pump system helps in the reduction of diesel consumption. The solar water pump is no novelty it has existed since three decades also solar water pump are available for different types. And despite being blue, uses up to 30% of the country's productive energy would devour precious resources continue to use most of the electrical energy production. it insists that many costs on society and the environment, based on the frequency in the electric sector and thermal power plants to the environment imposes. From the above, we conclude that, compared with diesel engine pumping system, the solar pumping system is more feasible for irrigating the farms in India. In economic basis, solar water pumps are not more expensive if the solar energy are used continuously, though their capital cost is high.

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