



## Solar Photovoltaic Water Pumping System for Pressurised Irrigation

Saad Asghar Moeeni<sup>1</sup> and Monawer Alam<sup>2</sup>

<sup>1</sup> Department of Civil Engineering, Jamia Millia Islamia,

<sup>2</sup> Department of Electrical Engineering, Integral University

Email: smoeeni@gmail.com

### ABSTRACT

Solar powered drip irrigation is the marriage of two systems that have enormous independent impact. Solar powered pumps save potentially hours of labor daily in rural off-grid areas where water routing is traditionally done by hand by woman. They are durable and immune to fuel shortage and in the medium-to-long-term costs less than traditional diesel powered generators (e.g. Kohle et al. 2002). Automated Drip Irrigation System provides a sustainable solution to workmanship that is needed for flooding irrigation. The use of this photo-irrigation system will be able to contribute to the socio-economic development. It is the proposed solution for the energy crisis for the Indian farmers. This system conserves electricity by reducing the usage of grid power and easy to implement and environment friendly solution for irrigation fields.

**Keywords:** Drip irrigation, Solar powered pumps, Solar photovoltaic's, water pumping system, irrigation, photovoltaic (PV) pumping system.

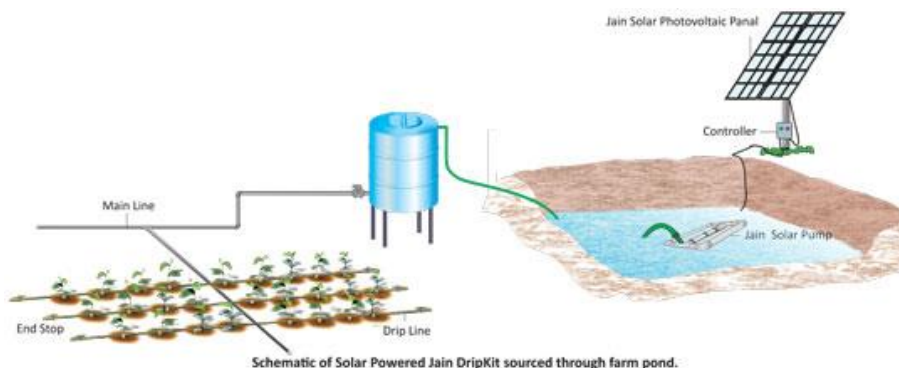
### 1. INTRODUCTION

The aim of this study is to provide small farmers in developing countries with an affordable, eco-friendly and easy to maintain irrigation method that promotes the sustainable use of Photovoltaic energy. A suitable source of Power for irrigation include the use of gasoline and diesel powered water pumps. It is risky for small farmer to rely on oil for food production given the fluctuation of prices. The use of photovoltaics to provide electricity eliminates the need to use gasoline or diesel. The benefit also applies to small scale and solar powered drip irrigation which when well designed and implanted presents great potential for productive uses of photovoltaic.

### 2. PV APPLICATIONS

Solar panels are used in a variety of applications. The applications vary from small simple lanterns to large elaborate power plants.

- i) Rural and urban households for domestic purposes like lighting.
- ii) Communities, small industries and institutions like schools, for lighting as well as for powering television sets, computers, etc.
- iii) Water pumping systems.
- iv) Telecommunications, as these systems are often installed in isolated places with no other access to power.
- v) Refrigeration of vaccines at health center in rural areas. Such solar refrigerators are also utilized to store blood plasma. WHO supports programmes that install solar power for medical purposes.



### 3. SYSTEM COMPONENTS

The whole system of solar pumping includes the panels, support structure with tracking mechanism, electronic parts for regulation, cables, pipes and the pump itself.

**i) Solar panels or modules:** Solar panels are the main components used for driving the solar pump. Several solar panels connected together in arrays produce DC electricity, interconnections are made using series or parallel combinations to achieve desired voltage and power for the pump.

**ii) Solar Pump:** Centrifugal or submersible pumps are connected directly to the solar array using DC power produced by the solar panels. Solar pumps are available in several capacities depending upon the requirement of water.

**iii) Support structure and tracking mechanism:** Support structure provides stability to the mounted solar panels and protects them from theft or natural calamities. To obtain maximum output of water, a manual tracking device is fixed to the support structure. Tracking increases the output of water by allowing the panels to face the sun as it moves across the sky.

**iv) Foundations (array and pump):** Foundations are provided for support structures and pump.

**v) Electrical interconnections:** A set of cables of appropriate size, junction boxes, connectors and switches are provided along with the installation.

**vi) Earthing Kit:** Earthing kit is provided for safety in case of lighting or short circuit.

**vii) Plumbing:** Pipes and fittings required to connect the pump come as part of the installation.

#### How the solar pump system works

A 50-Watt photovoltaic solar panel can power a 12-volt pump, which can move 1,300 to 2,600 l/h. Standard plastic fittings and half-inch piping connect these elements to a water saving tank of 500 to 1,000 L. A study stand should be built for the water tank to provide gravity flow, and a frame should also be constructed to provide the best angle for the solar panels. Multiple filters are needed to protect the life of the pump and minimize clogging in sprinkler emitters and tubes. A solar pump combined with affordable drip irrigation kits can be used with a wide variety of high-value crops to increase water efficiency, minimize fertilizer loss, and irrigate hilly terrains.

### 4. ASPECTS

In general, the investment required for a PV pumping system is Rs. 250-300/Wp (where Rs is the Indian rupee and Wp is watts peak). For example, the cost of a 900 Wp unit would be Rs. 225,000-270,000, but with subsidies, this will be reduced to Rs.50,000. To make the best use of solar energy, the PV system, the groundwater pump and the water distribution system have to be well matched. The PV power provided must cover the power demand of the pump adequately. This is determined by the relationship between the required discharge flow, the total head and the pump efficiency. This depends on the type of pump, which in turn depends on the depth of the available water source. Although positive displacement pumps are preferred for large heads, centrifugal pumps are most commonly used for this as shown in Figure. 1

Another important aspect would be the ability to model the potential solar radiation, PV power output, and subsequent water output for the purpose of irrigation scheduling. Photovoltaic powered water pumping systems (photo irrigation) have been studied by researchers for many years. Studied mostly concentrated on DC motors because energy obtained from solar panel is DC (Lawrence et al, 1995; Dursun and Saying, 2005). These are shown that better results were obtained for performance analysis (Kolhe et al. 2004, Kolhe et. al, 2000) Drip irrigation system has advantages over flood irrigation, for bringing efficient utilization of water sources, preventing erosion and growing of weeds (Cuadros et al, 2004), decreasing moisture stress (Pande et al, 2003), no operation cost, providing opportunity for local energy sources and exhibiting a parallel point of view with water requirement (Ghoneim, 2006). In terms of automation, developed wireless technologies, researches focused on automatic irrigation with sensors in agricultural systems (Kim and Evans, 2009, Stone et. al, 1985).

The cost of solar PV has come down and cost of diesel has been regularly increasing. At present the cost of solar PV is very much less than diesel, solar PV cost shall be half of diesel within three to four years, since approaching towards grid parity. 400,000 telecom towers are associated with diesel generating sets having capacity 3 to 5 kW 60% Telecom towers located in urban and semi urban areas and 100% located in the villages are run by diesel generating sets. In fact, off-grid potential is unlimited in India and is about 20 to 25% potential of the world (Arora,2014). Solar water pumps are often thought of as being an expensive technology, which is not able to pump enough water and which is not durable. However, solar water pumps have come a long way in 25 years and today there are solar pumps on the market which have improved on previous technology, e.g. Submersible pumps which can pump up to 200 m heads: pumps that are able to pump larger volumes of water, e.g.” At 100 m, about 10,000 L/day; At 50 m, about 20,000 L/day. Above performance can be doubled through dual system (if the borehole allows this).

### 5. CONCLUSION

Photovoltaic systems are especially designed to supply water and irrigation in areas where there is no mains electric supply. Their main advantages over hand pumps or internal combustion engine pumps are their practically zero maintenance their long useful life that they do not contaminate and finally that they are straight forward to install, it is estimated that India's potential for solar PV pump sets, that is at least 255 billion litres of diesel savings.

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