Floating Solar Pumping System

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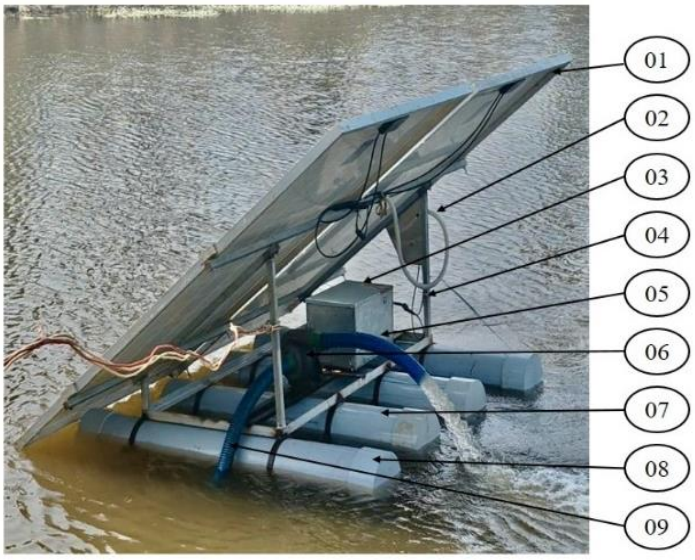
Introduction

With the rising demand for sustainable and energy-efficient solutions in water management, solar-powered pumping systems have emerged as a promising alternative to conventional energy-based methods. Among these, the development of floating solar pumping systems represents a significant innovation, especially in regions with limited land availability and abundant water bodies. These systems utilize photovoltaic (PV) panels mounted on floating structures, enabling efficient solar energy capture while simultaneously reducing water evaporation and algae growth. By harnessing solar energy for irrigation and water supply, floating solar pumps offer a clean, eco-friendly, and cost-effective solution. This approach supports the goals of renewable energy integration, climate resilience, and agricultural sustainability, particularly in off-grid and rural areas.

Solar pumping has less GHG contributions to the atmosphere also can be a replacement for diesel operated or electric power (power grid) supplied pumping system where sufficient solar energy flux is available. While solar pumping unit can be installed in the ground, but can also be mounted over a well-designed floating unit so as to use for pumping surface water while remaining floated over the water besides reducing the evaporation losses from the surface water sources.

Specifications of CRRI floating solar pumping System:

A floating solar pumping system was developed at ICAR-CRRI Cuttack and was tested in a surface water pond at the farm. The unit comprised of solar photovoltaic panels (2nos, 335Wp) mounted on a PVC floating base, a DC motor (40V, 500W), pump and solar panel mounting frame. The floating frame has been designed keeping 50% submergence in the water body for better stability of the floater. The calculated total buoyancy force acting over 4 pipes(200 mm)has been 981N.The discharge of solar-powered water pump has been observed between 3,000 to 7,000 litres per hour (lph) which varied with water head (lift distance), and available sunlight. The developed floating solar pumping unit is shown in Figure below.



Serial No.	Name of the Parts
01	Solar Panel
02	Motor Switch with MCB
03	Motor Box
04	Frame
05	Outlet Pipe
06	Pump
07	Float Pipe with Length 1.3m
08	Float Pipe with Length 1.5m
09	Inlet Pipe

Fig.1. CRRI developed floating solar pumping unit [**While operating, run the pumping unit for about 20 minutes. Stop for 10 minutes, then run the pump again for about 20 minutes. Use this unit in above manner while irrigating].

Table1: Design specifications of the developed floating solar pumping unit:

Parameter	Detail (value)
Number of floats	04
Diameter of each float	20 cm
Length of float	1.50 m
Weight of the developed floating pumping unit	88 Kg
Vertical tilt angle of the solar panel from base	31^{O}
Total Buoyant Force	1725.0 N
Percentage submergence of the float under water	50%
Maximum pump discharge with optimal delivery head of 1 m	12000 lit/h

Performance of the developed pumping unit

The developed unit was tested against incoming solar radiation vs. pump discharge and also for the variations in discharge rates pertaining to incident solar radiation and varying pump delivery heads during month of December, 2025 at CRRI research farm. The unit was also tested with drip irrigation system. Maximum pump output was obtained during 10.30 am to 12.30 pm in a bright sunny day due to maximum incident radiation during this time period in this month. It was observed that during winter the unit can be used for operating drip irrigation system between 9.00 am to 2.30 pm at the location with a peak discharge attainable during 10.30 am to 12.30 pm (Figure 3) with maximum attainable inlet pressure to drip lateral is 0.5 kg/cm^2.

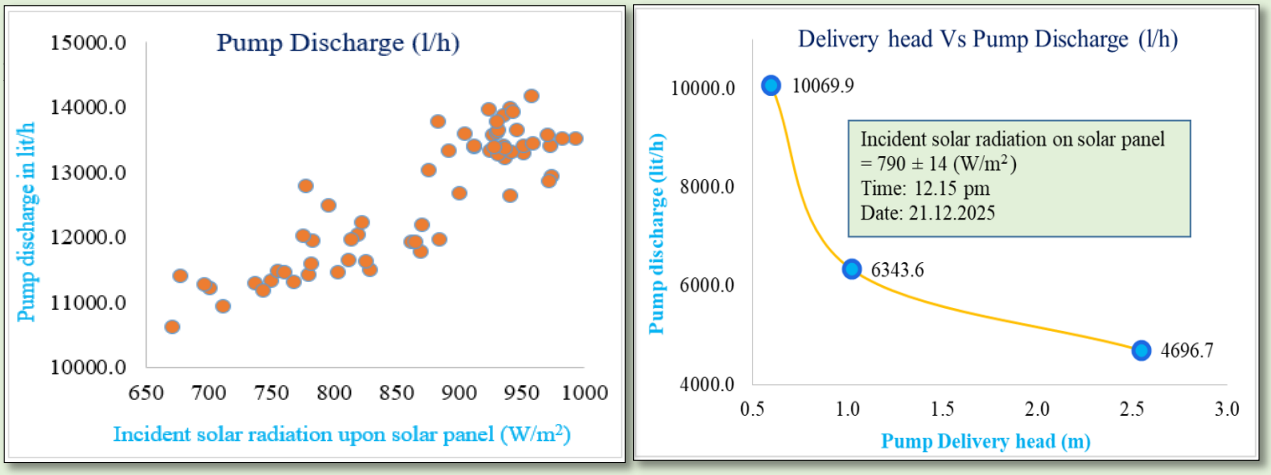


Fig.2. Incident solar radiation Vs. pump discharge (Left) and variation of pump discharge for varying pump delivery head (Right)

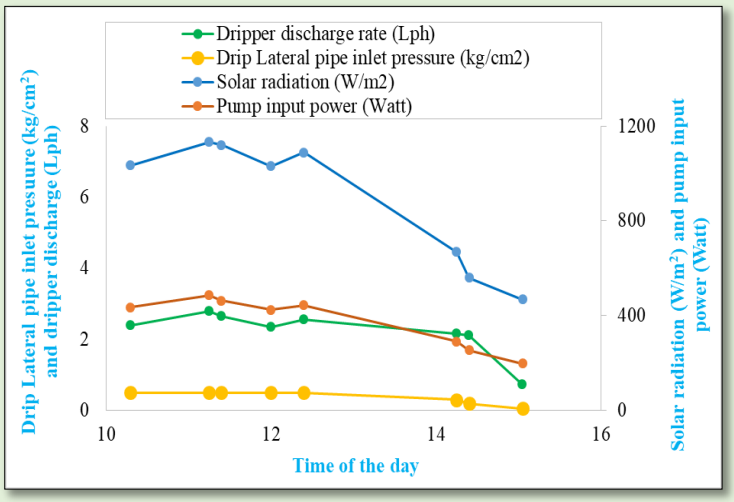


Fig.3. Available pump inlet pressure, lateral pipe inlet pressure and dripper discharge

Fig.4. The floated solar pumping unit in operation

Advantages of the developed unit

Uses Clean & Renewable Energy	• Powers water pumps directly from sunlight for irrigation or water lifting. Can be off-grid, ideal for remote rural areas.
Efficient Pumping System	• Powers water pumps directly from sunlight for irrigation or water lifting. Can be off-grid, ideal for remote rural areas.
Improved Solar Efficiency	• Water under the panels helps cool the system, increasing panel efficiency
Cost Savings	• Low operating costs after installation. Saves on electricity bills or diesel expenses.
Easy Maintenance	• Panels are often less dusty over water, requiring less frequent cleansing. Floating platforms can be accessed and maintained without major disruption.
Eco-Friendly	• No noise or air pollution. Minimizes land disturbance, maintaining local biodiversity.

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