Project Proposal

Topic: Solar Flood Irrigation

Solar (photovoltaic) powered pump systems (PVP) use lifted water for traditional irrigation systems, like rice (flood) irrigation.

Introduction

Traditional irrigation systems use minimum pressure (head) to lift and distribute water to the crops or plants by flooding or in form of furrow irrigation. Supplement irrigation supports the natural rainfall and therefore reduces the risk of crop loss and improves yield and quality. In general irrigation aliments crops with water in the dry season or arid regions and is a main factor for the success of agriculture production. Water demand depends on crop water requirements, detailed information can be found in special literature or gained from local experts. The efficiency of traditional irrigations systems is lower when compared to modern systems, but can be improved by good irrigation management and water-tight distribution (conveyer) systems. Improvement in efficiency can be as high as 40 to 70 %.

In many Asian countries, where rice production with irrigation dominates the staple food production, the energy consumption for pumping with diesel engines dominates the fuel demand and is therefore the main cost factor. PV systems do not need any fuel, so that despite higher setup cost pay off the investment in short time.

Thanks to the flexibility of PV pump systems, traditional irrigation systems can easily be combined with solar pumps (PVP). Some advantages are:

- The PV generator can be erected at any place, preferably closer to the water source and thus reducing cable length.
- The PV generator (power) can be flexibly extended, if the farmer needs more water for new acreage.
- Modern PV pump systems need no fuel or lubrication. Hence the PV generator can be installed in the water or in environmentally protected zones where no emission of fume and noise is tolerated.

- With solar tracking systems the solar energy yield and accordingly the amount of daily pumped water can be increased by approx. 33%. This reduces the number of panels needed to run the system and lowers the investment.
- PV panel manufacturer usually give performance warranties between 20 to 30 years. This ensures long-term safety of the investment.

Flood (Border) Irrigation

Water is distributed at low pressure through pipes and hoses to the water outlets, so called single or multiple water intakes. The results are water fronts, which move from the water inlets to the field ends on a nearly horizontal surface. The field length depends on the flow rate, soil texture and surface inclination. PV pumps lift the water from canals, rivers or wells; afterwards the water flow is done by gravity, so called “gravity irrigations systems”.

For border irrigation, used mainly for paddy rice production, the water is poured into a basin until is reaches a certain height related to the plant development of e.g. the rice seedlings. The young plants (roots) are complete grown in stagnated water. Periodically the irrigation is repeated until the crops are mature and ready for the dry harvest.

The water borders (levees) are natural property limits or man-made for irrigation schedule purposes: Normally for such kind of traditional irrigation system a proper drainage system should be included.

The solar pump system could be as close as possible to the water source or be made floatable to be moved along the irrigation canal or natural rivers. The overall irrigation efficiency is higher as less percolation and drainage losses occur along the open ditch conveying systems.

Particular in regions where the supply of fuel is a major problem or fuel supplies often get stolen, solar power could be an ideal solution to enhance the food security. Many countries support the introduction of this renewable energy, also to reduce the heavy burden of costly fuel imports. Normally these are sunshine countries with abundant solar radiation during the rice growing season.

The management of the solar pump for flood irrigation is comparatively simple. Using an ordinary water meter you can decide upon the right amount of water inside the field boundaries and monitor the daily pump capacity.


Pressure

The system pressure is very low (1 to 3 meters). After being lifted to the field level, the water is merely poured into the irrigated fields (landscape). Therefore a high volume, low pressure pump is needed. In this case a centrifugal pump is most adapted for open surface water with a low content of dirt or organic material.

Lift

The normal lift is approx. 1 to 15 meters. For pumping from often shallow sources, floating pumps can be used that always stay in an optimum distance to the water source. Alternatively a submersible pump can be installed in a horizontal position, if vertical is not possible or missing the required water cover. Dry running pumps with PV-operated motors do not have the required high flow rate; therefore submersible pumps are the better solution. Besides they come with better motor cooling and are saver with regard to theft protection.

Nighttime Irrigation

PV-powered pumps, lacking solar irradiation, cannot operate at night if not amended by costly battery systems. For nighttime irrigation by PV pump systems there are the following economical solutions:

Reservoir (tank)

The tank capacity should be equal to the minimum daily requirement as security stock. This is only for very small plots (field beds) feasible. For medium size fields (basins) a reservoir with plastic lining is an option. In this case often a booster pump is requested, if the water level is too low for gravity flow. For bigger systems ONLY the daytime irrigation is possible. But the solar pump controller has an early morning start up, that means it uses the whole daytime hours and even if the sky is cloudy or it rains, the pumps is working, but with a lower capacity.

Water Requirements

Rice (paddy) and other border irrigated field crops have specific water demands and irrigation timing (schedule). Very often the soil (field) must be wetted for field bed preparation (paddling). The crop water requirements (Kc values) can be found in the specialized literature (e.g. FAO standards). If you have rainfall during the rice production period (Monsoon), the effective rainfall must be subtracted from the water demand, inclusive the water capacity in the root zone.

Examples for a LORENTZ PV Pump System for Flood Irrigation

Like all other pumps, LORENTZ solar pumps are defined by the vertical lift [H, measured in metres] that must be coped with and the water volume pumped up [Q, measured in m^3/day]. The following example shows standard demands and pumping solutions in flood irrigation (paddy rice)

Example A

Model:
PS 9K C-SJ95-1 with a 8.400 W(p) solar generator, 500 V DC
(with LORENTZ tracker)

Output:
Volume [Q] = 600 m^3/day at a lift [H] = 15 m

(600 m^3/day = 159.600 US-Gal./day; 15 m = 46 ft)

With 600.000 l (159,600 US-Gal.) per day you can provide water for the following flood irrigation area:

Evapo-Transpiration (ETo)	Irrigation Efficiency	Irrigation Area
5.5 mm/day	65 %	app. 7.1 ha (28.7 acres)
7.0 mm/day	50 %	app. 4.3 ha (17.3 acres)

Note: Calculation is based on assumption on a location with moderate temperature and dry summer seasons .

About LORENTZ

Since more than a decade, LORENTZ successfully produces solar pump systems and solar tracking systems. In R&D, LORENTZ pays special attention to the maintenance-free long-term service of its products. The success of this concept is proven by the daily performance of LORENTZ pumps and trackers in more than 100 countries all over the globe.

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