Solar Water Pumps and Appropriate Agricultural Technologies: Managing Irrigation Efficiently and Reducing Carbon Foot Prints

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Irrigation system is India is often thought of as big dam, hundreds of kilometres of canals incurring huge capital expenditure. Hence policies at central and state level are mostly tilted in favour of mega project often neglecting micro level solutions. Solar water pumps coupled with appropriate agricultural technologies and water conservation at local level has huge potential in India as it provides water for irrigation to villages at micro level. Such local level provision of water leads to less wastage and no use of electricity or diesel for pumping out water, thereby reducing expenditure of farmers. Government and not for profits have been trying to pilot such initiatives in different parts of India which has thrown up important issues for irrigation system in India such as cost of solar pumps, building network of farmers who can invest collectively in the technologies, promoting water conservation through various harvesting structures at village level and making farmers aware of appropriate technologies such as zero tillage and laser land levelling for water efficiency.

The pilot of solar pumps by Sehgal Foundation in some locations of Bihar has brought out interesting experiences. Solar pumps can be very useful in Bihar as most of the forms are not electrified, so dependency of farmers on diesels water pumps is huge. Hence solar water pumps had been focus of Bihar Renewable Energy Development Agency which tries to promote use of solar pumps through schemes by giving subsidy ranging from 75 percent to percent. But the number of pumps available is very few mainly for demonstrations. NABARD also has a capital subsidy schemes for promoting solar photovoltaic water pumping systems for irrigation purpose wherein it provides 40 percent subsidy. However, the process of accessing this subsidy is complex and farmers are not aware of the details for accessing these schemes, thereby making it unattractive to small farmers. Procedure issues in getting the solar pumps are still to be streamlined so that villagers can get such programmes easily (Durga, Verma, et al., 2016).

Sehgal Foundation follows a cluster development approach for making technology accessible to farmers. It has formed a solar pump group of 15 farm families whose fields are irrigated by one solar pump costing Rs 3.0 lakhs. One farmer contributes Rs 30,000/- and Sehgal

Foundation provides a grant of Rs 1.5 lakhs and Rs 1.20 lakhs is leveraged from government subsidies through effective partnership with banks and government agencies. The members of solar pump group who have not contributed to capital cost, buy water at the rate of Rs 40/ hour where as market rate of water from diesel pump is Rs. 90/ hour and it increases to Rs 130/- per hour during peak demand. But the rate per hour of solar pump is fixed and money collected is used for maintenance of the system. We put major emphasis on building capacities of farmers owning solar pumps to develop them as Entrepreneurs. These entrepreneurs are supported in establishing norms for solar powered pumps that can generate revenue through cost effective water-as-a-service approach. They are also trained on basic up-keep and maintenance of solar pumps and panels. They are also provided training on usage of water for different crops, micro irrigation, water harvesting in local ponds and zero tillage.

Zero tillage and laser levelling is not known to most farmers in India. Zero tillage preserves moisture in the soil thereby reducing cycle of irrigation for crops. Laser levelling technologies has also huge potential for saving irrigation water. It is a precision levelling technique for agricultural fields which levels the field making it slope less. Laser land levelling promotes water efficiency in flood irrigation and improves crop productivity. Water efficiency will reduce the cost of production and improved productivity will enhance income thereby making agriculture more remunerative for marginal and smallholder farmers. Water use efficiency in agriculture is also critically important for the sustainability of agriculture, particularly in water stressed region. Water saving in irrigation will reduce burden on ground water reserve and improve water security. These technologies have been potential for saving water in India.

Sehgal Foundation has piloted fourteen solar pumps in East Champaran and Samastipur districts of Bihar and the experiences of farmers show that it has good potential for irrigation not only in Bihar but other parts of India with high water table. However, these methods must be combined with other water saving technologies as mentioned above; otherwise it will increase water stress in the area.

Solar water pumps: Benefits for small farmers

-Type of pump: 2 HP, Submersible

-Gross irrigated output: 15 acres

-Water for field of 15 farmers

- Zero operational cost

Experiences of farmers who are members of solar water pump group

-Irrigation cost of farmers reduced from Rs. 900/ acre to Rs 250/ acre

- Timely and sufficient irrigation

- Irrigation as per requirement

- Reduced drudgery for women in fetching water for household and livestock

Other important aspect of solar water pumps usage is irrigation water is accessible at reasonable cost to poor and marginal farmers who had buy water from water sellers at prohibitive prices. Irrigation is a major input in agriculture amounting to about 70 percent of the total input cost, and use of solar powered pumps can decrease the input cost to 25 percent. For a small and marginal farmer this is considerable and can be game changer in making small and marginal farming more remunerative. Solar pumps are an attractive alternative technology for irrigation, which serve as a cost effective mode of irrigation with low maintenance requirements.

In addition, solar water pumps operate with zero carbon footprints in comparison to diesel pumps. Environmental impact caused use of diesel pump is often not known to people. According to a study, use of diesel based irrigation pumps to operate wells and tube wells across India result in the emission of an estimated 3.29 million metric ton of Carbon. This

represents approximately 1 percent of India's total Carbon emissions (Shah, 2009)[1]. Blessed with abundant groundwater resources, the major source of irrigation in Bihar is groundwater. This is mostly accessed through diesel based pumps. According to Agricultural Census (2010-11), Bihar has 30.52 lakh hectares of net irrigated area, of which 66 percent is irrigated by wells and tube wells. The number of shallow tube wells has increased significantly in last two decades. Their number in 2009 was estimated to be 25,267, most (46 percent) of which were owned by marginal farmers (Mukherji 2009). Ninety percent of these wells and tube wells use diesel pumps as lifting devices. Bihar, with 48% of India's diesel based pumps, is the primary contributor to the carbon emissions from diesel pumps in India.

So, zero carbon foot prints, irrigation water accessible to poor farmers and lower cost of inputs are the important benefits of solar water pumps. Use of solar water pumps combined with usage of appropriate technologies such as zero tillage, laser levelling and water conservation at local level can very useful for water and agriculture in India.

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[1] http://iopscience.iop.org/article/10.1088/1748-9326/4/3/035005/pdf