Farmer Producer Organizations as Solar Entrepreneurs

The Case for Solar Pumps as Business Investments

Shilp Verma[1], Suraj Murmu[2], Philip Kuriachen[1], Dharmendra Kumar[2], Suchiradipta Bhattacharjee[1], Nikunj Usadadia[1], Bhawani Shankhar Mahto[1]

[1] International Water Management Institute (IWMI), Anand, India

[2] Collectives for Integrated Livelihoods Initiative (CInI), Jamshedpur, India

IWMI International Water Management Institute

IWMI-TATA Water Policy Program

SE4RL Solar Energy for Rural Livelihoods

CInI An Initiative of TATA TRUSTS

Current Scenario

Solar-powered systems can be instruments for transforming energy-starved and relatively water-abundant agrarian economies by ensuring access to affordable and reliable clean energy for irrigation. The Government of India (GoI) launched the *Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan* (PM-KUSUM) to harness the potential for solarisation of irrigation operations. Under component B of PM-KUSUM, the program aims to deploy 2 million off-grid solar pumps nationwide by 2026. However, the progress on these targets has been rather lukewarm and uneven over the years. Only about 250,000 such systems have been installed nationwide and most of these are concentrated in specific geographies while the rest of the country has seen very slow expansion.

Off-grid solar pumps hold immense potential in the Gangetic plains of Eastern India and Central India's tribal highlands, currently dominated by diesel pumps. However, despite significant support from the central and state governments and civil society organisations, the expansion of solar irrigation systems in the region has been tepid, with the exception of Chhattisgarh. The states of Jharkhand, Odisha and Bihar, for instance, account for only 6.4 percent of the off-grid solar pumps, while Haryana, Punjab, Maharashtra and Rajasthan account for 75 per cent of off-grid installations under PM-KUSUM. Further, the promotion of solar irrigation pumps has so far focused on offering large capital subsidies to beneficiaries (ranging from 75 to 95 per cent). Recent studies also illustrate the wide variability in utilising installed solar irrigation capacity. For instance, a recent survey of solar irrigation pumps shows that systems in Odisha and Uttar Pradesh are being used for 15-41 days in a year (roughly 200-300 hours of operation), while those in Rajasthan and Tamil Nadu are used for 130-178 days (approximately 750-1050 hours of operation (GIZ 2021).

Should we target individual solar pump owners?

Promoting solar irrigation pumps through government programs in eastern India has focussed on providing subsidised systems to individual farmers. However, financing solar irrigation pumps through grants often leads to under-utilization of these assets as they tend to be used as backup options to existing systems (Durga *et al*. 2016). The large subsidy component also limits the number of solar pumps available, leading to elite capture of the subsidised systems. Small and marginal farmers also tend to be excluded as the small size of holdings renders ownership of solar irrigation systems economically unviable. Further, the relatively thin water markets in Central Indian highlands limit the possibility of small and marginal farmers benefitting indirectly from these systems. Thus, subsidised expansion of off-grid, individual SIPs generates non-inclusive and sub-optimal outcomes.

What are the alternatives tested?

High upfront cost has been a major roadblock for small and marginal farmers to access these systems. The average holding size per agriculture household is 0.22 and 0.40 hectares in Bihar and Jharkhand, respectively (NSSO 2019). The average monthly income earned from agriculture for an agrarian household in Bihar and Jharkhand stands at ₹2,700 and ₹1,100, respectively ($1 = ₹ 86). Even with government subsidies, a 5 kWp solar irrigation pump requires an upfront payment of at least ₹10,000 in Jharkhand and even higher in Bihar.

Several alternatives have been field-tested to overcome this hurdle and make solar irrigation more inclusive and accessible. One such alternative is the solar irrigation group (SIG) schemes, with 30 percent of the cost either paid upfront or financed through micro-finance institutions. This model overcomes the bottleneck of high upfront payment, but several of these systems remain under-utilized. The typical size of the SIG ranges from 5-7 members, and these systems tend to service only the member farmers. The limited development of water markets has limited water sales outside the groups in Jharkhand. In Bihar too, with more vibrant water markets, water sales to non-members were found to be limited as the gains tend to be distributed among the several members.

Another alternative model tested by the IWMI-Tata Water Policy program is the 'solar irrigation entrepreneur' model, wherein SIPs coupled with a network of buried pipes are offered at a capital subsidy of 60 per cent. The entrepreneurs pay 10 per cent of the costs upfront, and the remaining 30 percent is recovered over a period of 3-4 years through annual instalments. When multiple such entrepreneurs are promoted in a village, it can catalyse vibrant, competitive and buyer-friendly irrigation service markets. The model yielded positive results in Bihar, with solar pumps significantly decreasing the cost of irrigation in local water markets (Shah *et al*. 2018) but the response was lukewarm in Jharkhand.

Developing an economically viable solution for solar irrigation expansion in Jharkhand

Promoting solar irrigation through water entrepreneurs yields socially desirable outcomes in terms of equity and capacity utilisation. However, low-income levels, endemic poverty and under-developed irrigation service markets limit its expansion, especially in states like Jharkhand. The irrigation economy is dominated by diesel pumps, with active pump rental markets. The high cost of diesel irrigation coupled with the active rental market for diesel pumps indicate that the farmers are willing to pay for irrigation services. Solar irrigation systems mimic a high flat rate tariff with zero marginal cost incurred on

additional irrigation. This would significantly reduce the cost of irrigation when serving a large command area and be particularly attractive to water buyers from diesel pumps. However, the high upfront cost of solar irrigation pumps limits individual adoption. The provision of irrigation services by an external agency on a pay-and-use model would offer a plausible solution for expanding solar irrigation in Jharkhand.

Rationale for FPOs as sISPs

Farmer Producer Organisations (FPOs) are being promoted nationwide with support from NABARD (National Bank for Agriculture and Rural Development) and civil society organisations. In Jharkhand, Agriculture Production Clusters (APCs) are promoted through FPOs by civil society organisations. Collectives for Integrated Livelihood Initiatives (CInI), through its *Lakhpati Kisan* initiative, targets the creation of millionaire smallholder cohorts supported by FPOs. The FPO acts as an aggregator, developing forward and backward linkages for smallholder cohorts in the vegetable value chain. However, access to irrigation has been a major constraint limiting the expansion and profitability of vegetable cultivation in their operational area. The *Lakhpati Kisan* initiative provides a opportunity for pilot testing the role of an FPO as an irrigation service provider on a pay-and-use model. The SE4RL pilot would test the efficacy of the idea that FPOs can invest in solar irrigation systems and offer irrigation as a member service, and that this would directly contribute to their core business while maximizing the social gains from solar deployment.

Providing irrigation services would also be an attractive business opportunity for FPOs, with water sales augmenting their annual revenues. Access to reliable and affordable irrigation would facilitate the creation of vegetable clusters. Thus, the provisioning of irrigation services by an FPO would have a multiplier effect on its revenue-generating activities. Additionally, this mechanism would improve the targeting of subsidies for solar irrigation, leading to socially desirable outcomes. In the long run, prioritising FPOs over individual beneficiaries would catalyse the development of robust irrigation service markets in the region.

Pilot Objectives

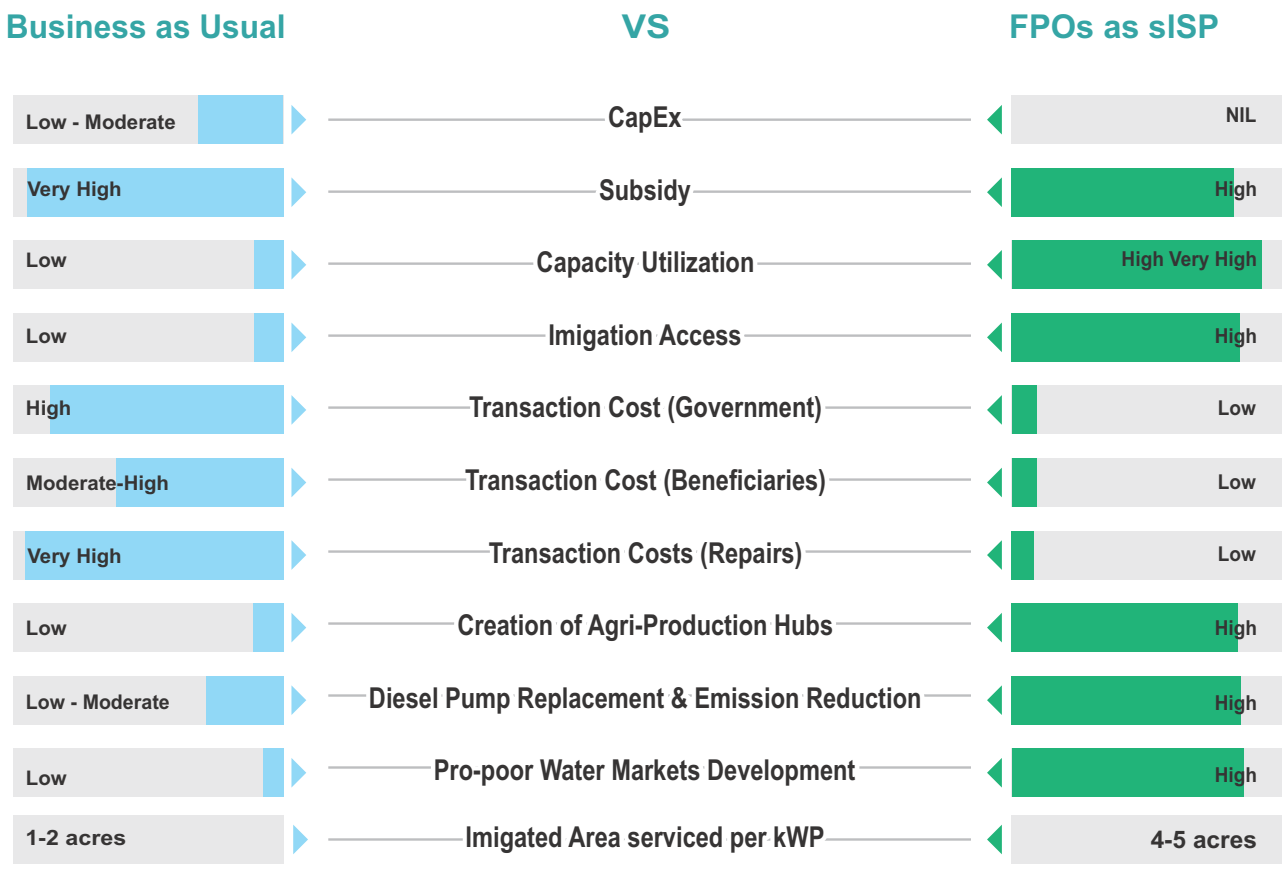
The novel idea of FPOs as an irrigation service provider is being field tested in one village in an action research collaboration between SE4RL, Sustain Plus Energy Foundation (SPEF), CInI, IWMI-Tata Program (ITP) and the *Gharonj Lahanti Mahila Utpadak* Producer Company Ltd. (GMPC). The objectives of the collaborative pilot are:

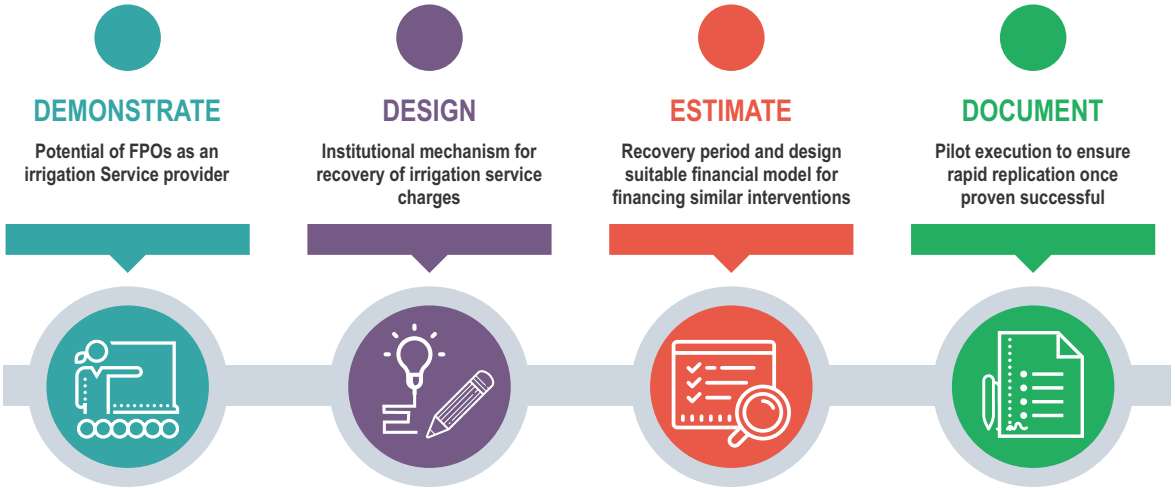
a) To demonstrate the potential of an FPO as an irrigation service provider.

b) To design and demonstrate an institutional arrangement to recover irrigation service charges.

c) To estimate the recovery period required for the SIP and design a suitable financial model for financing similar interventions.

d) Undertake careful process documentation of the execution to ensure the rapid replication of the model once proven successful.





Pilot Design

Based on technical and field surveys and consultations with partners and villagers, *Kuyani* village in *Bodam* district has been selected for implementation of the pilot. *Kuyani* and adjoining villages have witnessed several watershed interventions supported by NABARD and implemented through civil society organisations. The largest seepage tank in the village (*Khawasin Bandh*) serves as a perennial source of water for irrigation. Diesel pumps remain the principal source of power. A technical survey was conducted to assess the feasibility of the irrigation project, and the potential command area was estimated to be 65 acres in *Rabi* season, spread across three sites/ patches measuring 20, 25 and 20 acres, respectively.

The irrigation design requirements for the command area are a 3 HP solar pump with discharge of 18-19 litres per second at 3 to 8 metres head for patch 1, a 5HP solar pump with discharge of 23 to 28 litres at a head ranging from 8 to11 metres per second for patch 2, and a 5HP solar pump with discharge of 18 to 24 litres per second at a head ranging between 7- 18 metres. The irrigation system will be supported by a buried pipeline network of 1.488 metres. It has been recommended that the installation of the pumps in Patch 2 and Patch 3 be undertaken in a phased manner, with the solar pump serving the third site and providing irrigation to both patches in the initial phase of the project.

The FPO shall select and train an operator for the day-to-day operation of the irrigation services. The operator shall be incentivised to maximise irrigation sales and offered a share in the service fee collected. We expect that this would also lead to high-quality irrigation service delivery.

Theory of Change

On successful implementation, we are confident that the pilot would lead to a major rethinking on pathways for the expansion of solar irrigation, particularly in eastern and central India. This would imply: [a] prioritization of FPOs instead of individuals for targeting PM-KUSUM Component B subsidies; [b] generation of an additional revenue stream for FPOs that also directly augments their core business; [c] establishment of solar irrigation as a viable and profitable enterprise; and [d] faster, more efficient and more equitable solarization of agriculture.

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Contact

IWMI Anand
203, Second Floor,
Cube-0675, Vallabh Vidyanagar
Anand 388 120. Gujarat, INDIA
iwmi-anand@cgiar.org | iwmi-tata@cgiar.org

IWMI Delhi
2nd Floor, CG Block C,
NASC Complex, DPS Marg,
New Delhi 110 012, India
iwmi-delhi@cgiar.org

Global Headquarters
127, Sunil Mawatha, Pelawatte,
Battaramulla, Colombo, Sri Lanka
iwmi@cgiar.org | www.iwmi.org

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