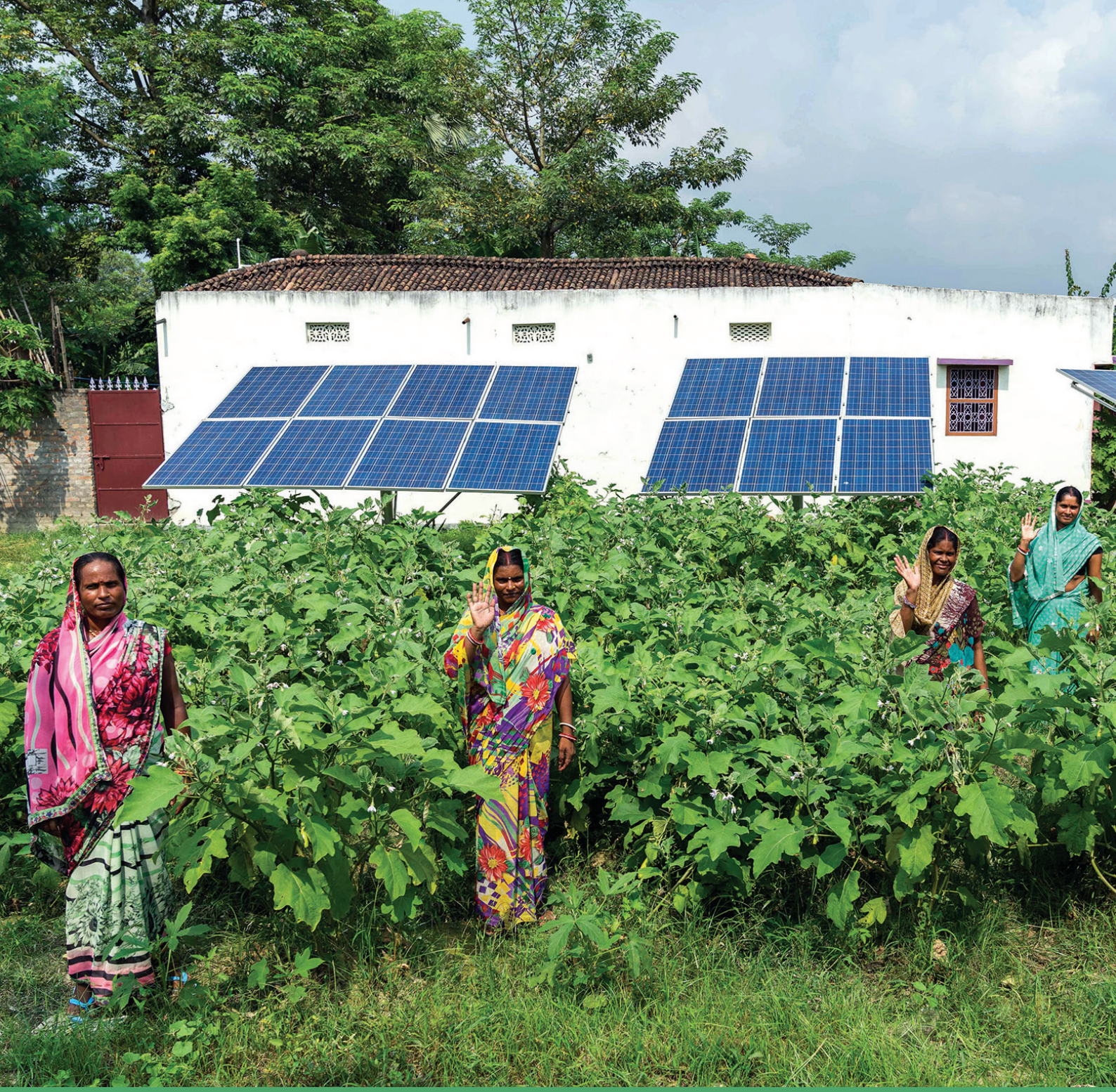

Solar Pumps as Micro-Enterprises for Women

Leveraging Bihar's Self-Help Groups for Equitable Irrigation Access

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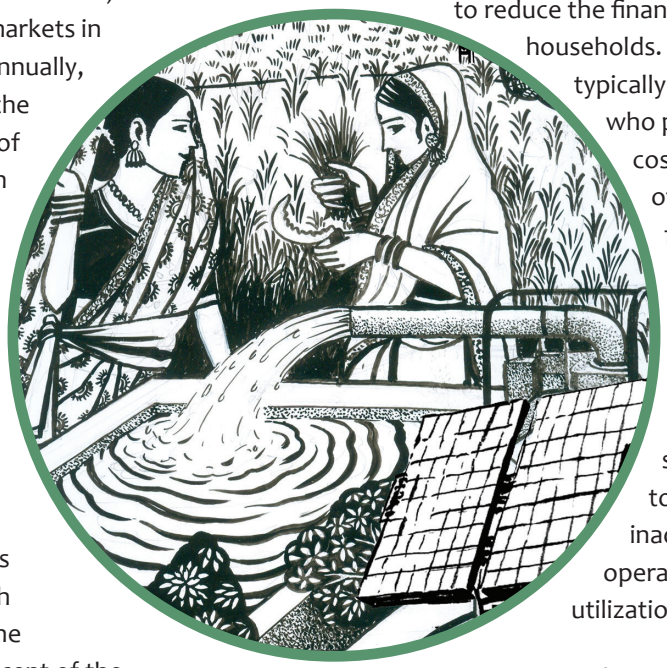
IWMI-TATA Water Policy Program

SE4RL Solar Energy for Rural Livelihoods

AKRSP (INDIA)

Despite a three-fold increase in per capita energy consumption over the last two decades, energy access is typified by regional inequities. At 311 kWh, the annual per capita energy consumption in Bihar is less than a quarter of the same for the average Indian (1327 kWh). Decentralized renewable energy has significant potential in improving and augmenting livelihoods of millions in energy starved regions such as Bihar. There has been a progressive increase in irrigation intensity in Bihar over the last four decades, with net irrigated area increasing from 2.8 million hectares to 3.0 million hectares between 1985 and 2021. This transition has been facilitated by a burgeoning groundwater economy servicing millions of smallholders through informal irrigation service markets (ISM's henceforth). For context, the size of the informal water service markets in Bihar amounts Rs 2000 crore annually, according to the 77th round of the "Situation Assessment Survey of Agricultural Households" (Shah 2024). Similarly, a recent RBI study has highlighted that the per hectare expenditure on irrigation in Bihar stands at Rs 2500 per hectare, which is approximately twice the national average. The pre-dominance of diesel-powered shallow tube-wells in Bihar explains the simultaneous expansion of irrigation and high irrigation costs. According to the Minor Irrigation Census, 79 percent of the groundwater structures in the state are powered by diesel pumps. With extreme land fragmentation and pre-dominance of small and marginal farmers, the higher cost of irrigation eventually trickles down to water buyers. Hence, despite its copious groundwater aquifers, the benefits of the resource endowment are distributed inequitably, in favour of resource rich farmers. Solar irrigation pumps (SIPs) have the potential to substantially reduce irrigation cost and catalyse the development of buyer-friendly irrigation service markets.



Bihar's Early Experience with Solar Pumps

Launched in 2013, the Bihar *Saur Kranti Sinchai Yojana* (BSKY) aimed to promote solar irrigation through large capital subsidies (75-90 %), prioritising small holders (0.4–2.0 Ha). Over 2000 pumps were deployed across the state. SIPs of 2-3 kWp capacity were promoted as the target beneficiaries were expected to have smaller pumping requirement. High capital subsidies limited the number of pumps that could be deployed, eventually leading to elite capture. An IWMI study highlighted that the lower capacity of pumps limited their participation in informal water markets and the pumps were primarily used as "back-up" options to existing pumps and hence remained under or un-utilized (Durga *et al.*, 2016).). Hence, the design features of BSKY failed to factor-in irrigation service markets, thereby limiting the trickle-down of SIP benefits to water buyers.

Alternative Models: Group Irrigation and Irrigation Enterprises

High upfront capital costs have been a significant barrier in upscaling SIP adoption. Group irrigation schemes have been promoted by several civil society organizations to reduce the financial burden on individual households. Solar irrigation groups typically comprise of 10-15 members who pay 20-30 % of the SIP capital cost. However, such schemes are often plagued by low operating factor, and irrigation access often limited to members. Price and non-price factors including differential pricing, and prioritization of members for irrigation scheduling serve as entry barriers to non-members. Further, inadequate incentives to pump operators have also limited full asset utilization.

Fostering solar irrigation enterprises has been mooted as another potential business model. Offering affordable irrigation through solar pumps of higher capacity (5 kWp), is a lucrative rural enterprise due to ubiquitous nature of irrigation service markets in Bihar. However, to service larger number of fragmented land parcels, solar pumps needs to be coupled with a network of buried pipelines. This increases capital cost, necessitating innovative financing solutions for upscaling solar irrigation as an enterprise.

The Chakhaji Experiment

In 2016, with support from the CGIAR research programs on Climate Change, Agriculture and Food Security (CCAFS) and Water, Land and Ecosystems (WLE), the IWMI-Tata Water Policy Program (ITP) collaborated with the Aga Khan Rural Support Program, India (AKRSP-I) to field test the 'solar irrigation service providers' (sISPs) model in CHakhaji village of Samastipur district in north Bihar. As many as 17 sISPs were supported to instal solar pumps with buried pipes; the financial model incentivised the

sISPs to maximize irrigation delivery and asset utilization. The pilot results were quite illuminating, each sISP services the irrigation needs of 60-80 farmers. Compared to the previous diesel irrigation service market, the effective cost of irrigation reduced to less than half; cropping and irrigation intensity improved significantly; and the value of the village's agricultural output doubled.

Since the experiment launched in 2016-17, AKRSP-I has installed more than 130 SIPs in the Samastipur-Muzaffarpur area; each deployed with a network of buried pipes to distribute water. Some of these are group irrigation schemes while others are operated by individual solar entrepreneurs.

Partnering with Jeevika

The government of Bihar's flagship rural livelihoods project, *Jeevika*, operates with the objective of enhancing social and economic empowerment of rural poor in the state. The core working strategy of Jeevika is the creation and strengthening of vibrant and bankable women's community institutions in the form of Self-Help Groups (SHGs). The SHGs in each village are federated into Village Organizations (VOs) and further into cluster and block level federations. Besides micro savings and credit, the SHGs also encourage women members to take up micro enterprises for long-term livelihood enhancement.

Together with AKRSP-I, SE4RL is piloting a unique model of solar enterprise where SHG women take up solar irrigation pumps as a business venture or a micro-enterprise. Doing this offers multiple co-benefits. One, the average irrigator is freed from the need to invest in and maintain an expensive asset – the solar irrigation pumping system. Two, each asset – because it services multiple farmers, can achieve higher capacity utilization, and therefore better economic viability. Three, the SHG network can offer loan to women entrepreneurs to invest in the SIPs. Four, the model creates green enterprises and empowers women to assume a leading role in the otherwise male-dominated irrigation economy. Finally, the model not only reduces the carbon footprint of irrigation, it can also significantly reduce the dependence of solar expansion on massive capital subsidies.

The SE4RL Pilot

Lohsari village in *Bochaha* district has been selected for implementation after technical and field surveys with support from a local partner, AKRSP-I. The village consists of four hamlets with a total agricultural area of ~325 acres. Most small and marginal farmers in the village own agricultural land under 2.5 acres and cultivate in *Kharif* and *Rabi* seasons only.

The selected water entrepreneurs are *Jeevika* SHG members, and own farmlands less than a hectare. Prior to the pilot, diesel and electric pumps were the primary means of irrigation, but due to the high cost of diesel and low water output with 2-3 HP electric pumps, their capacity to efficiently service irrigation demand remains constrained. A technical survey was conducted to assess the feasibility of the pilot and the potential command area was estimated to be 200 acres in the *Rabi* season, spread across ten sites, measuring 20 acres each.

To effectively service the potential command area, the recommended system design included a new 250-300 feet deep borewell, an AC solar pumps of 5 HP capacity coupled with 5 kWp solar arrays, pump house with fencing, and a 1500-feet buried pipe network. The total cost has been estimated at Rs. 600,000, with the women entrepreneurs contributing 50%. This contribution is financed through a combination of savings and loans from Jeevika SHG or any other micro-finance avenue.

Repayment of the loan component incentivises the entrepreneurs to maximize asset utilization and expand irrigation coverage and revenues. This creates space for buyer-friendly irrigation service markets. Further, a shift from expensive diesel to solar powered irrigation would significantly reduce the cost of irrigation. The ease of use of solar pumps and buried pipes make irrigation delivery much more convenient. As the solar irrigation service market matures and more entrepreneurs join-in, they compete for a greater share in the village irrigation economy by offering better irrigation service at the least possible cost. Access to

affordable and reliable irrigation is also expected to bring about changes in crops and cropping patterns with the addition of summer cultivation, a rarity in the diesel regime.

Our model of promoting solar pumps as a micro enterprise for SHG women not only improves the livelihoods of the entrepreneurs but also delivers more affordable and reliable irrigation to hundreds of water buyers. The model also frees small, resource-poor farmers from the need to invest in and maintain expensive capital assets and yet benefit from the advantages of solar technology.

Theory of Change

IWMI and AKRSP-I have had several encouraging discussions with officials in the Government of Bihar to offer solar pumps as micro-enterprises for Jeevika's SHG women. On integration in Jeevika's standard operating procedure, the model will:

- Catalyse meaningful and commercially lucrative micro-enterprises for Jeevika's SHG members
- Empower poor women by enabling them to be a part of the energy transition and agricultural growth
- Enable higher utilization of solar irrigation assets by delivering its benefits to multiple small farmers
- Enable increase in cropping and irrigation intensity, leading to crop diversification, shift towards high-value agriculture, and improved nutritional security.

Reference

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