Community-Based Solar Irrigation in Chhattisgarh

Prospects and Challenges

Anas Rahman and Abhishek Jain

Issue Brief | January 2022

Image: Ajay Gupta, PRADAN

Abstract

Promoting solar pumping technology among marginalised and low-income farmers and scaling it up sustainably requires innovations in solar pump delivery models. In this brief, we investigate a community-owned and managed model of solar irrigation implemented by Professional Assistance for Development Action (PRADAN) in the Bastar district of Chhattisgarh.

We conducted baseline and end-line interviews as well as focus group discussions with users to evaluate the cost effectiveness and efficiency of community-owned solar pumps over a 11-month period. We found that the model is economically attractive to farmers, translating to an estimated 32 per cent increase in agricultural income for participants. In this model, the government can reach 15–20 low-income farmers with one solar pump instead of providing one subsidised

> Through community ownership, goverment can significantly expand the reach of solar pump schemes.

pump per farmer – significantly expanding the reach of government-supported solar pumps. We also found that there is scope to reduce the subsidy by partly replacing it with self-help group (SHG) loans. We also found that starting with a lighthouse project is an effective strategy to spread awareness and set expectations. The government can replicate this strategy while scaling up the programme by setting up one project each at the block or cluster level in the first phase.

However, there are also many challenges in sustaining group-based initiatives. We found that groups based on existing social structures resolve issues better. The model included two kinds of projects – one in which a solar pump is shared within one SHG and another in which the pump is shared between the members of multiple SHGs. We found that projects where only one SHG was involved had much better cohesion and dispute resolution mechanisms than the other type. We identified multiple stress points in group cooperation, primarily arising from a lack of clear-cut rules and codification of by-laws. We propose that sustained hand holding and group capacity building is essential to tackle the challenges arising from water-sharing disputes. Complementary support mechanisms like training in cultivation practices and input support can greatly augment outcomes. For the state-wise scale-up of the model, the state rural livelihood mission (SRLM) should take the leading role.

Introduction

Almost half of India's rural population relies on agriculture for its livelihood (MOSPI 2021). However, over the years, agricultural incomes have witnessed slower growth compared to other sectors in the Indian economy. Lack of irrigation access is still the biggest constraint to farm productivity. More than 50 per cent of Indian agricultural landholdings lack access to assured irrigation (PIB 2020).

Solar pumps can help improve irrigation access for communities and areas hereto deprived of electricity-based irrigation. They can technically operate almost anywhere and cost less than diesel pumps over the long term if used sufficiently.

However, most marginal and small Indian farmers cannot afford solar pumps without financing. So far, most solar pumps in India are supported by hefty government subsidies (anywhere between 60–90 per cent of the capital cost, which translates to a fiscal outlay of INR 1,00,000–2,50,000 per farmer depending upon the size of the pump). Such a fiscally-intensive approach limits the scaling up of solar pump use. Further, despite the subsidy, the farmer contribution is still too high for very poor farmers to pay in one go.

Studies show that individual solar pumps are often underutilised. The utilisation rate of individual off-grid solar pumps is typically less than 30 per cent, representing poor social returns against the public money invested in the pump (Rahman and Jain 2021b).

A sustainable scale-up of solar pumps need innovative models that can address such challenges. One such potential model is community-owned solar pumps.

Community ownership model for solar pumps

As the name suggests, ownership of a solar pump is shared by multiple farmers in such a model. The model potentially offers the following benefits:

- Brings down the cost for individual farmers as the farmer contribution is shared by a group.
- Reduces the government's outlay per farmer, effectively enabling access to irrigation for more farmers within the same fiscal outlay.
- Improves the utilisation of solar pumps as farmers can stagger their irrigation.
- Promotes judicious use of water by farmers, as a common and explicitly shared resource is used to pump water.

Thus, conceptually, community-owned solar pumps can help states provide irrigation access to poor farmers while addressing groundwater exploitation concerns.

4. A renowned non-governmental organisation (NGO) in the Indian development sector, PRADAN has been working in various parts of India, primarily focusing on livelihood generation. One of the focus areas for PRADAN is promoting vegetable cultivation through lift irrigation. PRADAN had tried lift irrigation with diesel pumps in Gumla and West Singhbhum districts of Jharkhand in the past with great success (Kaushal and Kumar 2020).

CEEW partnered with PRADAN to assess a pilot community-ownership model of solar pump irrigation.

How do community-owned solar pump models fare in practice? To answer this question, we partnered with Professional Assistance for Development Action (PRADAN) to assess a pilot community-ownership model of solar pump irrigation in Bastar, Chhattisgarh. We ran an impact evaluation to assess the real-world feasibility and dynamics of the model.

The history and experience of community-owned irrigation models

Groundwater-based irrigation assets in India are predominantly privately owned. However, in some states like Uttar Pradesh and West Bengal, state irrigation departments have been promoting the use of public tubewells with diesel or electric pumps since the 1960s to expand irrigation to small and marginal farmers and areas without access to surface irrigation projects (Naz and Subramanian 2010). But many of these programmes did not reach the target beneficiaries and failed to meet performance expectations. While technical issues like poor quality of power supply and infrastructural shortcomings have played a role (Kolavalli and Shah 1993), poor institutional building was also one of the main reasons for their failure (Pant 1993).

But there are success stories as well. For instance, in Vaishali and Deoria districts of Bihar, the government set up community tubewells in partnership with an association of small and marginal farmers and funded them through group-based loans from a commercial bank. Loan payments were divided among group members in proportion to the size of their landholdings. Project outcomes in terms of asset utilisation and targeting of small and marginal farmers were much better than in other public tubewell models (Pant 1984). Pant (1984) attributes the success of these experiments to the emphasis on community capacity building and leadership development.

Similar community-based models have been deployed for solar-based irrigation as well. In Bangladesh, the Infrastructure Development Company Ltd (IDCOL) provides financing for solar pumps shared by 20–25 farmers. In their 'pay-for-fee' model, IDCOL partners with local organisations that own the asset and sell water to group members (IRENA 2016). A similar pay-per-use model was trialled in Nalanda, India, where diesel pumps in community tubewells were replaced with solar pumps. A private organisation installed and operated the pumps under a government contract and sold the water for a fixed rate for five years. But as the area's power supply improved, farmers reduced their reliance on the solar pumps and shifted to individual pumps (Shirshath et al. 2021). In a similar model, the International Water Management Institute (IWMI) – Tata Program implemented a *Solar Irrigation Entrepreneurship Scheme* in partnership with the *Aga Khan Rural* Support Programme (AKRSP) in Chakhaji village, Bihar. The programme encouraged local entrepreneurs to set up solar pumps to sell water to neighbouring farms through pipeline networks. The project significantly reduced the cost of irrigation as farmers moved away from diesel-based alternatives, and it increased the income of both buyers and sellers (Shirshath et al. 2021).

Beyond pay-per-use models, community-owned and managed solar pumps have also been deployed in various regions. One strategy is to support farmer groups in jointly procuring small portable solar pumps that are shared between members on a fixed schedule. In Nepal, the IWMI piloted this model with multiple groups of 5–8 farmers. In Betul, Madhya Pradesh, BAIF Development Research Foundation helped women SHGs acquire a small (1 hp) portable solar pump. The group rented it to its members and those outside the group (Shirshath et al. 2021). These pilots demonstrate that the success of the model depends on the group's capacity to collectively manage irrigation schedules and collect funds for the upkeep of the pump. They also showcase the importance of complementary support like training and extension service to ensure the long life of the pumps (Bastakoti, Raut, and Thapa 2020).

IWMI also piloted a model that featured a medium scale solar pumps (3 hp), owned and managed by member farmers in the Cooch Behar and Alipurduar districts of West Bengal. The farmers managed the water-sharing and periodically saved a fixed amount for the repair and maintenance of the pump (Bastakoti, Raut, and Thapa 2020). However, an in-depth study of this model is not available yet.

About the Chhattisgarh programme

PRADAN has been working with tribal communities in Darbha block, Bastar district, for more than eight years, supporting the formation of women self-help groups (SHGs). In 2020, PRADAN helped 40 SHGs set up 27 solar pumps under the community-ownership model. We partnered with PRADAN to study these projects over 2020–21.

The programme strategy is to promote vegetable cultivation on homestead lands, especially in non-Kharif seasons, by providing irrigation access. The programme targeted women SHGs in the region. Each SHG consisted of about 10–15 women from the habitation with adjoining homesteads. In some projects, members from a single SHG were the participants ('single-SHG project'), and in others, where there was more than one SHG in the habitation, members from two or three SHGs shared the pump ('multi-SHG project'). Each pump was shared by 10–25 farmers who formed a 'water user association'.

The pumps were partially financed through government subsidies under the state scheme, *Saur Sujala Yojana*, which provides about 90 per cent subsidy for solar pumps. The water source in all except one project was streams with small check dams. For all the projects, PRADAN also designed a network of pipelines to pump water to the homestead lands of project participants. The Bastar district administration provided additional subsidies from the District Mineral Fund (DMF) for the pipeline cost. The project participants also contributed in cash and labour for pump and pipeline installation.

> **The programme supported tribal women SHG members to cultivate vegetables on their homestead lands in non-Kharif season.**

BOX Project JOHAR

Another similar project is being trialled in Jharkhand. *Jharkhand Opportunities for Harnessing Rural Growth*, aka JOHAR, is a livelihood initiative run by the Jharkhand State Livelihood Promotion Society (JSLPS) with the support of the World Bank. It is the first large-scale, solar-based, community-led irrigation project implemented by any state government. The project, among other interventions, supports tribal women SHG farmers in the state to adopt a 5–7.5 HP solar pump to cultivate high-value crops. The SHG members are part of larger producer groups (PG) that receive other forms of support including training on cultivating high-value crops and marketing. The pumps and the main pipelines are fully subsidised under the project. However, the participants have to pay an hourly rate for the water to the SHG. The individual project designs are prepared by the para irrigation engineers (PIE) and district-level consultants. The project also hired experts to provide technical training to people from the local community so that they can serve as technical service providers (TSPs). The TSPs manages the day-to-day operations of the pump and are paid a fixed salary by the group. According to JOHAR team members, about 1,000 solar pumps have been installed already, and the project aims to support more than 3,000 pumps by 2023.

Image: Ajay Gupta, PRADAN

Objectives of the study

The study aims to assess the sustainability of the women-SHG-based community solar irrigation model. We attempt to answer the following research questions:

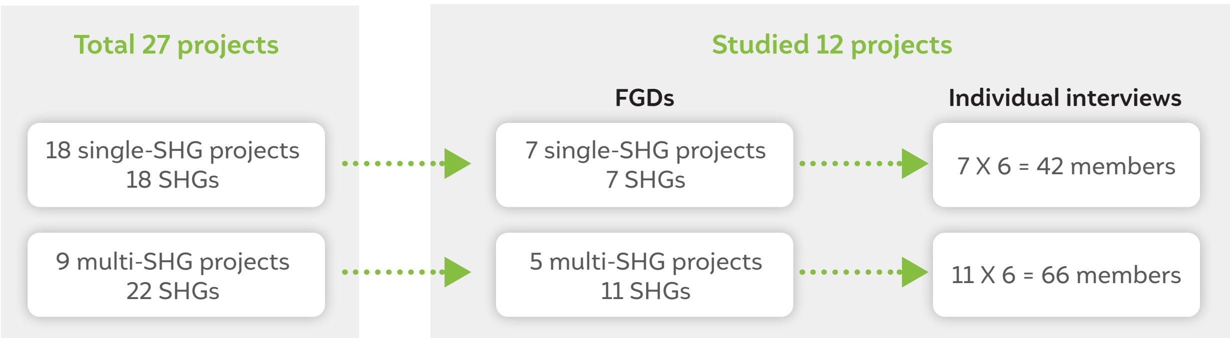
- How does the irrigation access provided through the project impact the agricultural incomes of farmers?
- What were the different strategies used to get farmers to buy into the model and how effective have they been?
- What are the potential challenges for SHGs in the community management of solar irrigation?
- What are the potential roadblocks in scaling up this model, and what are the measures required to tackle them?

Methodology

We studied the programme through multi-level engagements with stakeholders:

- We engaged with PRADAN to map the processes and strategies adopted for programme facilitation.
- We selected 12 projects out of the 27, comprising 18 SHGs, for more intensive study. Seven installations were single-group projects, and the remaining were shared among two or three SHGs each. For these 18 SHGs, we:
  - Conducted focus group discussions (FGDs) to understand their motivations to participate in the project and their experience thus far. We conducted two rounds of FGDs with them, one before the start of the project and a follow-up after 11 months.
  - We selected six members per SHG and conducted a baseline and end-line survey to assess the project impact on individual farmers. As all the group members affirmed their intention to participate in the project during the baseline FGD, we selected farmers for the baseline and end-line surveys randomly. As a control group for the impact assessments, we interviewed six randomly selected farmers from the respective villages who were not part of the SHGs. In total, we interviewed 108 SHG members and 108 non-SHG members (Figure 1).

Figure 1 **We studied 12 projects involving 18 SHGs through FGDs and individual interviews**



Source: Authors' illustration

One major limitation of this study is that the farmers included in the control group were not part of any SHG. Hence, the study outcomes cannot be fully attributed to the solar irrigation programme; rather, they should be considered the result of a collection of interventions, including SHG formation, training, and capacity building. Further, as the farmers had faced an abnormal year due to Covid-19 and related restrictions, the economic outcomes reported in the study may not reflect outcomes in other conditions.

We also did a semi-structured interview with the project director of JOHAR to discuss their experience and the institutional challenges in scaling up a community-led irrigation model in the state.

> **The farmers included in the control group were not part of any SHG.**

Profile of the programme farmers

Image: Ajay Gupta, PRADAN

Darbha block is located in the Dandakaranya region of central India, which is predominantly tribal populated. The survey participants belonged to nine different communities, of which seven are categorised as Scheduled Tribes.

Agriculture on own land and/or agricultural labour are the main livelihood sources in the region; almost all of the survey respondents relied on agriculture for their livelihoods. The region has plentiful surface water resources with perennial rivers and creeks. However, due to limited access to irrigation, agriculture is primarily limited to the Kharif season. Out of the 108 SHG members we interviewed during the baseline survey, only ten cultivated crops outside the Kharif season. The average landholding per household is two acres, but ownership ranges from 0.3 acres to 13 acres. Apart from cultivation in the Kharif season, local dwellers rely on the *Mahatma Gandhi National Rural Employment Guarantee Scheme* (MGNREGS), livestock rearing, and collecting minor forest produce for their livelihoods.

More than 90 per cent of the respondents cultivate rice in the Kharif season. Maize, vegetables, and Kodo millet are the other main crops cultivated in the Kharif season. The participants mostly practised subsistence agriculture. Their expenditure on seeds, fertilisers, and pesticides is meagre, with the average expenditure on pesticides and fertilisers cumulatively being less than INR 500/acre. Only 5 out of 108 respondents had prior experience of using a pump for irrigation before the programme. Given that low-input rainfed agriculture was the norm, the average rice yield during the Kharif season for the sample group was about 930 kg/Ha compared to the Chhattisgarh average of about 1,810 kg/Ha (Ministry of Agriculture & Farmers Welfare 2019). The average seasonal net income from agriculture for the sample was about INR 7,300/acre and was almost the same for both SHG and non-SHG respondents. With such a low income level, an upfront contribution of INR 20,000 for an individual subsidised solar pump remains a barrier for adoption.

Project outcomes and key learnings

All the 18 groups we studied followed through on the initial interest that they had expressed during the baseline FGDs and paid the upfront contribution by the end of 2020, despite the pandemic. Some SHGs faced delays in project commissioning due to reasons beyond their control. In two projects involving four SHGs, the pumps were installed late into the summer due to administrative delays. In another project involving one SHG, the pump broke down three days after installation. These SHGs could not utilise the pump during the full one-year study tenure.

In this section, we share the key lessons emerging from the study. We look at the economic and institutional aspects of the model.

The community-owned solar irrigation model could be economically very attractive.

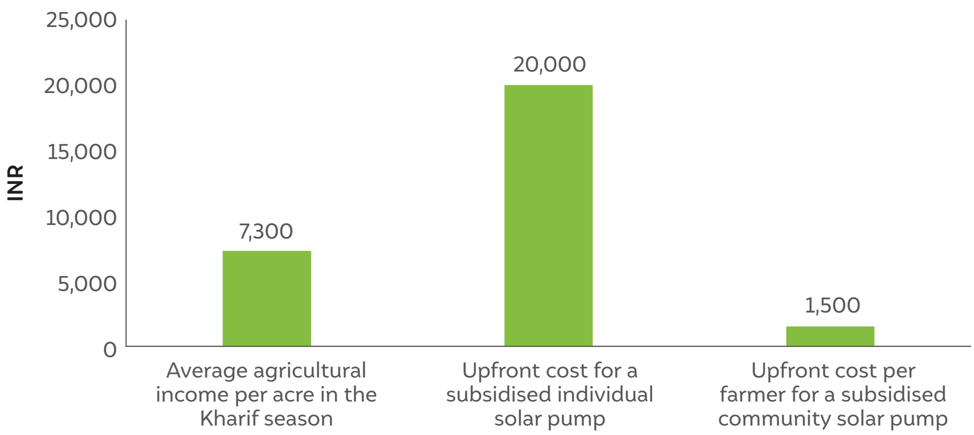
The SHG members cultivated their homestead lands, typically ranging between 0.2 and 0.6 acres, using irrigation from the pump. The average land area cultivated per farmer (in summer 2021) using the pump was 0.35 acres.

Most of the groups decided on an individual upfront contribution between INR 1,000–2,000. Such low-cost access to an asset with a 20-year operating life makes subsidised community pumps economically attractive to farmers (Figure 2). Many SHGs also collect a fixed recurring monthly charge from group members to cover any future expenditure on pump maintenance and repair. The monthly contributions varied between INR 30–100 across projects and were only collected in the seasons when the pumps were used. Thus, the average seasonal cost of irrigation due to solar pumps comes up to INR 350–1350 per acre. There were no diesel-pump-using farmers among the survey respondents to compare the cost of irrigation with diesel pumps. The average seasonal cost of irrigation using diesel pumps in the state is INR 3,000/acre[2] (Rahman and Jain 2021a). Overall, the model proved to be very economical for participants.

Solar pumps are expected to have the most impact in the non-Kharif season by enabling cultivation through irrigation access, particularly during summers. None of the participants used the pump during the Kharif season as good monsoons last year ensured adequate surface water supply. Of the 51 members who got early water access, 46 cultivated vegetable crops with solar pumps in the non-Kharif seasons – 43 of them cultivated in two seasons and three cultivated in three seasons (Figure 3). Only nine among them had cultivated in the non-Kharif seasons in the previous year. In comparison, only three respondents from other projects (which did not get operationalised till summer) and only two from the control group cultivated crops during summers (Figure 3).

> The initial upfront investment per farmer is as low as INR 1000 making the solar pump economically attractive.

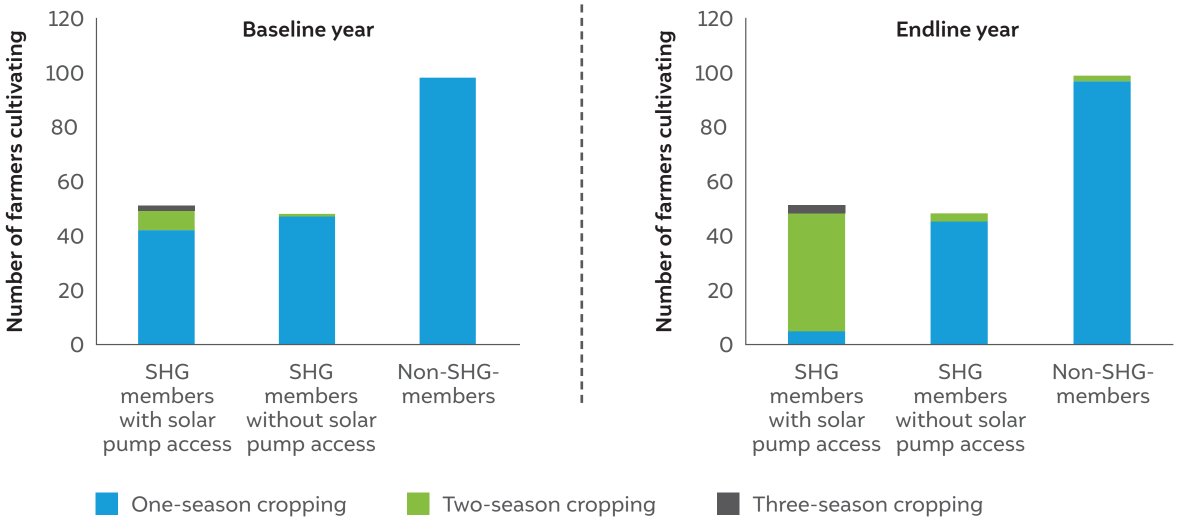
Figure 2 **The community ownership model provides low-cost access to solar pumps**



Source: Authors' analysis

2. This value could be on the higher side considering that the value is an estimate for the Kharif season during which paddy is the predominant crop. We do not have crop-wise data for cost of irrigation for a more apt comparison.

Figure 3 Access to solar pumps significantly improved cropping intensity among participants



Source: Authors' analysis

> **The additional income was about 32% of the project participant's annual agricultural income from previous year.**

During the baseline FGDs, participants mentioned that they primarily sell their harvests in nearby weekly haat bazaars. However, due to the Covid-19-induced lockdown, the SHGs could not market the produce cultivated in summer 2021. Most of the respondents self-consumed their harvest, while some were able to sell it within their village. Hence, the overall impact on income was difficult to estimate. Also, since the produce was self-consumed, participants could not recall details pertaining to quantities harvested for individual crops. Among those who could sell their crops[3], the average net income accrued through agricultural sales was about INR 5,300[4] (or about INR 11,900 per acre) over the non-Kharif season. The additional income from the vegetable cultivation was about 32 per cent of their previous year's annual income from agriculture on average .

Considering that the additional income from just one year's non-Kharif crop is much higher than the capital cost, there is enough buffer to ensure the model's viability even if the government decides to reduce the subsidy on community-based deployments as the model scales up. SHGs can use their bank linkages to obtain credit for upfront capital. Assuming that each member is willing to pay at least one season worth of income towards the capital cost, an average group can contribute almost 40 per cent of the pump cost upfront. For the government, the model presents a fiscally prudent way to reach more low-income farmers.

Beyond cultivation, the pump also helped improve the quality of life of participants. Almost half of the participants used water from the pump for household needs and livestock rearing. One group, whose pump was connected to a borewell, used the water for drinking purposes as well (Other groups mentioned that they prefer community handpumps for drinking water since the water from solar pumps was sourced from surface resources like streams, which they did not prefer for drinking). During FGDs, participants highlighted that the pump eliminated the drudgery of carrying water from community hand-pumps to the home since the water from the pump reaches their homestead directly. Overall, almost 95 per cent of participants expressed complete satisfaction with the projects and said that the investment was fully worth it. About 73 per cent of the non-SHG respondents also expressed interest in participating in the scheme.

The programme focuses on homestead lands because of the larger programme design and colocation of interventions by PRADAN. However, we found that there is ample scope for increasing the area of cultivation as most of the groups did not use the pump for 3–4 days a week, even in summers.

Group building is a long-term exercise. Community projects developed around existing social structures are more likely to sustain.

Enduring community-irrigation institutions need strong community cohesion. Agarwal (2015) emphasises that such collectives are more likely to sustain in the long term if they are "small-sized, voluntary, socio-economically homogeneous and participatory in decision-making" (Agarwal 2015). SHGs satisfy most of these criteria due to their inherent design, but they need to be supported through training and capacity building.

Although the solar pump programme has been operational for only a year, the foundational process underlying the project started much earlier. Figure 4 illustrates the different stages leading to this project. The process of group development took almost 5–8 years in this case. Since the treatment group is fully comprised of PRADAN-supported SHGs, the role of group building in the project outcome cannot be fully captured from this sample. However, the different outcomes among single-SHG and multi-SHG projects indicates what its impact might be. The programme design took each habitation as a unit. Hence, in larger habitations, where there was more than one SHG, the participants were from multiple groups.

While single-SHG projects relied on a group structure that had been in existence for years, multi-SHG projects were relatively newer water user associations. We found a marked difference in outcomes for single-SHG projects and multi-SHG projects.

In the single-SHG projects, 47 out of the 49 members (96 per cent) who expressed interest in being part of the project followed through with their initial commitment. Only one member cited the lack of group cooperation as a reason for not participating. In contrast, dropout rates were substantial for multi-group projects (Figure 5).

> **There were marked difference in outcomes between projects based on single group and multiple groups.**

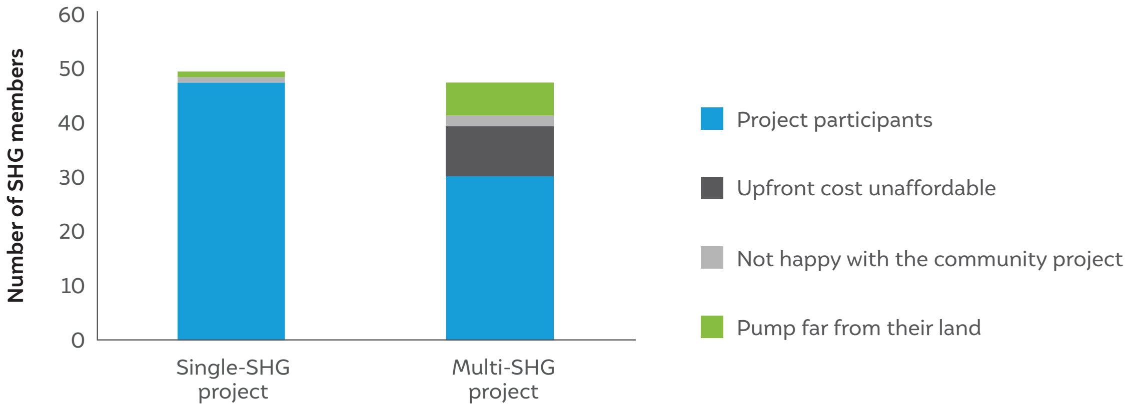
Figure 4 The project is a result of a series of activities taken up by PRADAN

SHG formation	Most SHGs in the project were formed with the support of PRADAN in the past 5-8 years.
Group-based livelihood	PRADAN initiated livelihood promotion activities, particularly vegetable cultivation with additional support in the form of training, inputs, and market linkages.
Project ideation & consultation	PRADAN conceptualised the solar pump project for increasing non-Kharif production. They started with one group in 2019. Exposure visits and orientation sessions were organised for the 40 group members and consultation were held at the group and household levels.
Technical planning & coordination with departments	PRADAN handled all the technical planning, including area identification and piping network design, and coordinated with district officials for mobilising funds.
Pump deployment	The SHGs worked with the vendors allotted to them by the department. The members contributed all the labour required, including for earth removal and pipe laying, reducing the cash outlay of the project.

Source: Authors' analysis

3. Only 13 out of the 46 cultivating farmers sold their produce.
4. Lockdown prices may not be reflective of normal prices. Depending on the context it could be higher or lower compared to normal prices range.

Figure 5 Single-SHG projects have markedly higher participation, probably due to better group cohesion



Source: Authors' analysis

Nine respondents, all from multi-group projects, cited unaffordability as the reason for non-participation. During the FGDs, we found that unaffordability was a challenge in both kinds of projects. But single-SHG projects were able to solve this problem through various ways – either through lending between group members, or by giving members the option of paying it in instalments, or even reducing the contribution for struggling members. One SHG took a group loan from the bank for this purpose and is repaying it regularly. We did not observe such group cooperation to solve members' problems in multi-SHG projects.

Within the multi-SHG projects, six respondents cited the field being far away from the pump as the reason for non-participation. A few had contributed to the project fully or partially, but other group members told them that the pipes bought with government support were not adequate to reach their homesteads and that they had to buy their own pipes. During the individual interviews, they stated their hope that this problem would be resolved. But in the FGDs, these members mostly remained silent, and when the issue was brought up, the other group members seemed unwilling to share the pipeline cost equally.

It was clear that the overall SHG structure built over many years helped smooth over such differences and took everyone along. These SHGs had grown organically, with most starting with a small savings routine of INR 5 per member per month. Cluster-level facilitators trained by PRADHAN help handhold these groups. Over the years, these groups have developed robust savings. Several members mentioned that the group savings now act as a critical financial cushion in times of distress. In the absence of a strong institutional structure and bonding between members in multi-SHG projects, intra-group friction emerges.

Alternative project designs may mitigate some of these problems but could lead to other challenges. For example, in the JOHAR project, friction between group members was not a major concern, at least so far, as the beneficiaries did not have to pay upfront and the water sharing was on a pay-per-use basis. But, besides being more costly to the government, this model also carries the risk of elite capture and exclusion if the groups are not sufficiently cohesive. This also points towards the critical role of supporting organisations.

The strategy of starting with a lighthouse project worked very effectively.

PRADAN started the pilot project with just one SHG in 2019. In 2020, they took all the SHG households for an exposure visit to the first group, which worked very effectively in generating interest and buy-in for the project. During the surveys, 98 per cent of the

> **Seeing the lighthouse project's success was the main motivation for members to join the programme.**

SHG members mentioned that seeing the first group cultivating crops in the summer season was the primary motivation for them to install a community solar pump. During the FGDs, a few groups also mentioned that some members had been apprehensive about participating in the project and paying the upfront contribution. However, household-level discussions organised by the groups and the exposure visits had made them more confident about the project.

The effectiveness of demonstration projects in raising awareness about solar pumps has been documented in various studies (Jain and Shahidi 2018; Bastakoti, Raut, and Thapa 2020). In the case of community-based irrigation, lighthouse projects can also serve to demonstrate collective management of water-sharing. The exposure visits also helped set expectations among the participants. We found during the baseline survey that almost all the participants were clear about the project goals – it is for irrigating their homestead land and not their main farmlands. They were also clear that vegetables are most suited to be cultivated with a shared solar pump.

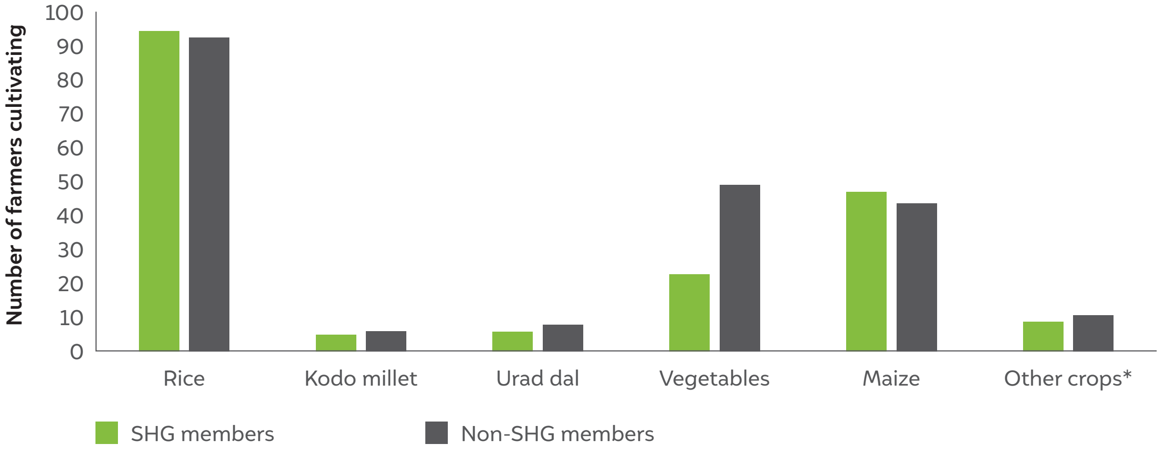
The role of supporting organisations is critical. Complementary support greatly enhances outcomes.

As outlined in the process map (Figure 4), PRADAN had laid the groundwork for the intervention on solar pumps with a holistic programme to improve vegetable cultivation practices. They trained SHG members on vegetable cultivation and provided inputs for agriculture through the SHG federation. They also initiated the marketing of vegetables by the SHG federation, where vegetables grown by individuals are collected by the SHG federation and sold in the market. The impact of these interventions is visible in the baseline survey, with 45 per cent of SHG members cultivating vegetables in the Kharif season alongside other crops, compared to 21 per cent of non-SHG-members (Figure 6).

> **The main challenge in scaling up this model state-wide is in ensuring technical and managerial support for SHGs.**

Image: Anas Rahman/CEEW

Figure 6 **Due to PRADAN's intervention, SHG members were actively cultivating vegetables in the Kharif season even before the project inception**



Source: Authors' analysis

*Note: Other crops include groundnut, sesame, ragi and pulses other than urad dal.

In the baseline FGDs, many members indicated that the recent experience of cultivating vegetables and marketing them through the SHG federation was a major reason for their interest in the project. It also seemed to have impacted outcomes favourably. As mentioned previously, about 46 of the 51 members who got access to water started cultivation in the summer season right away.

However, the handholding support needs to continue till the group masters the trade. Several members mentioned that the agricultural output in the first year was sub-optimal due to several reasons – some faced crop losses due to faulty irrigation practices and grazing by livestock. Pump utilisation in the first year was poor. While 80 per cent of the group members had access to water cultivated during summer, only three members (5 per cent) cultivated during the Rabi season, though they had access to the water from early Rabi. They cited lack of planning as the main reason for not cultivating during the Rabi season. Even during the summer, most of the groups operated the pump for only 2–3 days a week, indicating the untapped potential of the asset. However, some groups expressed interest in incrementally expanding the irrigation area next year but cited the lack of fencing as the main challenge. These gaps call for continuous support through training and facilitation activities like community fencing.

According to the representative from JOHAR, the main challenge in scaling up this model state-wide is in ensuring technical and managerial support for SHGs. Creating detailed project plans at such a large scale would require technical expertise at all administrative levels. According to the representative, large-scale interventions under this model through state rural livelihood missions (SRLMs) would require significant capacity addition.

The JOHAR project has also significantly invested in creating a pool of trained resource persons at the local level to provide farmers support in terms of operations and efficient use of water. The team hired external experts to train local resource persons (technical service providers) who will support the group in managing the pump and crop planning. Experience with the JOHAR project shows that their role is critical in ensuring the sustainability of the model.

For instance, in Chhattisgarh, we observed significant variations in the schedules developed for water-sharing across groups – some opted for supplying water to all

About 46 of the 51 members who got access to water started cultivation in the summer season right away.

> **According to the representative from JOHAR, in a scale-up scenario, states will have to create a dedicated pool of resource persons to support sustainable projects in the long term.**

members every day, some supplied water on alternate days, etc. However, the variability of solar pump output through the day could pose a challenge. In one project, some participants complained that they were getting less water than others. Currently, there is enough buffer time between pump operation days to meet any additional water requirements. But as usage intensifies over time, there could be dissatisfaction and conflicts in the future.

To manage such conflicts, groups need to be able to evolve new water-sharing rules. PRADAN is intensely focusing on training and capacity building for this reason. The PRADAN representative mentioned that the training and capacity-building modules for water user associations could not be implemented as planned in the last year due to pandemic-related restrictions. They hope to compensate for it in this year. There were also examples of groups adapting to the situation. For instance, one group (single-SHG project) that had already started facing higher demand decided to rent out the pump on buffer days based on an hourly fee.

Evolving such localised solutions would need continuous handholding during the scaling-up process. According to the representative from JOHAR, in a scale-up scenario, states will have to create a dedicated pool of resource persons to support sustainable projects in the long-term.

Institutionalising processes is key to managing uncertainties

Group-based activities can also throw up many challenges due to the behaviour of certain individuals. For instance, in one group (a single-SHG project), after the installation of the pump and pipelines, one member withdrew from the project and took back their upfront contribution. However, the member continued to take water from the pipe passing through her field without group permission. This caused much consternation among the group. The group finally agreed to let the member take water by paying the recurring cost (and waiving the upfront cost). In a different project, some non-SHG households demanded water without paying any upfront contribution as the pipelines passed through their land. They threatened to remove the pipelines unless given water, although they had given consent initially.

Ensuring more robust organisational design can mitigate at least some of these challenges. Ostrom (1993) proposed eight design principles for long sustaining irrigation groups that could be adapted to guide training and capacity building in this model. For instance, one principle is to create clearly defined boundaries between who is in and out. In the instance where non-group members demanded water because pipelines passed through their field, we found that they had also participated in the manual work required for pipeline installation. Further, the group had not secured a clear agreement with non-members for the passage of pipelines. This probably gave rise to false expectations among non-members. Defining the project beneficiaries clearly and negotiating passage rights would have mitigated such circumstances. Similarly, the 'graduated sanction' principle demands action against the group member who withdrew from the project after the pump installation. As no such action was taken against the member, it gave her a sense of impunity and led to the attempt to free-ride.

However, not all such incidents are predictable and cannot always be planned for. The best strategy is to learn from different groups' experiences constantly. Formalising group rules and arrangements with non-members should be a part of continuous learning. Facilitating sharing of experience across groups can also help in faster learning and achieving smoother group operations.

Conclusion and the way forward

The community-ownership model holds potential for expanding irrigation access through solar pumps, especially among low-income farmers. It can support groups of 5–25 farmers, depending on the size of the individual plots. With the support of government subsidies or SHG-based financing, the farmers would be able to afford irrigation at a low recurring cost. Depending on the subsidy share, the payback period can be as low as one season, and the increase in annual agriculture income can be significant.

Based on the early learnings, scaling up this model at the state level would require several steps from the state government:

- States could focus on leveraging existing networks of SHGs created under the *National Rural Livelihood Mission*. Project JOHAR – *Jharkhand Opportunities for Harnessing Rural Growth Project* – by the Jharkhand State Livelihood Promotion Society (JSLPS) in partnership with the World Bank provides a template for a state rural livelihood mission–led adoption of this model.
- Anchoring organisations have a critical role to play in providing additional support such as project design and capacity building. SRLMs should evaluate the capacity of their networks to undertake such tasks. They could hire a dedicated staff pool focused only on solar pumps to make the model more sustainable. The state could also partner with facilitator organisations, like NGOs working in an area or registered producer organisation promoting institutions (POPI), wherever they are present for handholding the groups.
- Sustained engagement with farmer groups, converging with support from existing departments such as livelihood missions, would be essential to ensure long-term sustainability. The engagement should focus on capacity building and group strengthening.
- A key strategy in this multi-step programme is framing group rules to manage group dynamics through iterative learning.

Although it is an effort-intensive model for states to adopt, with the right kind of planning and investment, states could consider it to rapidly expand irrigation access within limited fiscal resources.

Image: iStock

References

Agarwal, Bina. 2015. "Rethinking Agricultural Production Collectivities." *Economic and Political Weekly*, June, 7–8. https://www.epw.in/journal/2010/09/special-articles/rethinking-agricultural-production-collectivities.html.

Bastakoti, R, M Raut, and B R Thapa. 2020. *Groundwater Governance and Adoption of Solar-Powered Irrigation Pumps: Experiences from the Eastern Gangetic Plains*. Water Knowledge Note. Washington DC: World Bank. https://openknowledge.worldbank.org/handle/10986/33245.

IRENA. 2016. *Solar Pumping for Irrigation: Improving Livelihoods and Sustainability*. Abu Dhabi: The International Renewable Energy Agency. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_Solar_Pumping_for_Irrigation_2016.pdf.

Jain, Abhishek, and Tauseef Shahidi. 2018. *Adopting Solar for Irrigation*. New Delhi: Council on Energy, Environment and Water. https://www.ceew.in/publications/adopting-solar-irrigation-0.

Kaushal, Sneha, and Raju Kumar. 2020. "Swadesh in Bastar: How Lift Irrigation Changed Lives in Kelaur Village." Sampark.Net, July 30. https://www.pradan.net/sampark/swadesh-in-bastar-how-lift-irrigation-changed-lives-in-kelaur-village/.

Kolavalli, Shashi, and Nitin Shah. 1993. "Management of Public Tube Wells in Uttar Pradesh." In *Groundwater Irrigation and the Rural Poor, Options for Development in the Gangetic Basin*, edited by Friedrich Kahnert and Gilbert Levine, 131-144. Washington DC: The Word Bank.

Ministry of Agriculture & Farmers Welfare. 2019. "Agricultural Statistics at a Glance." https://eands.dacnet.nic.in/PDF/At a Glance 2019 Eng.pdf.

MOSPI. 2021. "Periodic Labour Force Survey - Annual Report 2019-20." Ministry of Statistics & Programme Implementation. https://www.mospi.gov.in/documents/213904/301563/Annual_Report_PLFS_2019_20m1627036454797.pdf/18afb74a-3980-ab83-0431-1e84321f75af.

Naz, Farhat, and Saravanan V Subramanian. 2010. "Water Management across Space and Time in India." Zentrum Für Entwicklungsforschung / Center for Development Research (ZEF), University of Bonn. http://hdl.handle.net/10419/88305.

Ostrom, Elinor. 1993. "Design Principles in Long-Enduring Irrigation Institutions." *Water Resources Research* 29 (7): 1907–12. https://doi.org/10.1029/92WR02991.

Pant, Niranjan. 1984. "Community Tubewell: An Organisational Alternative to Small Farmer's Irrigation." *Economic and Political Weekly* 19 (26): A59–66. https://www.jstor.org/stable/4373350.

———. 1993. "Performance of the World Bank Tube Wells in India." In *Groundwater Irrigation and the Rural Poor, Options for Development in the Gangetic Basin*, edited by Friedrich Kahnert and Gilbert Levine, 119–30. Washington DC:The Word Bank.

PIB. (2020). Land under irrigation. Press Information Bureau. https://pib.gov.in/newsite/PrintRelease.aspx?relid=199881.

Rahman, Anas, and Abhishek Jain. 2021a. "Can Chhattisgarh Further Equity, Prosperity, and Sustainability Through Solar Pumps?: Indications from a Beneficiaries' Survey." Council on Energy, Environment and Water. https://www.ceew.in/publications/saur-sujala-yojana-for-sustainable-solar-pump-programme-in-chhattisgarh.

———. 2021b. "How Is India Using its Solar Pumps for Irrigation?" New Delhi: *Council on Energy, Environment and Water*. https://www.ceew.in/publications/solar-pumps-underutilization-and-usage-patterns-in-india.

Shirshath, Paresh B, Sakshi Sain, Neha Durga, Diego Senonor, Nilanjan Ghose, Shilp Verma, and Alok Sikka. 2021. *Compendium on Solar Powered Irrigation Systems in India*. Montpellier.

Sugden, Fraser, Bina Agarwal, Stephanie Leder, Panchali Saikia, Manita Raut, Anoj Kumar, and Dhananjay Ray. 2020. "Experiments in Farmers' Collectives in Eastern India and Nepal: Process, Benefits, and Challenges." *Journal of Agrarian Change* 21 (1): 90–121. https://doi.org/10.1111/JOAC.12369.

The authors

Anas Rahman
anas.rahman@protonmail.com | @rahManPage

Anas was a Programme Associate at CEEW, working on solar-powered irrigation and energy access for rural livelihoods. He is a Prime Minister's Rural Development Fellow and an alumnus of the Tata Institute of Social Sciences and IIT Madras.

Abhishek Jain
abhishek.jain@ceew.in | @ajainme

As a Fellow at CEEW, Abhishek develops and leads its practices on energy access, rural livelihoods, and sustainable food systems. He also directs 'Powering Livelihoods', a USD 3 million initiative. He co-conceptualised and currently leads CEEW's flagship research project, 'Access to Clean Cooking Energy and Electricity – Survey of States'. He is a Chevening Fellow and an alumnus of the University of Cambridge and IIT Roorkee.

Copyright © 2022 Council on Energy, Environment and Water (CEEW).

Open access. Some rights reserved. This work is licensed under the Creative Commons Attribution Non-commercial 4.0. International (CC BY-NC 4.0) license. To view the full license, visit: www.creativecommons.org/licenses/by-nc/4.0/legalcode.

Suggested citation: Rahman, Anas, and Abhishek Jain. 2022. *Community-Based Solar Irrigation in Chhattisgarh: Prospects and Challenges.* New Delhi: Council on Energy, Environment and Water.

Disclaimer: The views expressed in this issue brief are those of the authors and do not necessarily reflect the views and policies of the Council on Energy, Environment and Water.

The views/analysis expressed in this report do not necessarily reflect the views of Shakti Sustainable Energy Foundation. The Foundation also does not guarantee the accuracy of any data included in this publication, nor does it accept any responsibility for the consequences of its use. For private circulation only.

Peer reviewers: Nilanjan Ghose, Senior Advisor, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH; Neha Durga, Researcher – Water and Energy, International Water Management Institute, and Shruti Jindal, Programme Associate, CEEW.

Organisations: The Council on Energy, Environment and Water (CEEW) is one of Asia's leading not-for-profit policy research institutions. The Council uses data, integrated analysis, and strategic outreach to explain – and change – the use, reuse, and misuse of resources. It prides itself on the independence of its high-quality research, develops partnerships with public and private institutions, and engages with wider public. In 2021, CEEW once again featured extensively across ten categories in the *2020 Global Go To Think Tank Index Report*. The Council has also been consistently ranked among the world's top climate change think tanks. CEEW is certified as a Great Place To Work®. Follow us on Twitter @CEEWIndia for the latest updates.

Shakti Sustainable Energy Foundation (SSEF) seeks to facilitate India's transition to a sustainable energy future by aiding the design and implementation of policies in the following areas: clean power, energy efficiency, sustainable urban transport, climate change mitigation and clean energy finance.

COUNCIL ON ENERGY, ENVIRONMENT AND WATER (CEEW)

Sanskrit Bhawan, A-10, Qutab Institutional Area
Aruna Asaf Ali Marg, New Delhi - 110067, India
T: +91 (0) 11 4073 3300

info@ceew.in | ceew.in | @CEEWIndia | ceewindia