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Solar Irrigation for Agricultural Resilience (SoLAR)

Solar irrigation in Bangladesh: Current situation and future prospects

Summary Report of Webinar 3

3 February 2021

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List of Abbreviations

IWMI	International Water Management Institute
SIP	Solar Irrigation Pumps
IDCOL	Infrastructure Development Corporation Limited
SoLAR	Solar Irrigation for Agricultural Resilience
SERD	*Southeast Asia Regional Department*
SARD	South Asia Regional Department
SREDA	Sustainable and Renewable Energy Development Authority
SPV	Solar Photo voltaic
BADC	Bangladesh Agricultural Development Corporation
BREB	Bangladesh Rural Electrification Board
BMDA	Barind Multipurpose Development Authority
BARD	Bangladesh Academy for Rural Development
BADC	Bangladesh Agricultural Development Corporation
BREB	Bangladesh Rural Electrification Board
PM-KUSUM	Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan
RE	Renewable Energy
DISCOM	Distribution Companies

Webinar 3: Solar irrigation in Bangladesh: Current situation and prospects

The region in focus for webinar 3 was Bangladesh. The country is one of the most climate-vulnerable places in South Asia, and solar irrigation could help mitigate climate shocks. Webinar 3 was titled*: 'Solar Irrigation in Bangladesh: current situation and future prospects'*. The webinar was attended by 68 people, including the four speakers and the four panellists. Dr Aditi Mukherji moderated the session.

Bangladesh has committed to reducing its carbon emissions unconditionally by 5% by 2030 in its Nationally Determined Contributions (NDCs) pledges under UNFCCC. Solar irrigation provides an excellent opportunity to achieve carbon emission reductions by replacing diesel pumps in off-grid areas with a cleaner energy alternative. Till mid-2020, more than 1800 solar irrigation pumps had been set up, with a total installed capacity of 46.2 MW, and this is expected to expand substantially in the coming years. The Infrastructure Development Corporation (IDCOL) is a pioneer in developing the SIPs business model in Bangladesh. It has set a target of installing 10,000 SIPs by 2027. Other organisations like BMDA, BADC, and BREB have also promoted solar irrigation pumps in the country. The purpose of this third webinar was to explore some of the broader questions around clean energy transition and solar irrigation in Bangladesh, viz., Is Bangladesh on track to meet its targets for solar irrigation pumps? What are some of the operational models for SIP promotion in the country? What are the challenges and emerging opportunities for this sector in the coming decade? Experts and practitioners working in the solar irrigation sector, both from Bangladesh and outside, were invited to discuss the current status and future challenges for solar irrigation expansion in Bangladesh.

Table 1: Schedule of Webinar 3

Webinar	**Date & time**	**Speakers/Presenters**	**Panellists**
Webinar 3	3 February 2021(3:00-5:00 PM IST)	Mr Anthony Jude Mr Mohamad Golam Sarware Kainat Dr Marie-Charlotte Buisson Mr JK Jethani	Mr Mohammad Sarwar Hossain Ms Salima Jahan Md Shamshul Huda Mr Anwar Hossain

Recording of webinar 3: https://www.youtube.com/watch?v=EePUjoRWe6c

I. Presentations

a) Roadmap of solar irrigation in Bangladesh

Mr Anthony Jude, Senior Energy Adviser (as consultant) to Energy Divisions in Southeast Asia Regional Department (SERD) and Energy Division, South Asia Regional Department (SARD) of Asian Development Bank, gave a presentation in this session.

Mr Jude is one of the principal authors of the 'Roadmap for solar irrigation in Bangladesh' as prepared by ADB for the coming decade, i.e., 2021-2030. He presented the likely policy pathway to transition from diesel-based irrigation to SIPs in Bangladesh from this roadmap. The roadmap aimed at a maximum new PV capacity of 2000 MWp and proposed an approach comprising three components -

Component A: Standalone SIP systems to replace diesel pumps, with a target of 1,000 MWp capacity by 2030 and with a budget of USD1.54 billion. Grants will cover at least 50% of the project cost initially, which can be reduced up to 40% if the equipment costs go down.

Component B: Hybridisation/solarisation of electric grid-connected pumps, with a target of 25 MWp capacity by 2023 under the net-metering scheme. This will be the pilot phase, and conditional on positive assessment, an additional 475 MWp is targeted by 2030. However, this is only for existing electric pumps and does not replace diesel pumps with hybrid electric pumps. The pilot phase is expected to cost around USD20 million, out of which 30% is proposed as grant financing.

Component C: Decentralised ground-mounted SPV systems on agricultural lands, where solar energy production and agriculture will go hand-in-hand. Farmers or private developers are envisioned to become independent power producers setting up projects ranging between 50 kWp - 10 MWp, but without compromising agricultural production. DAE and SREDA provide technical guidance on continuing cultivation below the panels and set acceptable limits to yield reduction before green-lighting such projects. 25 MWp capacity is targeted under Component C in the pilot phase, with a budget of USD25 million (USD5 million in loans/grants). After a positive assessment, an additional 475 MWp is to be set up by 2030. Farmers are expected to take an equity stake in these projects.

In these above plans, grid connection is likely to play an important role. It assumes that farmers/ sponsors who took loans and invested their own money will sell excess electricity back to the grid and help recover their investments. But despite the recent progress in extending grid connection across the country, this is likely to be a challenge. Last-mile connectivity issues are reporting huge voltage drops along distribution lines that restrict energy evacuation into the system. It will require more investments in the distribution network and substations to help improve voltage regulation before grid connection can be scaled up.

Financing this ambitious roadmap is another challenge. In the Paris climate agreement, Bangladesh Government indicated to put aside USD 600 million for Solar PV. Taking a cue from that, the roadmap suggests the government create a SIP fund and put aside 250 million for this purpose. Another USD 400-500 million is expected to be provided by international donor agencies and climate funds. The remaining amount is to be raised from the private sector in Bangladesh, including commercial banks, project developers and farmers.

Mr Jude spoke about how the transition from diesel to solar would require a specific enabling environment that tackles issues of the institution, finance and sustainability. In the context of the energy-water-agricultural nexus, there is a need to promote efficient agricultural and micro-irrigation practices. To maintain quality, SREDA should work with different agencies to set technical standards for solar equipment. Standardised financing products and credit availability at concessional rates for farmers are also crucial if this roadmap has to be achieved. To ensure project sustainability, the roadmap suggests raising farmer awareness, developing some insurance mechanisms for loan processing, technical support for O&M, and 2% of the grant money allocated to implementing agencies for developing a proper O&M plan.

Mr Jude also emphasised that the roadmap envisions a transformational change that not only addresses climate change but will help farmers fight poverty by gaining an equity stake in the SIP investments. Especially component C of the roadmap can play a crucial role in this transformational change.

Table 2:Q&A with Anthony Jude

Sl no	Questions	Answers
1.	How big is the area for Component C? (Marie-Charlotte Buisson)	Mr Jude mentioned that since land is a big issue, they have kept this flexible, and it is up to the farmers to decide how large a project they want to set up, a 50 KWp or few megawatts peak projects, which will require areas in acres. It will depend on how many farmers (5, 10 or 50) come together and get the consolidated land for setting up the project.
2.	What has been the experience of the solar irrigation project being implemented by BREB vis-a-vis the solar irrigation projects implemented by the others? (Devendra Adhikari)	Although BREB received 4000 applications initially, by the end of 2020, it came down to just 400 applications. One of the challenges was that grid extension has not taken place fully (only ~68%). Currently, grid extension is

		up to 98%. BREB also raised the grant financing portion to 50% to shore up more demand. Other organisations like BADC have an even higher grant portion (up to 65%), as for them, the SIP programme is about extending irrigation service.

b) Solar Irrigation: Future prospects

Mr Mohammad Golam Sarware Kainat, Director (Joint secretary), Renewable Energy, Sustainable and Renewable Energy Development Authority (SREDA) of Power Division under Ministry of Power, Energy and Mineral Resources, Bangladesh, gave a presentation in this session.

Mr Kainat discussed the current situation and prospects of solar irrigation in Bangladesh, focusing on the issue of grid connection of SIPs from SREDA's perspective. SREDA has two primary functions: promoting renewable energy and adopting energy efficiency plus energy conservation measures. Despite Bangladesh's carbon emissions being very low, it has committed to its NDC target to reduce GHG emissions by 5% unconditionally till 2030. Transitioning to solar energy will not only achieve a reduction in greenhouse gas emissions but will play a crucial role in Bangladesh's food and energy security.

Both in terms of addressing climate change impacts and mitigating the risks of international oil price rise, solar irrigation has potentially a significant role to play, provided a suitable business model can be developed. One of the critical challenges in the expansion of solar pumps is that electricity connection has already reached almost all corners of the country and solar irrigation faces tough competition from electric pumps.

From the government's side, many policies (7th FYP, Minor Irrigation Policy, 2017, Bangladesh Delta Plan, National Agricultural Policy, 2018, National Agricultural Mechanization Policy, 2019 etc.) have been developed to encourage the use of solar irrigation pumps. Mr Kainat mentioned that currently1.24 million diesel pumps are operational in BD, which uses approximately 1.25 million tons of fuel annually and costs around 45.8 billion BDT to import. The solar roadmap envisioned replacing 0.32 million diesel pumps and reducing annual diesel use by 0.3 million tonnes. Currently, SIP installed capacity in BD is around 46 MW, most of which is in Rangpur, followed by Khulna. Most of the current SIPs are through IDCOL, with BADC, BMDA, BREB and RDA. Other organisations have also planned new SIP projects, including 2000 SIPs by BREB, 11 SIPs by BARD, and another eight projects by BARI in the coastal regions.

Finally, Mr Kainat highlighted some of the main challenges for the promotion of SIPs in BD, which include – excess energy utilisation in the irrigation off-season (further complicated by the fact that often these SIPs are located in the middle of farmers' fields, making it difficult to connect with grid), competition with electric pumps due to rapid grid expansion, finding suitable business models etc.

The government has already worked on the SIP grid integration models and net metering guidelines, enabling farmers/sponsors to sell their power to the national grid, against which they will get credits that will be squared off at the end of the financial year.

c) Early results from IWMI-IDCOL Impact Evaluation study

Dr Marie-Charlotte Buisson, Researcher, IWMI, gave a presentation in this session.

Dr Marie-Charlotte Buisson presented some early results from the IWMI-IDCOL impact assessment study, focusing on how SIPs have developed in Bangladesh till now through the experience of IDCOL SIPs; and highlighting the challenges and opportunities it has encountered.

Dr Buisson started by reminding the audience that the SIP sector is still nascent, as SIPs irrigate a minuscule area compared to the site under diesel and electric pumps. But even at this nascent stage, already there are a rich set of different institutional and financial models for SIP promotion – IDCOL's fee-for-service model, the soon to be implemented ownership model of BREB and the group ownership models of BMDA, BADC, RDA etc. Currently, the primary model is the fee-for-service model of IDCOL, where sponsors (either private/ non-profit organisations) get a grant plus loan from IDCOL to set up SIPs (with 15% own equity) and then sell water to farmers against irrigation charges.

Based on telephone surveys conducted in 2020 on a representative random sample of IDCOL SIPs, she found that the demand for irrigation during monsoon season is relatively low. 49% of schemes provided any irrigation during this season, and even for these schemes only, 35% of the command area required any irrigation. Also, very few SIPs provided any other service than irrigation during this season. During this season, Aman was the most important crop, with few growing other crops like Aus, jute, chilli, maise. She also found that in terms of allocation of irrigation water, in 58% of cases, the operators decided to allocate water based on their observation, 36% when farmers demanded, and 5% cases on a watering schedule established in advance. More importantly, in 65% of cases, they did not require the presence of the farmer during irrigation, in contrast to diesel irrigation which requires constant presence and effort from the farmer side. In terms of the beneficiaries, she found that 36% of farmers receiving irrigation from SIP were not the direct owner of the land (share-cropper/tenant), and 62% were tiny farmers (cultivating less than 0.5 acres).

In 2020, there was cyclone Amphan in May, and 2 SIPs in Khulna were damaged, but other than that, it

did not affect the pumps' operation much. Then the floods happened during July-August, which completely flooded two SIP command areas, but more importantly, 25 SIPs did not require any irrigation due to the heavy rainfall. Covid-19 was another vital factor in 2020, but it had a minimal effect on SIP operation (except for some delay in fee collection). The impact of COVID mainly was in terms of access and cost of inputs and labour for the farmers.

In terms of challenges, based on secondary data, she found that actual cropped area and actual irrigation charges for the projects were lower than the base estimates made before the start of the projects, as upper bounds of what can be achieved. It implies that the annual revenue from irrigation is lower than expected, and it will take longer for the sponsors to recover their capital investments. So there is a need to explore opportunities for making the SIP business more profitable, like developing market support through training organised for farmers and creating other revenue sources (like agricultural services and grid integration). But most importantly, Dr Buisson highlighted that this fee-for-service SIP business should not be judged on its profitability. Still, a proper appraisal would require a valuation of the co-benefits in terms of poverty alleviation, food security and climate change mitigation. For example, her preliminary calculations show that under certain assumptions, a 5% reduction in emissions from irrigation can be achieved with IDCOL's target of 10000 SIPs.

Table 3:Q&A with Dr. Marie-Charlotte Buisson

Sl no	Questions	Answers
1.	How can solar irrigation help efficient water management? How SIP benefits farmers, especially in terms of poverty alleviation and food security? – (Mohammed Mainuddin)	The impact of solar irrigation on efficient water use is a much broader question, but there is no proper reason to improve water use efficiency. It depends on the incentives set up and how solar is combined with other instruments for efficient water use. Our study will look into the impact on food security and poverty alleviation. Still, the richness of the fee-for-service SIP model in Bangladesh is that farmers themselves are not asked to pay for equity, and they are not the owners of the equipment, but they benefit from the service. So, it could be providing irrigation access to marginal farmers at a lower tariff than diesel, which is where probably the poverty angle will come in.
2	What models are there in practice	Two models are available for grid-connected SIP:

	for governance of grid-connected solar pump systems (e.g., ownership, investment, energy/benefit sharing, etc.)? – (Vishnu Pandey)	1) By Net metering guidelines 2018 2) Guidelines for the grid integration of solar irrigation 2020.
3	Any grid-connected solar has been piloted in the country? What are the experiences? – (Yashoda Yashoda)	Grid integration SIP is in the pilot stage with one pilot project at Kushtia bearing a capacity of 20kW. The technical performance has so far been good.

d) Challenges and opportunities of grid-connected solar irrigation pumps in India:

Mr J.K. Jethani, Director/Scientist-E in the Ministry of New and Renewable Energy (MNRE), Government of India, gave a presentation in this section.

Mr Jethani discussed India's KUSUM programme and the plans for grid connection, highlighting the technical and socio-economic challenges faced in the process.

There are 22 million electric grid-connected pumps and 7 million diesel pumps in India that use 80% of the available groundwater resources for irrigation. Agriculture constitutes 18% of total electricity consumption in the country, and most of it is subsidised (1000 billion INR). In March 2019, the PM-KUSUM programme was launched with the following objectives –reliable daytime solar power, land degraded/non-used land, additional income for farmers, water conservation, reduction in electricity subsidy, and promotion of decentralised solar power generation. It has the overall target of achieving 30.8 GW capacity by 2022.

Table 4: Components under PM KUSUM scheme

Components	Description
Component A	10 GW of grid-connected solar or any other RE Plants is planned to be achieved under component A. These solar power plants of sizes between 500 KW to 2MW capacity to be set up by farmer groups or project developers on barren/uncultivable land (if on agricultural land it is to be installed in stilt fashion). DISCOMs will purchase power at a pre-fixed tariff, and the duration of PPA will be 25 years. To incentivise the DISCOMs to buy power from these decentralised solar power plants, they will be given procurement based incentives @ Rs. 0.40 per unit

	for the first five years. In the case of the project set up by developers, the lease amount is to be paid to farmers directly by DISCOMs based on per acre per year or unit energy generated per acre per year.
Component B	Two million standalone Solar Ag Pumps are targeted under Component B of PM KUSUM. Individual farmers, Water User Associations and community/cluster-based irrigation systems are eligible under this component. The priority will be for small and marginal farmers and if they use micro-irrigation systems. A minimum of 60% subsidy is to be provided for these solar pumps, where the subsidy limit would be up to 7.5 HP pumps. However, state governments can increase the portion of the subsidy from their state budget. In Dark/Black zones, only diesel pumps will be replaced if they use micro-irrigation techniques. There will also be the Universal Solar Pump Controller (USPC) option to enable solar power for other activities.
Component C	Solarisation of 1.5 million grid-connected agricultural Pumps (up to 7.5 HP), where individual farmers, Water User Associations and community/cluster-based irrigation systems can apply. The surplus energy from these grid-connected solar pumps can be sold to DISCOM at a tariff set by the Regulator, and there will be different models under component C, namely, Net Metering/ No draw from grid/ Feeder level solarisation. The feeder level solarisation, which instead of going after individual pumps, solarise the entire feeder by setting a small solar power plant near the substation of the particular feeder, is often considered the most cost-effective and efficient way for transitioning to solar, according to Mr Jethani. This process does not require the farmer to invest and makes it easy to implement. The government can recover its cost from reduced subsidies to electricity. Farmers will also benefit from a reliable daytime electricity supply. They can also be incentivised to save on water and electricity use.

The PM KUSUM has been included in priority sector lending, and loans can be availed for this scheme from the Agriculture Infrastructure Fund that was approved in July 2020. The government has also developed different financing models with a mix of loans, grants, and equity for the farmers to invest in solar irrigation pumps.

Table 5:Q&A with Mr J.K. Jethani

Sl no	Questions	Answers
1.	Farmers can be incentivised for saving electricity and water - how do you ensure that farmers save water if they are getting it virtually for free? I did not quite get that. - Especially in water-scarce areas, over-irrigation is a significant concern in solar irrigation. – (März Tobias).	Under our feeder level solarisation programme, we will benchmark the consumption of farmers based on historical data on average consumption per farmer per hp. If farmers consume less than this benchmark amount under the programme, they will receive an incentive amount per unit, as decided by the state. So, this will incentivise the farmers to save electricity and water.

II. Panel Discussion

The panel for this webinar included four discussants - Mr Mohammad Sarwar Hossain -Deputy Chief Engineer in Bangladesh Agricultural Development Corporation (BADC); Ms Salima Jahan- Member (Joint Secretary), Renewable Energy; Md. Shamshul Huda - Superintending Engineer at Barind Multipurpose Development Authority (BMDA) under Ministry of Agriculture; Mr Anwar Hossain - Deputy Executive Director of Wave Foundation, Bangladesh.

Mr Jahan commented on BADC's role in promoting SIPs in Bangladesh, specifically in the context of small and marginal farmers. BADC serves as an irrigation provider by installing tube well all across the country. BADC installed its first SIP in the Dhaka division from 2009-2012. Currently, there are 243 SIPs of BADC spread across all divisions in the country, and their target is to have 1000 SIPs by 2023. BADC till now uses SIPs only for surface water irrigation. Since 76% of farmers in Bangladesh are small and marginal farmers, the benefits of SIPs must reach them. Still, it also poses a significant challenge for the government to devise a suitable business model for marginal farmers. SIPs can play an essential role for marginal farmers by providing low-cost irrigation, savings on diesel and electric pumps' operation and maintenance costs, and providing extra benefits like electricity for households, solar operated agricultural machinery, etc. According to Mr Jahan, small and marginal farmers should be targeted through an appropriately financed ownership model of SIPs.

Ms Salima Jahan from SREDA focused on the competitiveness of solar vis-à-vis electric pumps in BD and the challenges of grid connection in the country. She highlighted that while SIP has already proven to be a viable option in off-grid areas, the expansion of electricity supply across the country will open up new avenues of revenue for the existing SIPs through grid integration SREDA has already developed the policy

guidelines. At this moment, SREDA has no further interventions planned to make SIPs competitive with grid electricity. After approval of the draft SIP roadmap by the power division, SREDA will revise its 2008 Renewable energy policy and develop further action plans based on that roadmap. SREDA will also study the impacts of SIP grid integration projects, but the expectation is that it will make SIPs financially sustainable. However, there are many challenges of grid integration of SIPs – firstly, in most cases, project sites are sometimes up to 200 meters away from the grid, and the project owners have to bear the cost of grid connection, which could be a challenge. Grid stability is another issue that might affect the capacity to take the intermittent RE electricity. The grid can take up to 10% RE electricity (currently, RE share is less than 4%). Finally, grid integration will also necessitate enhancing substation capacity and capacity of the distribution network, which will be the government's responsibility. But even with all these constraints, SIPs still have a clear business case, according to Ms Jahan and should not require any more financial support from the government. But policymakers in Bangladesh should keep an open mind on judging SIPs, which might not be a cost-effective idea for scaling up RE in future, where new technology might be more suitable.

Md. Shamshul Huda from BMDA described BMDA's role in SIP expansion. BMDA is using only surface water for SIPs. According to the MI census, 173000 LLPs in Bangladesh are operated by diesel, so BMDA has the excellent potential of replacing diesel LLPs with solar power for irrigating surface water. Also, they follow a very different institutional model, where SIPs run on prepaid metering systems and all SIPs run under the supervision and logistic support of BMDA. Both IDCOL and BMDA are working on expanding SIPs in Bangladesh with very different models, but there is no challenge between IDCOL and BMDA.

The final panellist was Mr Anwar Hussain from WAVE Foundation, who shared the experience as a sponsor of IDCOL SIPs. He highlighted the challenges they are facing at the moment in terms of the profitability of their business. Their revenue depends on whether farmers are cultivating Boro rice, which requires a lot of irrigation. But with changing market conditions, farmers have shifted towards other crops. This has affected their revenue a lot, and the loan repayment has become an issue. In this context, grid connection has become very crucial for the viability of the business model.

Table 6:Questions to panellists

Sl no	Questions	Answers
1.	For the issue of Irrigation License, i.e., Solar Pump Vs Electrical Pump, which gets priority? Do you have any policy on these issues? – (Shamim Reza). Secondly, what do you think of the new GW legislation that requires a minimum distance	Mr Mohammad Sarwar Hossain: The new law should not impact the growth of SIPs, as it will protect the SIP command area from the competition with new diesel or electric pumps. SIPs are much less costly than diesel, and

	between pumps, and would that impact the growth of solar pumps in Bangladesh – (Aditi Mukherji)	hence farmers will replace their diesel irrigation with water from SIP.
2.	Any experience or view on the opportunity or need for 0.5-1HP standalone SIP in Bangladesh? – (Martina Groenemeijer)	Mr Mohammad Sarwar Hossain: BADC uses three types of pumps: 0.5 Hp, 1 Hp and 1.5 Hp, and they have not faced any challenge. Since most farmers grow paddy, they need bigger pumps, and according to Mr Hossain, 1 Hp pumps are suitable.
3.	Whether the arsenic contamination in groundwater also has been taken care of along with the solarisation for energy, especially for operating the pumps? – (Naveen Mangal Joshi)	Dr. Marie Charlotte Buisson: SIP site selection by IDCOL makes sure to avoid locations affected by arsenic contamination of groundwater.

Top three take away from the webinar 3, and how and whether SoLAR future work can address them?

Takeaway 1: There are many different models of SIPs in Bangladesh, and not all of them are yet operational. Some of them are in the pilot stage. It is crucial to study these alternative models, understand their strengths and weaknesses, and help make an informed decision on the suitability of alternative models under different conditions in the country. SDC SoLAR project will be making some of these comparisons of alternative models, for example, the fee for service model vis-a-vis the ownership model of BREB.

Takeaway 2: Another significant issue is that solar pumps are used for only a limited number of days during the year. Most of the energy from solar panels just gets wasted. Most of the current use is entirely dependent on Boro cultivation. Many financial models are based on the supposition that farmers will grow many areas under Boro, the more water-intensive crop. But if the cropping pattern changes, then those financial models are no longer viable. Grid integration of SIPs will enable selling the excess energy from solar panels into the grid and earn extra revenue. This can be the solution in making SIPs

financially viable, but their impact needs to be studied carefully, and appropriate adaptations might be needed to make it go forward. Our SoLAR project will explore several such cases and hopefully contribute to that discourse.

Takeaway 3: SIPs will have impacts, not all of which will be captured by analysing the financial viability of a particular model. Any informed decision on the future role of SIPs in Bangladesh should consider those impacts like reduction in green-house gas emissions, impact on poverty and food security of farmers through cheaper irrigation, impact on groundwater usage etc. Our study will look into these impacts to help policymakers make an informed decision.

Appendix A: Glimpses from webinar 3