International Water Management Institute

CGIAR

Early results from IWMI-IDCOL impact assessment

Marie-Charlotte Buisson

SoLAR Webinar
Solar irrigation in Bangladesh: Current situation and future prospects
3 February 2021

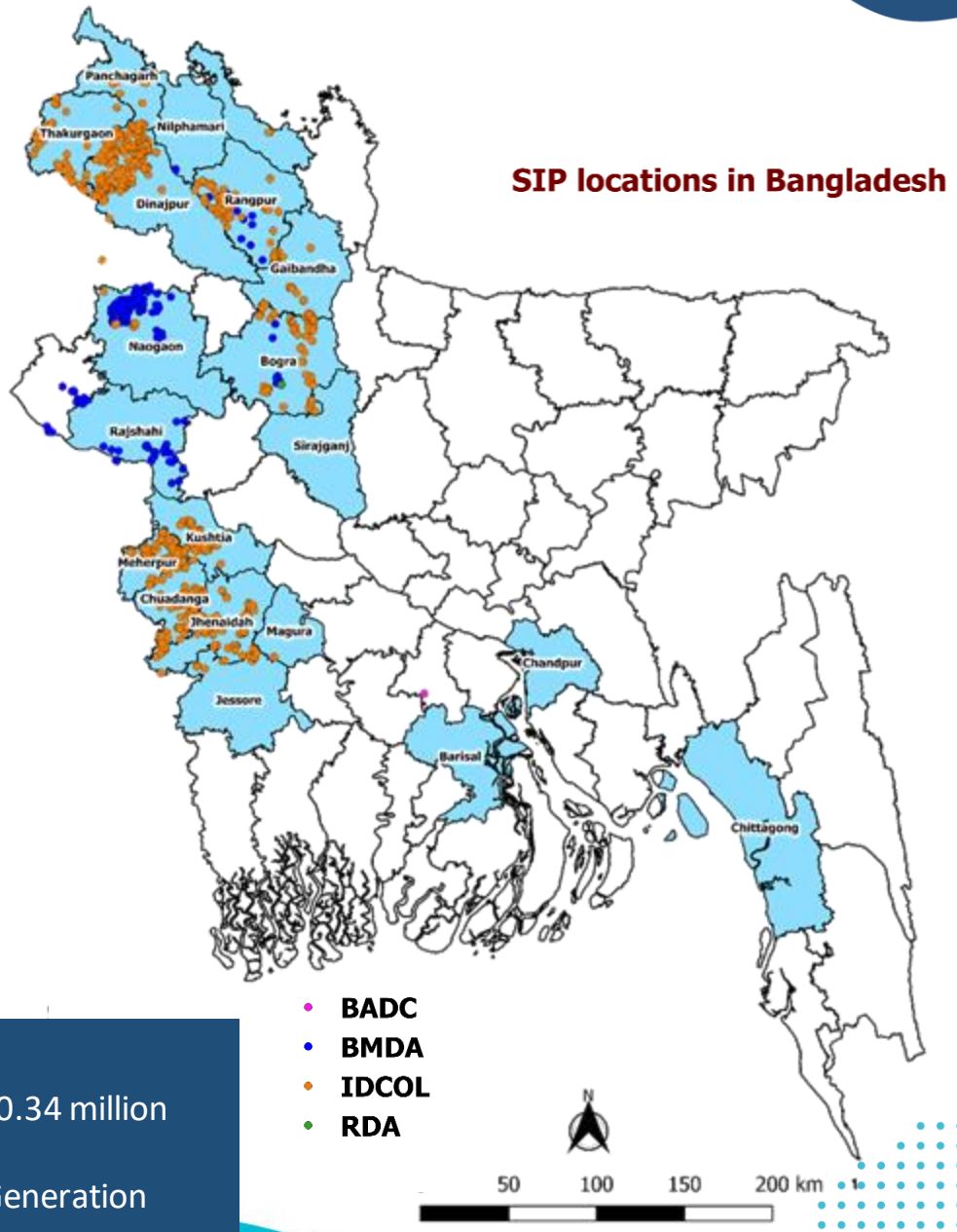
Innovative water solutions for sustainable development

Food · Climate · Growth

Current scenario of solar irrigation in Bangladesh

2293 Solar irrigation pumps (SIP)

- **Infrastructure Development Company Limited (IDCOL)**
  - So far 1,515 operational SIPs
  - Target 10,000 SIPs by 2027
  - Development partners and Government of Bangladesh
- **Bangladesh Rural Electrification Board (BREB)**
  - ADB funded project for 2000 SIPs (pipeline)
- **Barind Multipurpose Development Authority (BMDA)**
  - 453 SIPs
  - Mostly surface water pumps
- **Bangladesh Agricultural Development Corporation (BADC)**
  - 250 SIPs
- **Department of Agricultural Extension (DAE)**
  - 40 SIPs
- **Rural Development Authority (RDA)**
  - 35 SIPs



Into perspective:

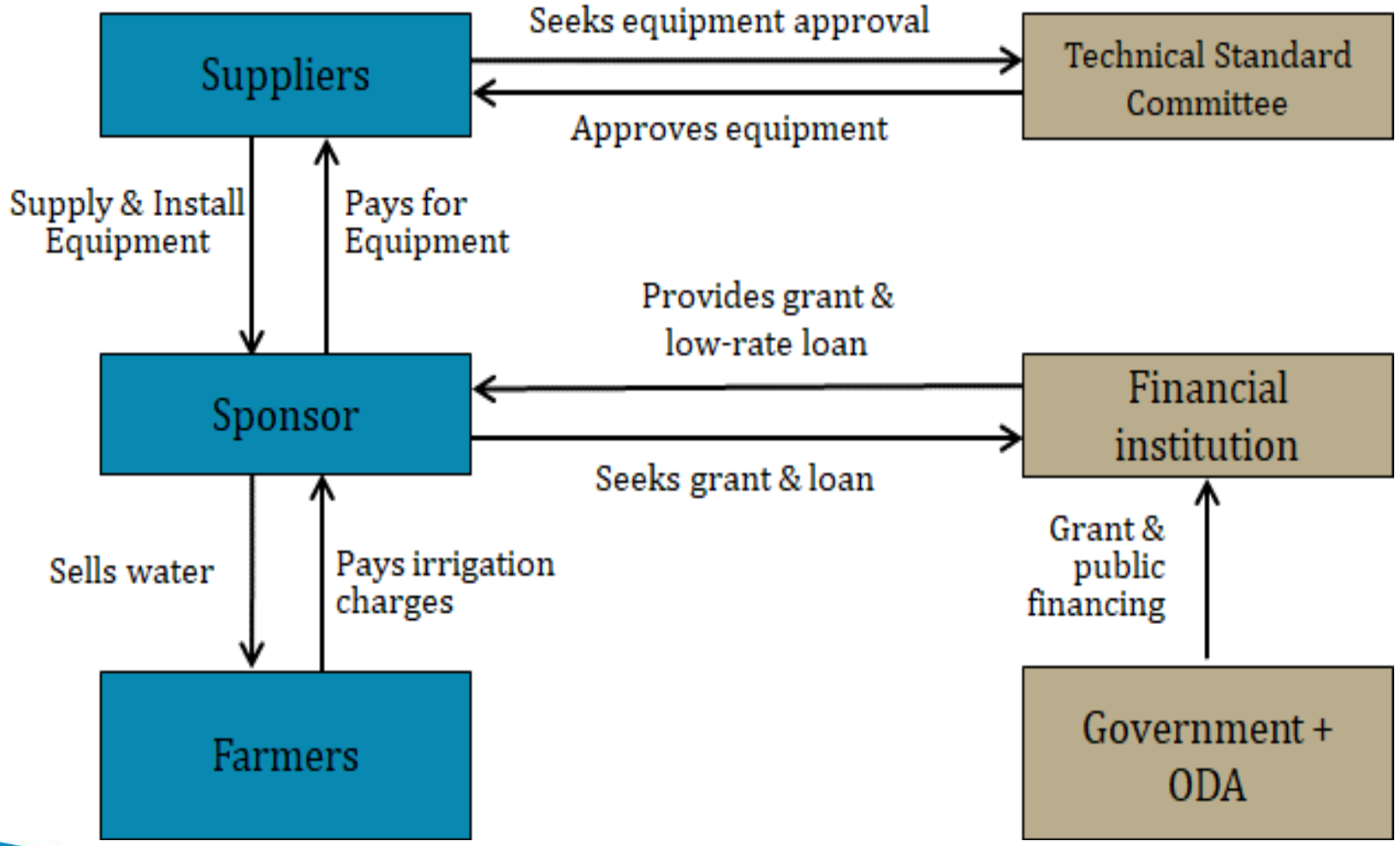
- 1.24 million diesel pumps irrigating ~ 3.0 million hectares and 0.34 million electric pumps covering ~2.3 million hectares
- Installed capacity of 46.98 MW, in the "500 MW Solar Power Generation Plan" (2012-2016) target of 150 M from SIPs

Financial and institutional modalities of solar irrigation in Bangladesh

	Fee for service model	Ownership model	Group ownership model
Organizations	IDCOL	BREB	BMDA, BADC, RDA
Grant: Loan: Down payment	50: 35:15	55: 35: 10	100% grant or minimal equity
Repayment time	10 years	10 years	-
Number of units installed	1,515	~400 in 2021	350
Average capacity per SIP (kW)	28 [2 – 46]	5 [2- 15]	6 [2 - 22]
Total installed capacity (kW)	44845.48	~11000	1816.28
Target group	Small and medium farmers	Small farmers	Very small and marginal farmers
Division covered	Kushtia, Rangpur, Thakurgaon	Rangpur, Rajshahi, Dhaka, Chattogram, Mymansingh, Khulna	Barisal, Rajshahi, Rangpur

Financial and institutional modalities of solar irrigation in Bangladesh

Fee-for-Service modalities

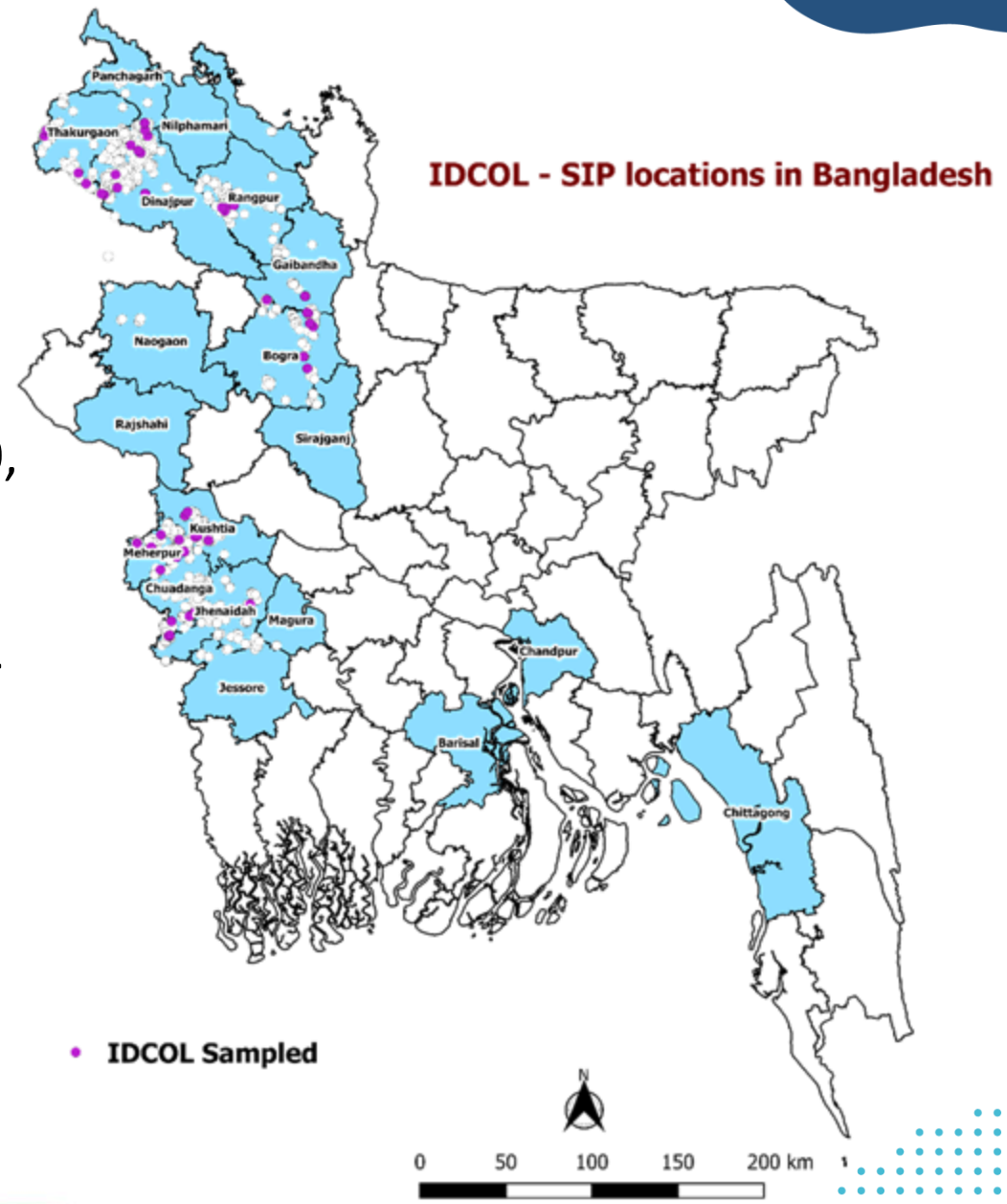


Impact Assessment of IDCOL supported SIPs

RESEARCH QUESTIONS	DATA AND METHODS
Farmers What is the impact of SIP on **agricultural practices and outcomes, farmers' behaviors and equity in water access**?	**Household survey** Baseline and follow-up survey among 900 farmers in SIP and control locations. Quasi-experimental methods
Resources What is the effect of SIP on **diesel consumption and water applications**?	**Household survey** Baseline and follow-up survey among 900 farmers in SIP and control locations. Quasi-experimental methods
SIP How does **SIP characteristics** (NGO/private sponsor, age, power installed, type of pump, financing) influence its **operation**?	**SIP survey** Representative sample of 80 SIP surveyed 3 times a year. Descriptive analysis.
Grid How does grid connection affect **the operation of SIP, water buyers and groundwater consumption**?	**Household and SIP surveys** Sample of 13 grid connected SIP and control SIP. Baseline and follow-up data from SIP and household surveys. Quasi-experimental and descriptive statistics analysis.

EARLY RESULTS | SIP survey in *kharif-2* 2020

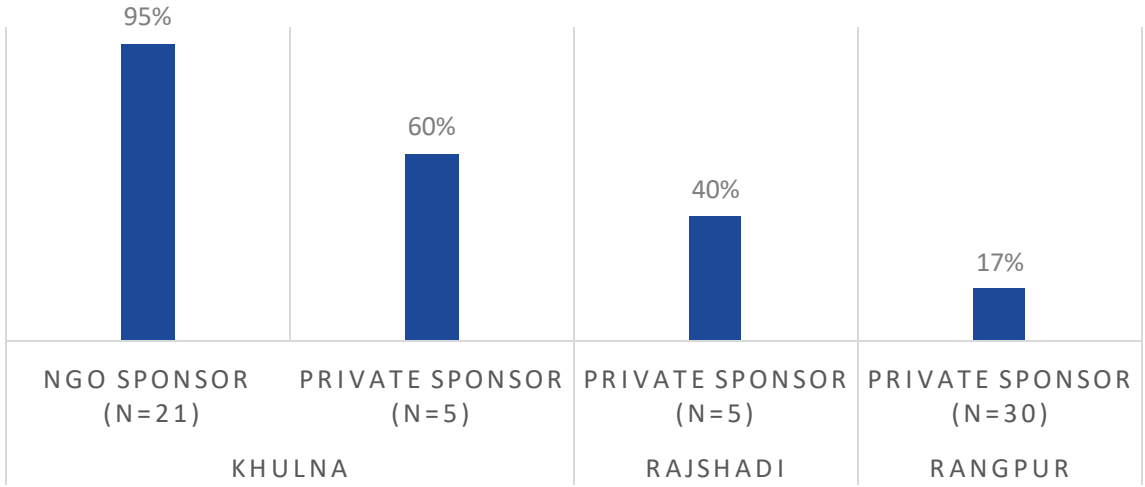
- Sample of **82 IDCOL SIPs randomly selected and representative of locations, NGO/private sponsors, years of approval**
- 61 SIPs operational during the *kharif-2* season in 2020, average command area of 15.9 ha
- *Kharif-2* season: from June/July to October/November
- **Phone surveys** with SIP operators in October and November 2020



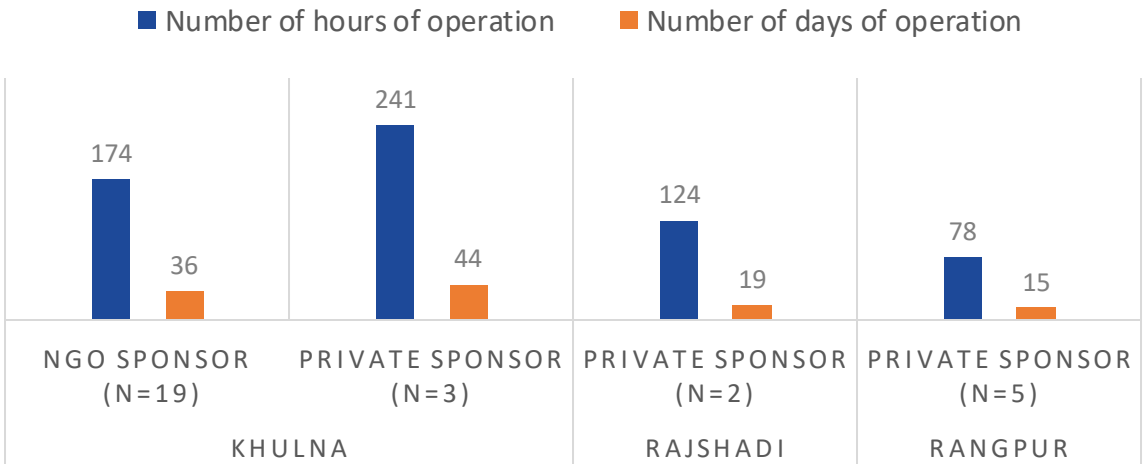
EARLY RESULTS | Operation in *kharif-2* 2020

- **49% of the SIPs provided irrigation** in the last kharif-2 season.
- For SIPs providing irrigation, 35% of the command area was served. On average, 19% of the SIPs command area was served in the last *kharif-2* season.
- Only 4 SIPs provided **other services** (husker, grinder) during this season.

Percentage of SIPs operated in *kharif* 2-2020

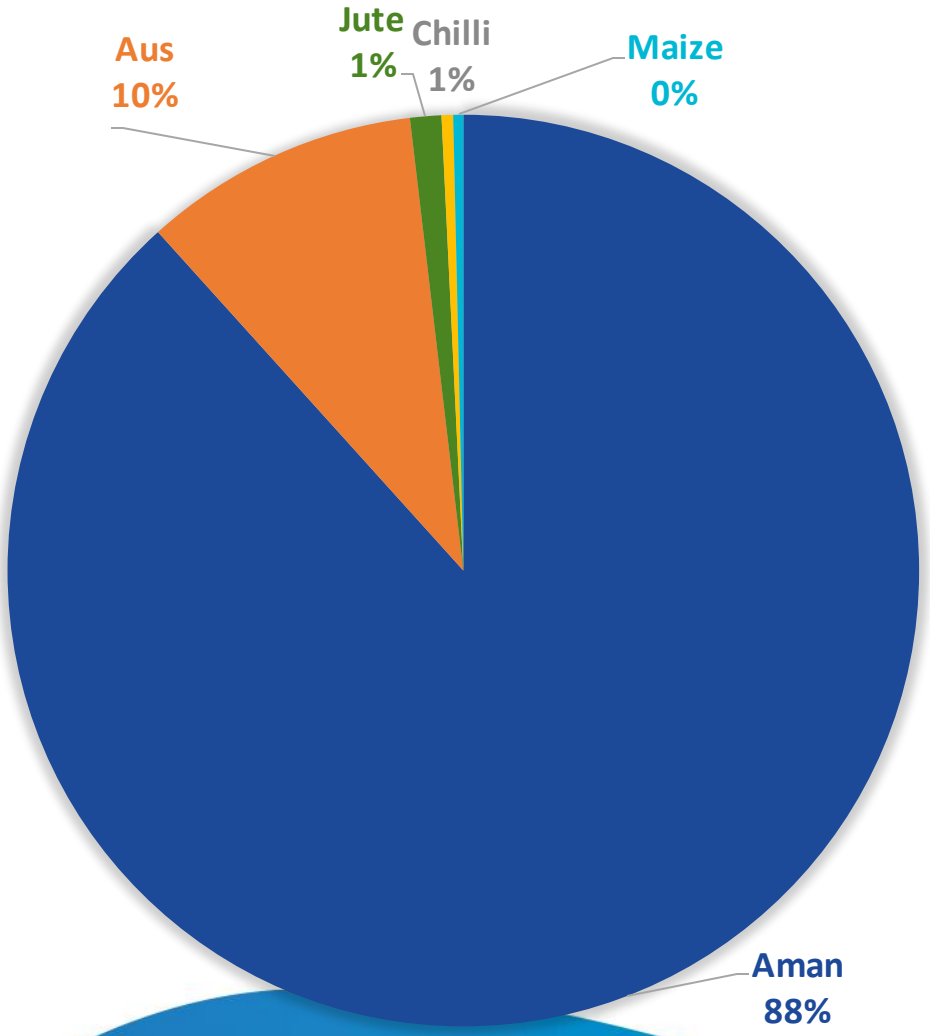


Hours and days of operation in *kharif* 2-2020



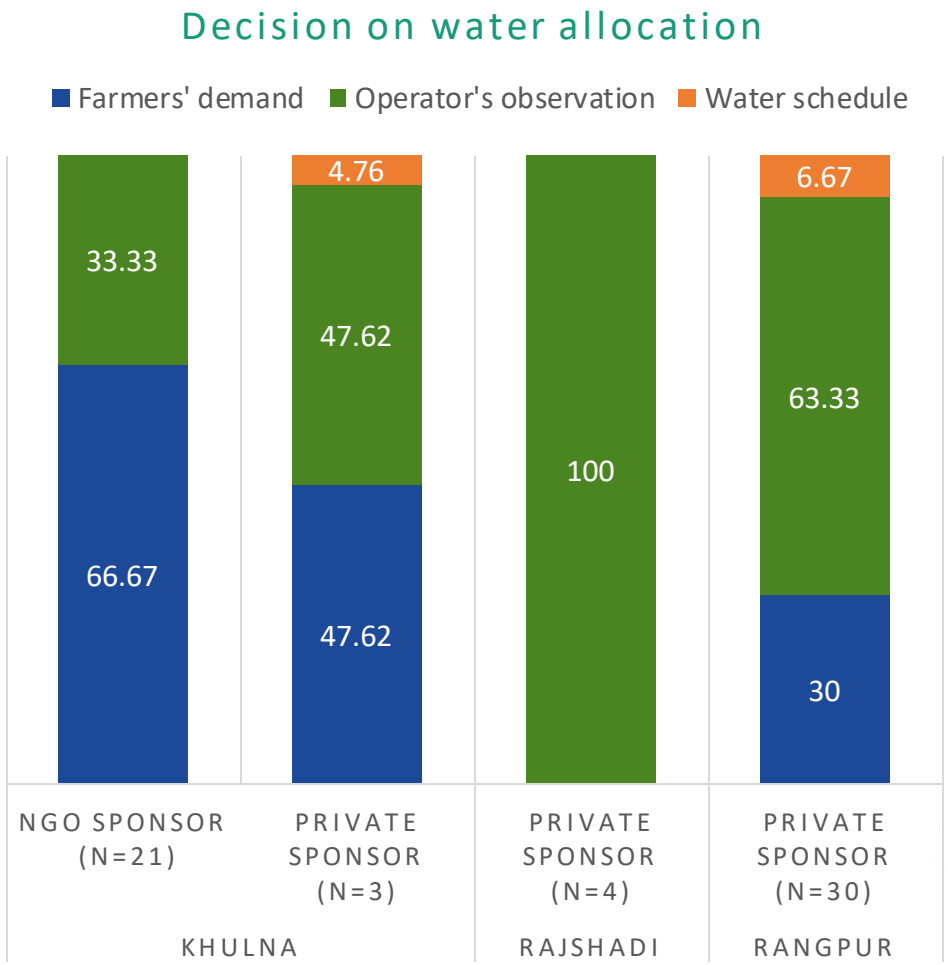
EARLY RESULTS | Crops irrigated in *kharif-2* 2020

Share of area irrigated by SIPs by crops



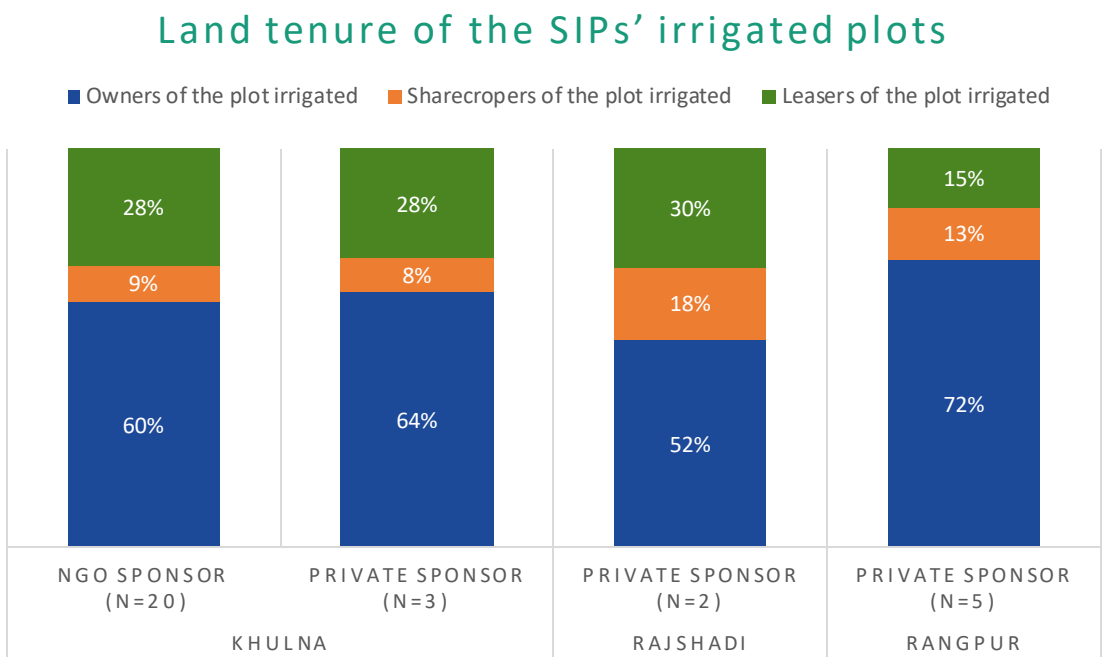
	Number of SIPs	Plots per SIP	Farmers per SIP	Contracts	Average tariffs
Aman (Monsson rice)	28	38	28	Per season	1,116 Tk/bigha
Aus (Summer rice)	7	22	11	Per season	928 Tk/bigha
Jute	1 in Khulna (Chuadanga)	7	7	Per irrigation	250 Tk/bigha
Chilli	1 in Rajshadi (Bogura)	28	18	Per irrigation	200 Tk/bigha
Maize	1 in Khulna (Jhenaidah)	15	3	Per season	800 Tk/bigha

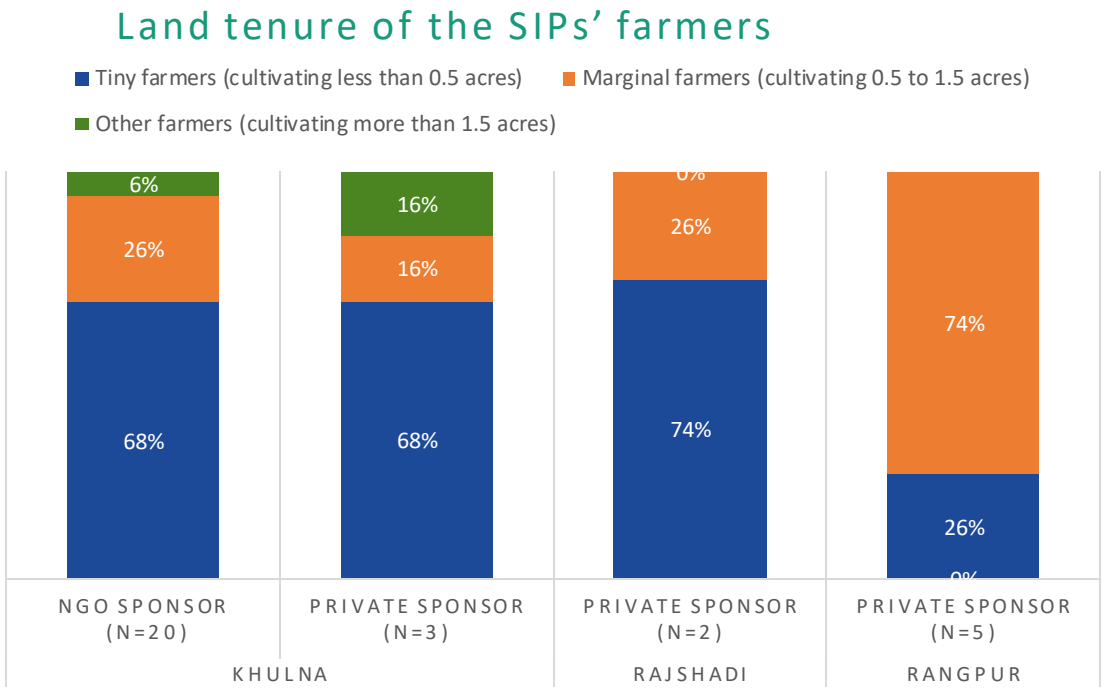
EARLY RESULTS | Irrigation services in *kharif-2* 2020



- Aman plots received in average **10 irrigations** during the *kharif-2* season.
- In 58% of the SIPs, the **operator decided the allocation of water** based on his observation of the plots, in 36% of the SIPs farmers demand for irrigations when needed and in 5% of the SIPs there was a water schedule established in advance.
- 65% of the operators **don't require the presence of the farmer** during irrigation.

EARLY RESULTS | Beneficiaries in *kharif-2* 2020





- 36% of the farmers' beneficiaries were not owners of the land cultivated and irrigated and were either sharecropper (10%) or leaser (26%).
- 10.9% of tenant only farmers in Khulna division, 16.9% in Rajshadi.

- 62% of the farmers served by SIPs in *kharif-2* were tiny farmers cultivating less than 0.5 acres of land.

On average, **33 farmers** served per SIP in the last *kharif-2* season.

SIPs and natural disasters in 2020

Cyclone Amphan

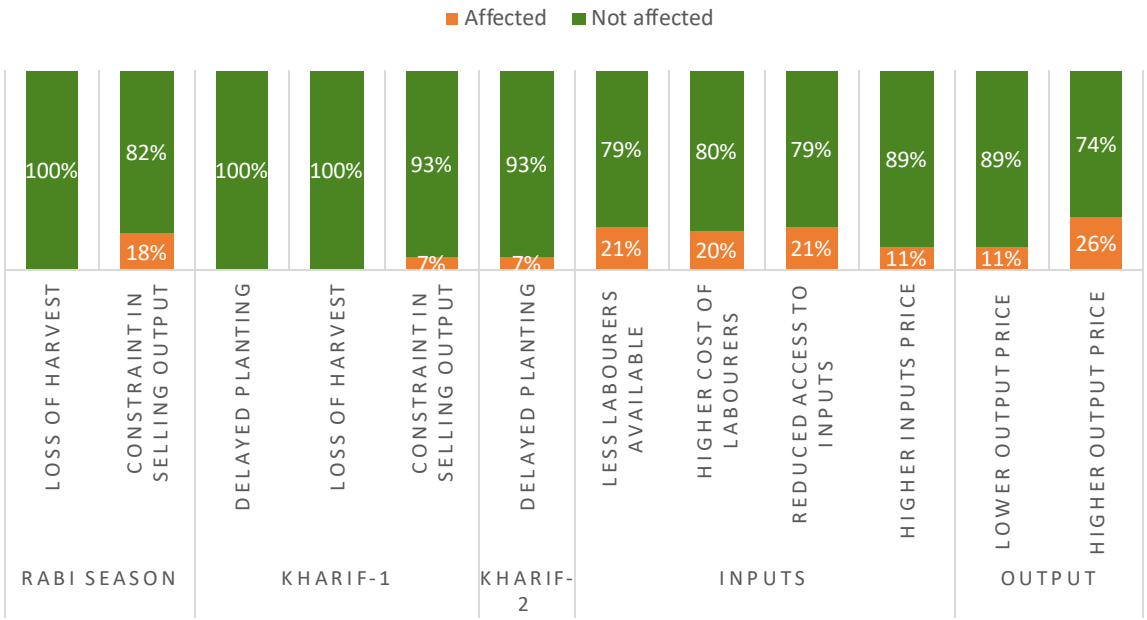
- 21 May 2020
- 149,000 hectares of agricultural land and 1 million people affected
- Only **2 SIPs** among 62 (26 in Khulna) had **damages on their panels**.
- **Limited effect on the operation**

Floods

- July-August 2020
- 159,000 hectares of agricultural land and 1.2 million farmers affected
- **2 SIPs command areas flooded**
- 25 SIPs not operational due to heavy rainfall, no demand for irrigation

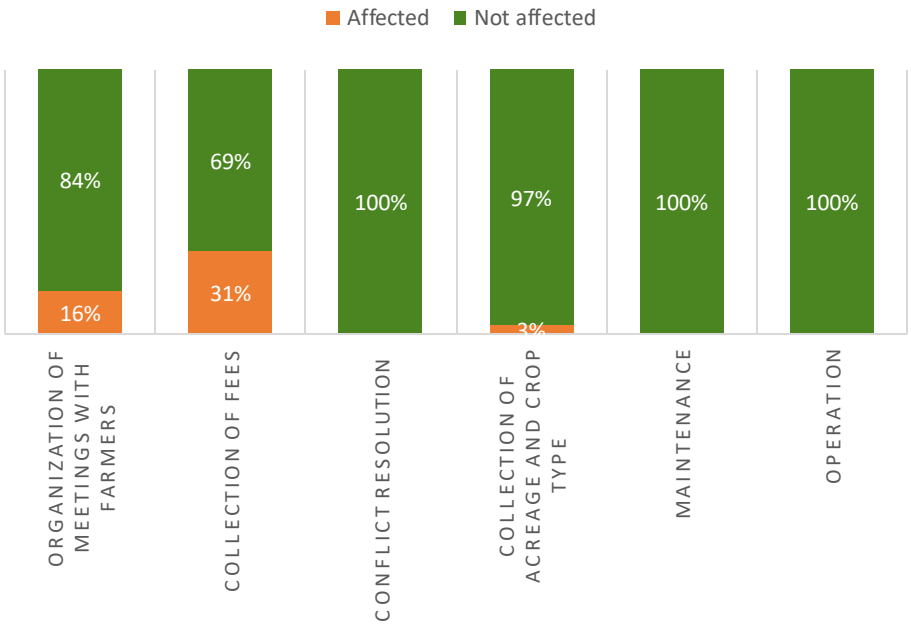
EARLY RESULTS | SIPs and COVID-19 in 2020

Consequences of COVID-19 induced measures on SIP farmers



COVID-19 induced measures

Consequences of COVID-19 induced measures on SIP operators tasks



- Limited effects of the COVID-19 induced measures in SIPs communities.
- Effects mostly on access and cost of inputs and labor: 21% of the operators mentioned that access to inputs was reduced for their customers in 2020 due to COVID-19 induced restrictions.

- Small number of operators saw their tasks affected, excepted for collection of fees.
- But 92% of rabi fees were collected in October 2020.

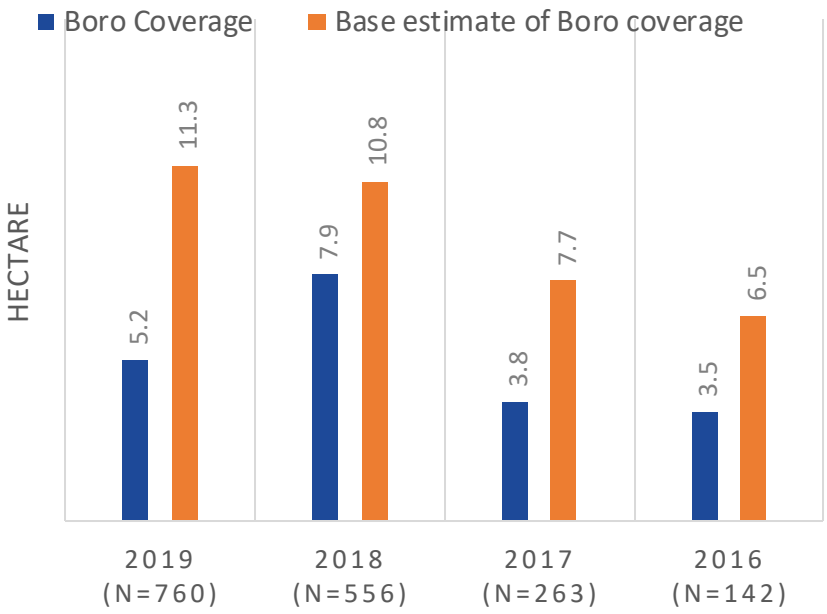
Solar irrigation as a `fee-for-service' business?

Sponsor revenues

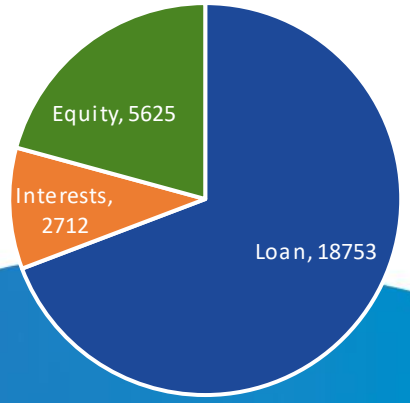
- Actual cropped area is lower than the base estimates, especially for **boro which account for 70% of the SIPs revenues.**
- Charges per bigha are lower than the base estimates.
- Average annual revenue from water charges in 2019 per SIP: 1,450 USD
- ➢ Revenue generated are below expectations.

Division	Average Yearly Revenue (Lakh/year)				Average Revenue Achievement			
	2019	2018	2017	2016	2019	2018	2017	2016
Rajshahi	1.35	1.37	0.57	0.57	45%	44%	29%	31%
Khulna	1.37	1.39	1.18	0.96	37%	37%	31%	25%
Rangpur	1.14	2.19	1.10	0.75	36%	65%	43%	35%
Total	1.23	1.85	1.09	0.80	37%	54%	35%	30%
	(N=743)	(N=547)	(N=261)	(N=139)	(N=743)	(N=547)	(N=261)	(N=139)

Coverage at IDCOL SIPs over the years



Capital cost for the sponsor



- Average capital cost of SIP for the sponsor: 27,089 USD.

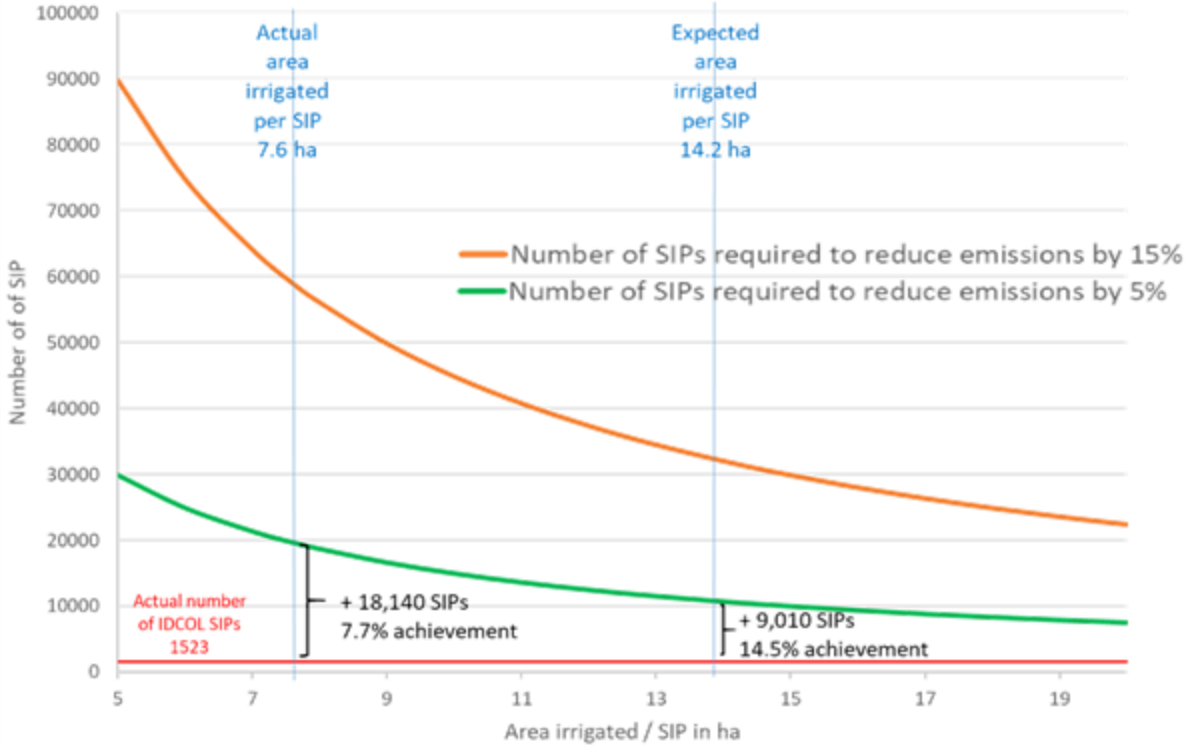
OPPORTUNITIES AND WAY FORWARD

- Development of **market support**
- **Other sources of revenue:** agricultural services, selling excess power to the grid.
- **Co-benefits** on poverty alleviation, food security, and climate change mitigation and adaptation.

Solar irrigation and climate change mitigation

- 3.5 million metric tonne of CO_2 emission per year from diesel used in irrigation (4.4% of national emissions)
- Intended Nationally Determined Contributions (INDC) under the United Nations Framework Convention on Climate Change (UNFCCC): reduction of Greenhouse Gas (GHG) emissions unconditionally by 5% by 2030 and conditionally up to 15% by 2030
- **Preliminary calculations** show that 5% reduction in emissions from irrigation may be **achievable and in line with IDCOL target of 10,000 SIPs,** provided area covered by each SIP reaches full potential.

Number of SIPs required to reduce CO2 emissions and meet INDC targets



Hypothesis / Caveats

- SIPs entirely replace diesel pumps, no shifting, no complimentary use
- Only IDCOL SIPs considered, operational in 2020
- 1 kg of diesel burning emits 3.186 kg of CO2 (WRI, 2015)
- Diesel sold to agriculture assumed to be diesel used for irrigation
- Only emissions from irrigation, potential effects from grid not included

QUESTIONS

- **Do SIPs replace diesel pumps? Or do they allow that the expansion of energy access comes from renewable sources and benefit marginal farmers?**

International Water Management Institute

Acknowledgements: The work presented here receives support from the Swiss Agency for Development and Cooperation (SDC). IWMI partners with IDCOL for this project in Bangladesh. NGO Forum for Public Health provides research support and data collection services.

Thank you.

For more information, questions and comments, contact Dr Marie-Charlotte Buisson (m.buisson@cigar.org) or visit the SoLAR project website: https://solar.iwmi.org/.

Innovative water solutions for sustainable development

Food · Climate · Growth

CGIAR