International Water Management Institute

TOGETHER FOR TOMORROW

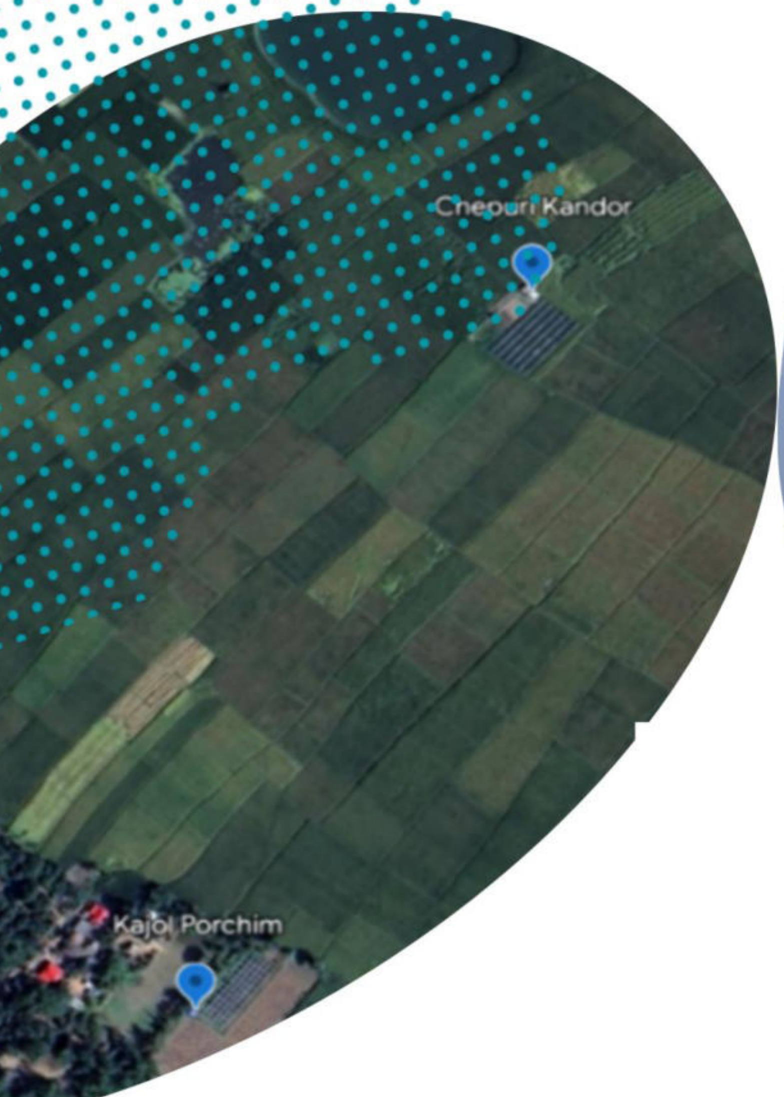
SoLAR
Solar Irrigation for Agricultural Resilience

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Grid Integration Report
[Chepuri Kandor, Bochapukur, Kajol Porchim, Kala Kandor] Bangladesh

Wakil Ahmed Arnob, Shisher Shrestha, Md. Abdullah Al Matin, Archisman Mitra



About IWMI: The International Water Management Institute (IWMI) is an international, research-for development organization that works with governments, civil society, and the private sector to solve water problems in developing countries and scale up solutions. Through the partnership, IWMI combines research on the sustainable use of water and land resources, knowledge services, and products with capacity strengthening, dialogue, and policy analysis to support the implementation of water management solutions for agriculture, ecosystems, climate change, and inclusive economic growth. Headquartered in Colombo, Sri Lanka, IWMI is a CGIAR Research Center with offices in 14 countries and a global network of scientists operating in more than 30 countries.

About CGIAR: CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to transforming food, land, and water systems in a climate crisis. Its research is carried out by 13 CGIAR Centres/Alliances in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector. www.cgiar.org

About SoLAR: Solar Irrigation for Agricultural Resilience (SoLAR) in South Asia aims to sustainably manage the water-energy and climate interlinkages in South Asia through the promotion of solar irrigation pumps (SIPs). The project's main goal is to contribute to climate-resilient, gender-equitable, and socially inclusive agrarian livelihoods in Bangladesh, India, Nepal, and Pakistan by supporting government efforts to promote solar irrigation. This project responds to government commitments to transition to clean energy pathways in agriculture. All countries in this project have NDC commitments to reduce greenhouse gas (GHG) emissions, and SIPs can play a significant role in reducing emissions in agriculture.

About SDC: The Swiss Agency for Development and Cooperation (SDC) is the agency for international cooperation of the Federal Department of Foreign Affairs (FDFA). Swiss International Cooperation, an integral part of the Federal Council's foreign policy, aims to contribute to a world without poverty and in peace for sustainable development. SDC, through its Global Program Climate Change and Environment (GPCCE), helps find solutions to global challenges linked to climate change. It engages in global political dialogue and manages specific projects in the fields of energy, climate change adaptation, sustainable development of mountainous regions, and prevention of natural hazards that are likely to influence regional and international policy.

About IDCOL: Infrastructure Development Company Limited (IDCOL) was established on 14 May 1997 by the Government of Bangladesh. The Company was licensed by the Bangladesh Bank as a non-bank financial institution (NBFI) on 5 January 1998. Since its inception, IDCOL is playing a major role in bridging the financing gap for developing medium to large-scale infrastructure and renewable energy projects in Bangladesh. The company now stands as the market leader in private sector energy and infrastructure financing in Bangladesh.

Authors: Wakil Ahmed Arnob, Shisher Shrestha, Md. Abdullah Al Matin, Archisman Mitra

Wakil Ahmed Arnob: Management Trainee, Renewable Energy Projects, IDCOL

Shisher Shrestha: National Researcher - Renewable Energy Water and Climate Change Climate Change Adaptation, IWMI

Md. Abdullah Al Matin: Assistant Vice President (Technical), Renewable Energy Projects, IDCOL

Archisman Mitra: Regional Researcher· Economics and Impact Assessment, IWMI

Please send inquiries and comments to iwmi-solar@cgiar.org

A free copy of this publication can be downloaded at https://solar.iwmi.org/reports/

Acknowledgments

This report is a part of the Solar Irrigation for Agricultural Resilience (SoLAR) project supported by the Swiss Agency for Development and Cooperation (SDC). The Infrastructure Development Company Limited (IDCOL) is the main project partner for the SoLAR-SA project in Bangladesh. We express our gratitude to the Gazi Group for sharing data and providing valuable insights. We also thank Mr. Tanmoy Bhaduri, IWMI and Ms. Shibani Chattopadhyay, IWMI for their editorial support and Mr. Aariz Raza, IWMI for his support in designing the report.

Donor

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

Swiss Agency for Development and Cooperation (SDC)

Partner

GAZIGROUP

Gazi Group

Contents

1. Introduction

Solar-based irrigation systems are an innovative and an environment-friendly solution for the diesel-dependent agro-economy of Bangladesh. The deployment of Solar Irrigation Pumps (SIP) in agriculture has the potential to simultaneously address two of the Sustainable Development Goals (SDGs) – one of which is SDG-2 (zero hunger), and another is SDG-7 (affordable and clean energy). SIPs are seen as one of the most promising uses of renewable energy that simultaneously provide access to energy and contribute to food production. Presently, the country has 1.34 million diesel pumps and 0.27 million electric pumps for irrigation purposes[1]. The diesel-run pumps consume at least 1 million tons of diesel worth $900 million per year, and the electricity-run pumps consume about 150 megawatt of power [BPDB-2015-2016]. It is important to note that Bangladesh has good solar resources, with high availability during the peak irrigation season; therefore, solar pumping of water for irrigation is a potential solution for its largely agro-based economy. The Infrastructure Development Company Limited (IDCOL), a government-owned financial institution, is implementing the Off-grid Solar Irrigation Pumps (SIPs) Program for their Partner Organizations (POs) to off-grid areas to reduce dependency on diesel and to benefit the farmers and marginalized populations.

However, the demand for irrigation in Bangladesh is seasonal, and the primary use of solar irrigation pumps is between 4-5 months during the year, mostly for the Boro crop that is grown between Jan-May. For the rest of the year, SIPs remain mostly unutilized. Since these SIPs tend to remain under-utilized over a significant portion of the year, which could be as high as 210 days in a year, most of the electricity generated from solar panels is getting wasted. If arrangements are made to supply electricity from these systems into the national grid during the off-season, paths to exploit the untapped potential will open up. Simultaneously, the Government envisions providing access to clean, affordable, and grid-quality electricity to all its citizens, as manifested by its efforts to expand the national grid. Thus, it is very likely that both the technical and financial challenges of integrating a huge number of off-grid SIP systems to the national grid will need to be tackled in the near future. The Sustainable and Renewable Energy Development Authority (SREDA) of Bangladesh has already piloted a successful Solar Grid Integration System in *Kushtia* district and has prepared a draft guideline for grid integration of SIPs. The guideline envisages the power distribution company to buy excess electricity from solar irrigation systems[2]. As a result, solar irrigation systems are going to become more popular, and additional revenue from grid integration of SIPs will make SIPs financially sustainable and work to support smaller farmers and marginalized communities, including women and youth.

---

[1]https://www.worldbank.org/en/results/2015/09/08/solar-powered-pumps-reduce-irrigation-costs-bangladesh

[2]https://www.bangladeshpost.net/posts/first-grid-integration-of-solar-irrigation-pump-successful-17684

2. Background on Grid Integration Pilot

2.1 Grid Integration of Solar Irrigation Pump [Model]

Under IDCOL, GREL is implementing four individual Solar Irrigation Grid Integration systems in a cluster model. Technical solutions are there for integrating solar-powered irrigation pumps into the national grid during the off-season where the SIP already exists. For grid integration of individual SIPs, a DC circuit breaker, an interlocking switch, an inverter, and a unidirectional meter are required. During off irrigation season, when the SIP is not operational, the PV array will only export electricity to the grid via the inverter. The component specifications of the SIP systems shall comply with the standards to be set by Sustainable and Renewable Energy Development Authority (SREDA) and the local body *Palli Bidyut Somitis* (PBS) under the Bangladesh Rural Electrification Board (BREB). It will be the net amount of exported electricity at the end of settlement period as per this guideline.

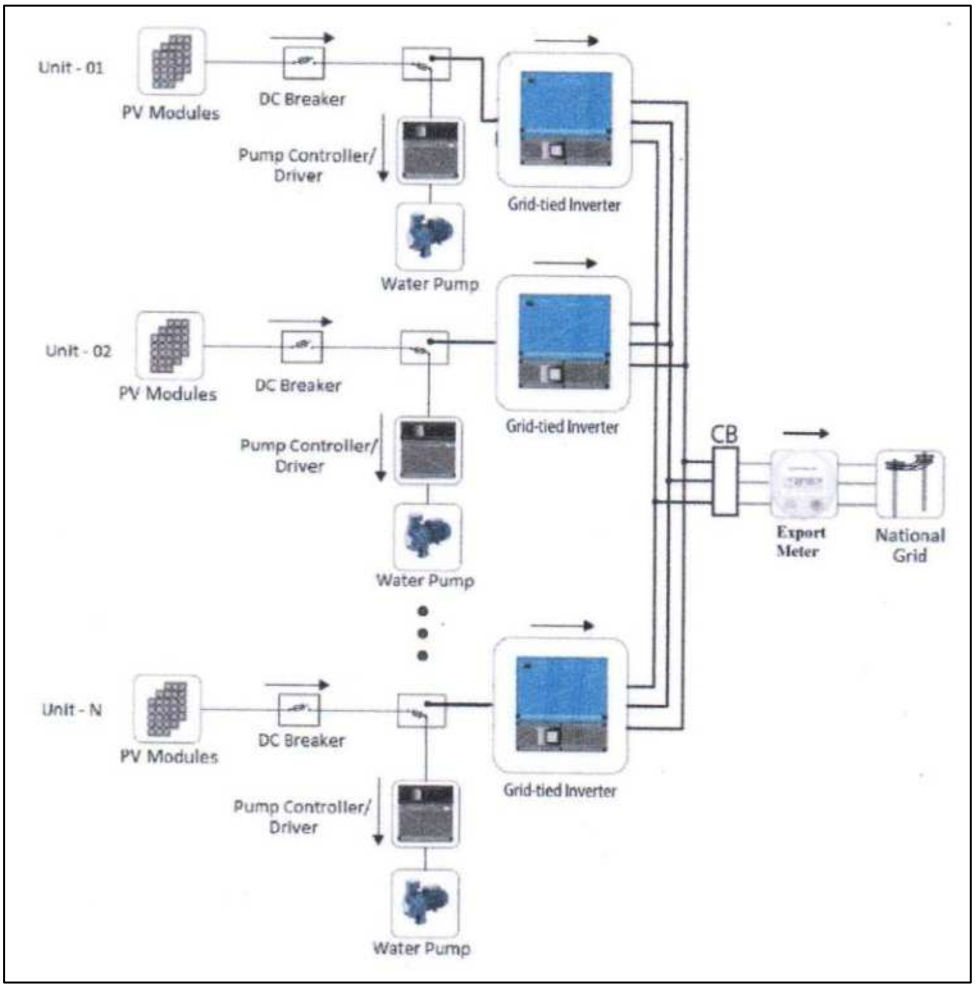


Figure 3.3: Schematic diagram of cluster type grid integration of SIP (Three Phase)
Source: SIP Draft Guideline by Sustainable Renewable Energy Development Authority (SREDA)

2.2 Site selection

The **process and the rationale** for the selection of **pilot locations,** and as per the SREDA SIP Grid Integration Policy, is that excess power can only be exported from the SIP to the grid, so sites have been selected where the pumps are near the grid line and comparatively have less irrigation coverage.

2.3 Site details

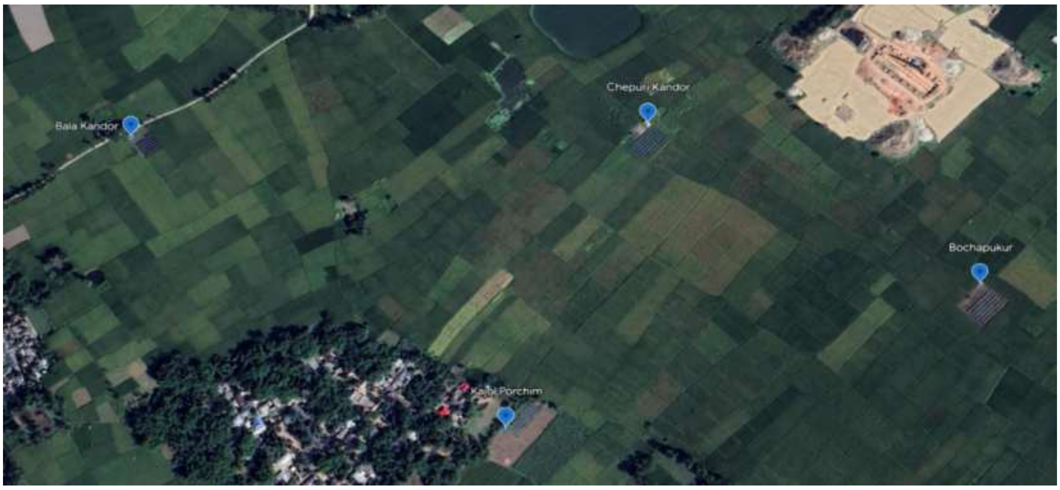


Figure: Location of four SIP sites

GAZI has installed 431 no. of SIPs in four phases. Out of these 4 sites namely Chepuri Kandor (Site 1), Bocha Pukur (Site 2), Kajol Porchim (Site 3), and Bala Kandor (Site 4) has been grid integrated in a cluster mode. Sites 1, 2 and 3 are the pumps of phase 2 and site 4 is the pump of phase 3. Specific details for each site are provided below.

Site 1: Chepuri Kandor Solar Irrgiation Pump, Boro Bochapukur, Nijpara, Birganj, Dinajpur

SITE NAME	Chepuri Kandor Solar Irrigation Pump
SIP ID	5220GZI0200123
LOCATION	BoroBochapukur, Nijpara, Birganj, Dinajpur
PROJECT COST	66,231 USD
SUPPORTED BY	THE WORLD BANK, jica
FINANCED BY	IDCOL
EPC CONTRACTOR	Solargao Ltd
COMMISSIONING DATE	03.05.2017
TECHNICAL DETAILS	
FLOW RATE	1802000 L/day
BORING DEPTH	160
Solar PV SIZE (kWp)	30
Individual Panel Size (Wp)	250
Number of Panels	120
Pump Size (kW)	15kw
Controller Size (kW)	15kw
GPS COORDINATES	25.8860508, 88.6456058

Site 2: Bocha Pukur Solar Irrgiation Pump, Pubo Chakay, Nijpara, Birganj, Dinajpur

SITE NAME	Bocha Pukur Solar Irrigation Pump
SIP ID	5220GZI020021
LOCATION	PuboChakay, Nijpara, Birganj, Dinajpur
PROJECT COST	66,231 USD
SUPPORTED BY	THE WORLD BANK, jica
FINANCED BY	IDCOL
EPC CONTRACTOR	Solargao Ltd
COMMISSIONING DATE	03.05.2017
TECHNICAL DETAILS	
FLOW RATE	18,02,000 L/day
BORING DEPTH	160
Solar PV SIZE (kWp)	30
Individual Panel Size (Wp)	250w
Number of Panels	120
Pump Size (kW)	15kw
Controller Size (kW)	15kw
GPS COORDINATES	25.8829825,88.6468423

Site 3: Kajol Porchim Solar Irrgiation Pump, Boro Bochapukur, Nijpara, Birganj, Dinajpur

SITE NAME	Kajol Porchim Solar Irrigation Pump
SIP ID	5220GZI020067
LOCATION	BoroBochapukur, Nijpara, Birganj, Dinajpur
PROJECT COST	66,231 USD
SUPPORTED BY	THE WORLD BANK, jica
FINANCED BY	IDCOL
EPC CONTRACTOR	Solargao Ltd
COMMISSIONING DATE	03.05.2017
TECHNICAL DETAILS	
FLOW RATE	18,02,000 L/day
BORING DEPTH	160
Solar PV SIZE (kWp)	30 kWp
Individual Panel Size (Wp)	250w
Number of Panels	120
Pump Size (kW)	15kw
Controller Size (kW)	15kw
GPS COORDINATES	25.8845525,88.6424180

Site 4: Bala Kandor Solar Irrgiation Pump, Boro Bochapukur, Nijpara, Birganj, Dinajpur

SITE NAME	Bala Kandor Solar Irrigation Pump
SIP ID	5220GZI0327
LOCATION	BoroBochapukur, Nijpara, Birganj, Dinajpur
PROJECT COST	58,205 USD
SUPPORTED BY	THE WORLD BANK, KFW
FINANCED BY	IDCOL
EPC CONTRACTOR	Solargao Ltd
COMMISSIONING DATE	08.08.2018
TECHNICAL DETAILS	
FLOW RATE	1695000 L/day
BORING DEPTH	200

Solar PV SIZE (kWp)	30.78kwp
Individual Panel Size (Wp)	270w
Number of Panels	114
Pump Size (kW)	15kw
Controller Size (kW)	15kw
GPS COORDINATES	25.8888584,88.6415822

3. Detailed Commissioning Report

Figure 1: Master site for cluster-type grid integration at Chepuri Kandor

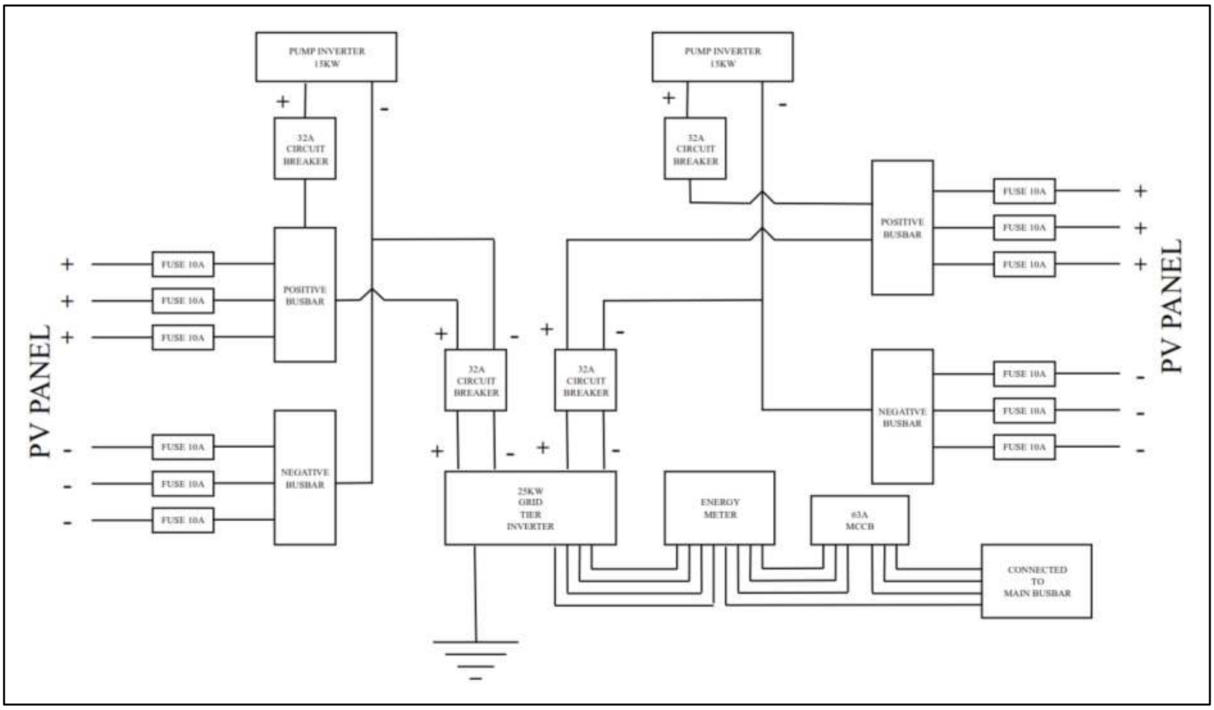


Figure 2: Slave Site design

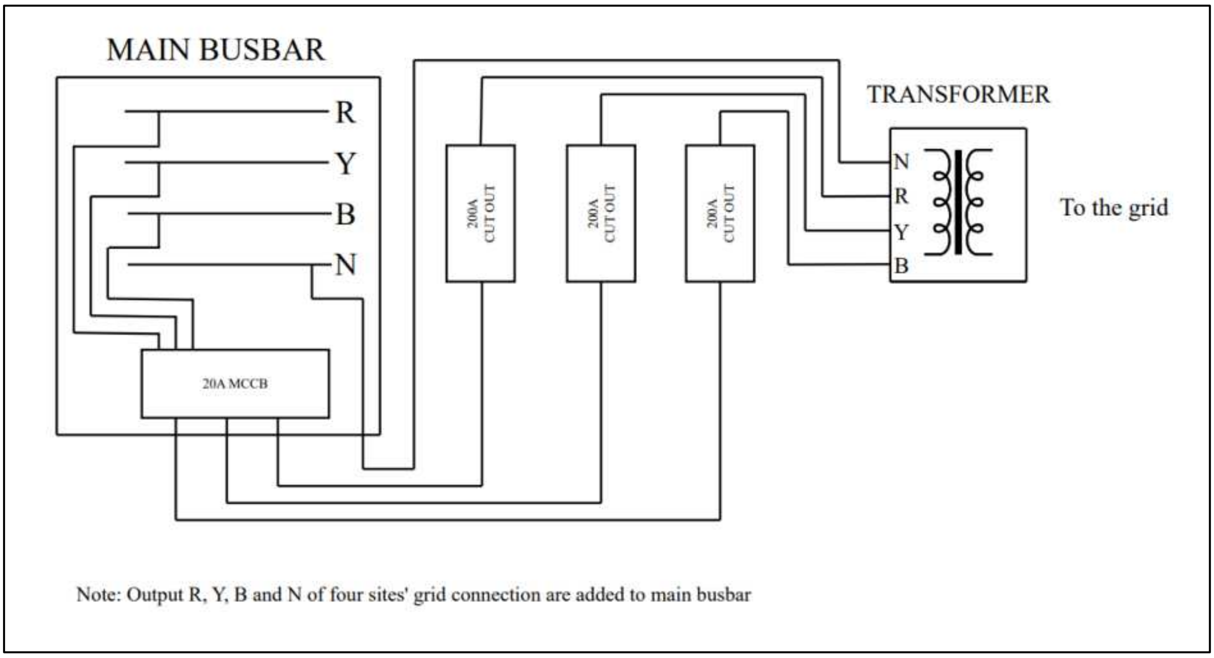


Figure 3: Master Site design

3.1 System Summary of Grid Connection Infrastructure

TRANSFORMER	
Size (kVA)	200
Type	Step up or down
INVERTER	
Size (kW)	25
Number of Inverters	4
Manufacturer	Sunway
Model	STT-25KTL
Serial Number	1102100102412076 (Site-1), 1102100102312076 (Site-2), 1102100102512076 (Site-3), 1102100102612076 (Site-4)
SOLAR ARRAY (Site 1)	
TOTAL PV SIZE (kWp)	30kw
SOLAR ARRAY SIZE (kWp)	5kw
NUMBER OF ARRAY	6
INDIVIDUAL PANEL SIZE (Wp)	250w
NUMBER OF PANELS	120
SOLAR ARRAY (Site 2)	
TOTAL PV SIZE (kWp)	30kw
SOLAR ARRAY SIZE (kWp)	5kw
NUMBER OF ARRAY	6
INDIVIDUAL PANEL SIZE (Wp)	250w
NUMBER OF PANELS	120
SOLAR ARRAY (Site 3)	
TOTAL PV SIZE (kWp)	30kw
SOLAR ARRAY SIZE (kWp)	5kw
NUMBER OF ARRAY	6
INDIVIDUAL PANEL SIZE (Wp)	250w
NUMBER OF PANELS	120
SOLAR ARRAY (Site 4)	
TOTAL PV SIZE (kWp)	30.78kw
SOLAR ARRAY SIZE (kWp)	5.13kw
NUMBER OF ARRAY	6
INDIVIDUAL PANEL SIZE (Wp)	270w
NUMBER OF PANELS	114
LT LINE	
Number of Poles	Cable underground with PVC pipe
Length of Cable (m)	10 m, 1231 m
Cable Size (mm)	95 RM, 16 RM
Type of Cable	Insulated
HT LINE	
Number of Poles	7
Length of Cable (m)	370m
Type of Cable	Non insulated

3.2 Array details

Site 1: Chepuri Kandor (GAZI 2)

Number of Arrays/Strings	6		
String 1			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 2			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 3			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 4			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 5			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*

String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 6			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		

Site 2: Bocha Pukur (GAZI 2)

Number of Arrays/Strings	6		
String 1			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 2			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 3			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 4			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	

String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 5			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 6			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		

Site 3: Kajol Porchim (GAZI 2)

Number of Arrays/Strings	6		
String 1			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box(m)	700		
String 2			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 3			
Parameter	Designed Value	Field Value	Remark

No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 4			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 5			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 6			
Parameter	Designed Value	Field Value	Remark
No of panels in series	20	20	
No of panels in parallel	6	6	
String Voc	36.3	33.63	*Using multi-meter*
String Vmp	30.6	27.3	*During operation*
String Imp	8.17	5.9	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		

Site 4: Kajol Kandor (GAZI 3)

Number of Arrays/Strings	6		
String 1			
Parameter	Designed Value	Field Value	Remark
No of panels in series	19	19	
No of panels in parallel	6	6	
String Voc	38.17	34.7	*Using multi-meter*
String Vmp	31.13	28.21	*During operation*
String Imp	8.67	6.71	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		

String 2			
Parameter	Designed Value	Field Value	Remark
No of panels in series	19	19	
No of panels in parallel	6	6	
String Voc	36.3	34.7	*Using multi-meter*
String Vmp	30.6	28.21	*During operation*
String Imp	8.17	6.71	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 3			
Parameter	Designed Value	Field Value	Remark
No of panels in series	19	19	
No of panels in parallel	6	6	
String Voc	36.3	34.7	*Using multi-meter*
String Vmp	30.6	28.21	*During operation*
String Imp	8.17	6.71	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 4			
Parameter	Designed Value	Field Value	Remark
No of panels in series	19	19	
No of panels in parallel	6	6	
String Voc	36.3	34.7	*Using multi-meter*
String Vmp	30.6	28.21	*During operation*
String Imp	8.17	6.71	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 5			
Parameter	Designed Value	Field Value	Remark
No of panels in series	19	19	
No of panels in parallel	6	6	
String Voc	36.3	34.7	*Using multi-meter*
String Vmp	30.6	28.21	*During operation*
String Imp	8.17	6.71	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		
String 6			
Parameter	Designed Value	Field Value	Remark
No of panels in series	19	19	
No of panels in parallel	6	6	
String Voc	36.3	34.7	*Using multi-meter*
String Vmp	30.6	28.21	*During operation*
String Imp	8.17	6.71	*During operation*
Wire size (mm^2)	4.5 RM		Material: Copper
Wire length to combiner box (m)	700		

3.3 On-grid Inverter details

Item	Remarks
Inverter Manufacturer	Sunway
Number of Inverter	4
Model	STT-25KTL
SN of Inverter 1 (Site 1)	1102100102412076
SN of Inverter 2 (Site 2)	1102100102312076 (
SN of Inverter 3 (Site 3)	1102100102512076
SN of Inverter 4 (Site 4)	1102100102612076
Wire Size	16RM
Wire length	1230m
Wire Material	Copper Wire

COMMISSIONING DATA				
Inverter 1	V_{OC}		V_{MP}	
	Designed	**Measured**	**Designed**	**Measured**
Input A	612	546	726	672
Input B	612	546	726	672
Inverter 2	V_{OC}		V_{MP}	
	Designed	**Measured**	**Designed**	**Measured**
Input A	612	546	726	672
Input B	612	546	726	672
Inverter 3	V_{OC}		V_{MP}	
	Designed	**Measured**	**Designed**	**Measured**
Input A	612	546	726	672
Input B	612	546	726	672
Inverter 4	V_{OC}		V_{MP}	
	Designed	**Measured**	**Designed**	**Measured**
Input A	725	660	591	536
Input B	725	660	591	536

3.4 Protection Device details

Arrestor	
Item	**Value**
Lightning arrestor type	Horizontal Type
No. of LA:	2
LA height (>1.5meters)	15ft
LA1 Earthing wire length (m)	20ft
Wire size (mm^2)	Solid copper wire
LA2 Earthing wire length (m)	20ft
Wire size (mm^2)	Solid copper wire
Earthing Rod	
Length (m)	15ft
Type	Solid Aluminum wire

4. Implementation of the Grid Connection Pilot

The step-by-step process regarding the implementation of grid integration is given below -

Inception Meeting with Concerned Stakeholders: At the beginning of the project, an inception meeting was arranged with the concerned stakeholders, like IDCOL, BREB, SREDA, and local PBS to share the objectives, methodology, and work plan of the project.

Sharing Meeting with the Local Stakeholder: The second step was to share the objectives and ideas about project implementation and highlight the importance of their role in project implementation, with the local administration, agriculture office, *Polli Bidyut Somiti* (PBS) zonal and local office.

Focus Group Discussion: Conducting a focus group discussion of primary selected sites with farmers and local people. In this step, the operating hours and demand for irrigation from the farmers' side was also considered and noted.

Site Assessment and Selection: Conducting a site assessment or site selection is an important step for designing and installation of a system. During the site assessment, all necessary information to optimize system design was collected, to plan for a time-efficient and safe installation.

Design Finalization of the Innovation: The selected design of the project was finalized by sharing it with the concerned local stakeholders and IDCOL, SREDA, and PBS Authority. GAZI and the technical team of the innovation led the activities.

Procurement, Construction, Installation, and Monitoring: After getting funds from IDCOL, based on the modification, a new refined design of innovation was constructed. During construction, close monitoring was done so that the quality of the construction work was assured. Experts from GAZI and the local electricity authority used to visit the construction site and provide feedback and suggestions. Total procurement was conducted by the Organizational Procurement Committee (OPC) as per the procurement policies. The transmission line of 11 KV was constructed by the contractor of local PBS.

Commissioning of the Innovation: The process of testing the SIP grid integration system to confirm that it is producing electricity and interacting directly with the electricity grid is known as system commissioning. So, this commission activity is performed after the installation of the system within a certain time period.

Operation, Training, and Maintenance: After the construction of the SIP Grid Integration System, orientation training was arranged for the project staff and the caretaker of the pump for proper operation and maintenance of the system.

Monitoring & Data Collection: From the start of the operation of the pilot, various data collection and monitoring is being done to test its effectiveness. Both qualitative and quantitative data will be collected to measure the SIP Grid Integration System.

Final Report Preparation and Submission: A final report will be prepared and submitted based on all the work, data, activities, and conditions of the project, and information related to the innovation.

4.1 Technical details

TRANSFORMER	
Size (kVA)	200
Type	Step up or down
INVERTER	
Size (kW)	25
Number of Inverters	4
Manufacturer and Model	sunways and STT-25KTL
LT LINE	
Number of Poles	Cable Underground with PVC pipe
Length of Cable (m)	10 m, 1231 m
Cable Size (mm)	95 RM, 16 RM
Type of Cable	Insulated
HT LINE	
Number of Poles	7
Length of Cable (m)	370 m
Type of Cable	Non insulated

4.2 Financial details

Total Cost of Grid Integration	5,594,920/-
Grant	2,597,460/-
Sponsor Contribution	2,997,460/-
IDCOL Loan	0

Detailed cost with BoQ

SN	ITEMS	Specification	Quantity	Unit (Nos./lot)	Cost (BDT)
1	Solar Grid Tie Inverter	Sunway Max PV Input: 40000W IC: 30A OC: 25000 MPPT Effi: 99.9%	4	Pcs	
2	MCCB & MCB	Circuit Breaker TP-63A MCB	04	Pcs	
		Circuit Breaker TP-63A MCCB	04	Pcs	
		Circuit Breaker TP-200A MCCB	01	Pcs	
3	AC and DC Box	Walton PVC 12”x12” Local MS (30”x24”) with Bas Bar	04 01	Pcs Pcs	
4	Cable & Accessories	SQ Cables (1x4Rm NYYF for DC) 4x16Rm BYM-FR for AC	01	Coil	

			14	Coil	
5	Transformer	Single-Phase Distribution Transformer Brand: TS Transformer Ltd. Capacity: 200 KVA	01	Pcs	
6	PBS Line construction with Fuse cut-out, lighting arrester and accessories	HT Three-phase line work with other equipment-related works up to meter.	300	Meter	
7	Cable tie, payroll & uPVC pipes	Local	As required		
8	Underground cabling system	for 4 sites clustering	4300	Feet	
9	Meter	Hosab Meter	4	pcs	
10	Licensing	From the Electric Licencing Board			
11	Transportation, Labour, Testing, Commissioning				
Total Cost					**5,594,920/-**

Note: They got bulk price for total work; therefore, there is no item wise price.

5. Monitoring and O&M

Ground water level, maximum power, energy generation, coverage, etc, are being monitored at the monthly frequency. Inspectors of IDCOL visit SIP sites on a routine basis, and if they find any technical problem, they inform the PO (Partner Organization) and the supplier. If the technical problem is identified by any supervisor of PO, they inform the supplier and IDCOL. In both cases, the monitoring team (HO) and the inspector dedicated to that site will track the issue until it is solved.

6. Conclusion

Potential Challenges:

- Local *Palli Bidyut Samitis* are not well acquainted with the Solar Irrigation Grid Integration Policy.
- There are several hidden and additional charges that hamper the total approval, installation, and operation of grid integrated systems.
- 100% solar power sharing in the grid from SIP is not possible due to following a policy of net metering system by the PBS.

The installation of the system and the continuous operation over the last few months show that the integration of the additional power to the grid is profitable. However, since the entire electricity generated is not integrated into the grid, the electricity tariff is low, and there is delay in getting revenue; more time is needed to determine its exact payback period for grid integration.

IWMI INDIA
IWMI India office, 2nd Floor, CG Block C, NASC Complex, DPS Marg,
Pusa, Opp Todapur, New Delhi 110 012, India
Email: iwmi-delhi@cgiar.org

International Water
Management Institute

CGIAR

IWMI is a CGIAR Research Center

The International Water Management Institute (IWMI) is an international, research-for-development organization that works with governments, civil society and the private sector to solve water problems in developing countries and scale up solutions. Through partnership, IWMI combines research on the sustainable use of water and land resources, knowledge services and products with capacity strengthening, dialogue and policy analysis to support implementation of water management solutions for agriculture, ecosystems, climate change and inclusive economic growth. Headquartered in Colombo, Sri Lanka, IWMI is a CGIAR Research Center with offices in 14 countries and a global network of scientists operating in more than 30 countries.

International Water
Management Institute (IWMI)

Headquarters
127 Sunil Mawatha,Pelawatta,
Battaramulla, Sri Lanka

Mailing address:
P. O. Box 2075, Colombo, Sri Lanka
Tel: +94 11 2880000
Fax: +94 11 2786854
Email: iwmi@cgiar.org
www.iwmi.org