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SoLAR
Solar Energy for Agricultural Resilience

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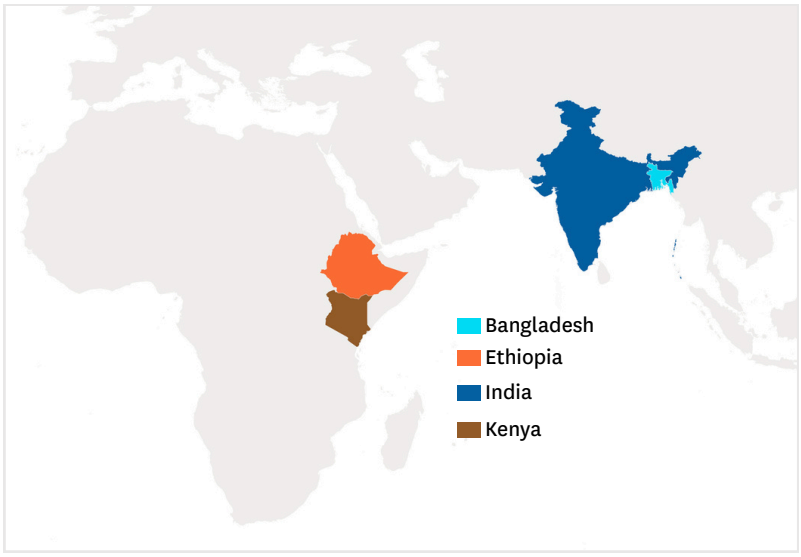
Learning and prospects in solarising energy towards sustainable agriculture

Solar Energy for Agricultural Resilience (SoLAR) project, supported by the **Swiss Agency for Development and Cooperation** and led by the **International Water Management Institute**, promotes solar energy as a sustainable solution for climate-resilient, inclusive, and low-emission agriculture.

Building on the achievements of Phase I (2019–2025), which generated evidence and policy insights across South Asia, Phase II (2025–2028) aims to strengthen the enabling environment for socially inclusive and climate-resilient solar energy systems in agriculture. Implemented in India, Bangladesh, Ethiopia, and Kenya, the project focuses on policy support, capacity building, innovation through living labs, and strengthened governance to improve water and energy security for smallholder farmers.



SoLAR project locations in South Asia and East Africa. *(Source: IWMI)*

Performance highlights of phase I

34% Income increase

Boost to farmer income from on-grid SIPs in India (Phase I evidence)

4 Countries

India, Bangladesh, Nepal, Pakistan

CHF 1 MW solarised feeder

Generates CHF 52,000 additional farmer income + saves CHF 640,000 subsidies

900K tCO_2e/year

Emissions avoided by scaling to 45,000 SIPs in Bangladesh

In **India**, our findings have been shared with Ministry of New and Renewable Energy (MNRE) and are expected to influence the design of Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) 2.0 in 2027.

In **Bangladesh**, using evidence from our pilots, Infrastructure Development Company Limited (IDCOL) have approved 56 new SIPs, of which 39 sites will be connected to the grid.

In **Nepal**, Alternative Energy Promotion Centre (AEPC) will revise its subsidy disbursement criteria in favour of women and small farmers and first grid-connected solar irrigation pilot was established via a net-metering agreement.

In **Pakistan**, web-based modules for solar suitability mapping and a solar irrigation pump sizing tool have been developed and extended to three provinces.

ESEDA
IDCOL
National Irrigation Authority
IES
Strathmore University
NGO FORUM FOR PUBLIC HEALTH

Our approach

Research-to-policy
All tools are co-designed with government partners for direct embedding into national programs.

Community-based and gender-inclusive
The Gender Equality and Social Inclusion (GESI) Multi-Dimensional Inclusivity Index guides every tool, training and financial model.

Technology-driven
GIS-based Water-Energy-Food (WEF) Solar Suitability Maps, digital SIP sizing tools, real-time PM-KUSUM dashboards, and carbon credit mechanisms form the digital backbone.

South-South learning
Bi-directional exchange between East Africa and South Asia accelerates uptake; practitioners visit field sites, share failures and adapt solutions across contexts.

Innovation value

Solar suitability mapping
First-of-their-kind composite maps integrating water, energy, food, gender and climate data across India, Bangladesh, Ethiopia and Kenya

KUSUM-Mitra extension agent model in India
A structured energy extension mechanism across 24 Krishi Vigyan Kendras (KVK) and 96 villages in India

Alternate Wetting and Drying (AWD) + Solar irrigation bundle with carbon market
Linking water-saving AWD practice with clean energy adoption in Bangladesh

GESI multi-dimensional inclusivity index
Embedded into every tool and model to ensure no group, especially women, marginalised and smallholders, is structurally excluded from solar energy benefits.

Theory of change for phase II

Activities	Outputs	Outcomes	Impact
WEF composite index and solar suitability mapping; Solar sizing tool and digital database	• WEF-responsive solar suitability principles • Decision-support tools for efficacy of solar schemes	Policymakers embed water energy food interlinkages in a socially inclusive manner, to enhance effectiveness of solar agri-tech programs	To strengthen the enabling environment and unlock investments for the sustainable scaling of socially inclusive, climate-resilient solar agri-tech solutions in South Asia (India, Bangladesh) and East Africa (Ethiopia, Kenya).
Assess finance models and identify partners for co-design of instruments in South Asia; Identify feasible investment solutions for East Africa	• Co-designed financial instruments in India and Bangladesh • Feasibility of a Solar4Africa Irrigation Investment Fund in Ethiopia and Kenya	Climate-smart and socially inclusive financing solutions for scaling solar agri-tech are co-developed and launched	
Training and capacity building; National, regional and global forums	• Training of targeted groups, including women • Multi-stakeholder forums and other platforms to disseminate findings	Strengthened knowledge, capacities and south-south collaboration leads to greater uptake of solar agri-tech applications	
Optimize solutions through bundling within existing platforms and pilots	• Optimizing Policies and Partnerships • Mapping Scaling Readiness	Existing platforms and living labs are assesed and optimized for scaling inclusive solar agri-tech bundles and innovations	

Inputs — Co-contribution from SDC, IWMI and implementing partners

SDGs Alignment

Key activties at a glance

Bangladesh

- SIP sizing tool adapted for Bangladesh, integrated with Sustainable Renewable Energy Development Authority (SREDA) National Solar Help Desk
- AWD bundling pilot across 15 IDCOL SIP sites with carbon credit mechanism
- Micro-SIP financial models for women & marginal farmers ((Chittagong Hill Tracts (CHT) Sylhet)
- Alternative RoI pathways – agrivoltaics, used batteries, grid integration
- Policy assessment on PV waste, groundwater governance, grid-solar co-expansion

Ethiopia

- Solar suitability mapping & sizing tool for smallholder contexts
- Solar pump standardisation support — Ethiopian Standards Agency
- Demand–supply linkage scaling through Partnership for Climate-Resilient Agribusiness (PACT), International Fund for Agricultural Development (IFAD), and Food Systems Resilience Program (FSRP), World Bank
- Training of Trainers for govt & private extension agents
- Tax exemption policy implementation assessment for Ministry of Agriculture (MoA)

India

- WEF–Solar Suitability Maps & composite index with MNRE
- Live digital PM-KUSUM indicator database hosted on national portal
- KUSUM-Mitras agents: 24 KVKs, 96 villages, ~20,000 farmers reached
- Co-design of financial instruments with National Bank for Agriculture and Rural Development (NABARD) for smallholders
- E-waste & after-sales policy assessment under Ministry of Environment, Forest and Climate Change (MoEF&CC) rules

Kenya

- 6-month inception phase: partner mapping, platform identification
- Investment landscape assessment for scaling solar irrigation
- Private sector scaling with SunCulture, FuturePump, CLASP
- Training curriculum with JKUAT & National Irrigation Authority
- Policy coherence assessment across national & county water strategies

From pilot to scale

Tool institutionalisation

The SIP sizing tool is hosted by MNRE (India) and integrated into SREDA's National Solar Help Desk (Bangladesh) , not on IWMI servers. Tools stay in use after the project ends.

Extension model adoption

The KUSUM-Mitra energy extension agent model is designed for adoption within ICAR's national KVK network — reaching farmers through existing government infrastructure at scale.

Policy embedding

Financial modelsfor micro-SIPs and incentives are piloted specifically to generate evidence for IDCOL and government agency policy uptake isolated experiments.

Investment pathway

TheSolar4Africa Investment Fund feasibility report hands a ready pathway to private and institutional investors — enabling capital flow independent of project duration.

Regional replication

WEF-SS framework and sizing tools are co-developed with ISA (International Solar Alliance) for potential extension across Asia and Africa beyond the four program countries.

South-South networks

Bi-directional exchange visits betw South Asia and East Africa create o peer-learning networks that contin independently of IWMI or project funding.

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Project

The Solar Energy for Agricultural Resilience (SoLAR) Phase II project builds upon learnings and experiences from Phase I of SoLAR (2019-2024) in South Asia while expanding its scope to East Africa through meaningful south-south collaborations. The program aims to strengthen the enabling environment and unlock investments for the sustainable scaling of socially inclusive and climate-resilient solar agri-tech solutions in South Asia (India and Bangladesh) and East Africa (Ethiopia and Kenya). Read more: iwmi.org/projects/solar

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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 17 countries and a global network of scientists operating in more than 55 countries.

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