SoLAR
Solar Irrigation for Agricultural Resilience

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Swiss Agency for Development and Cooperation SDC

IWMI
International Water Management Institute
CGIAR

ICIMOD

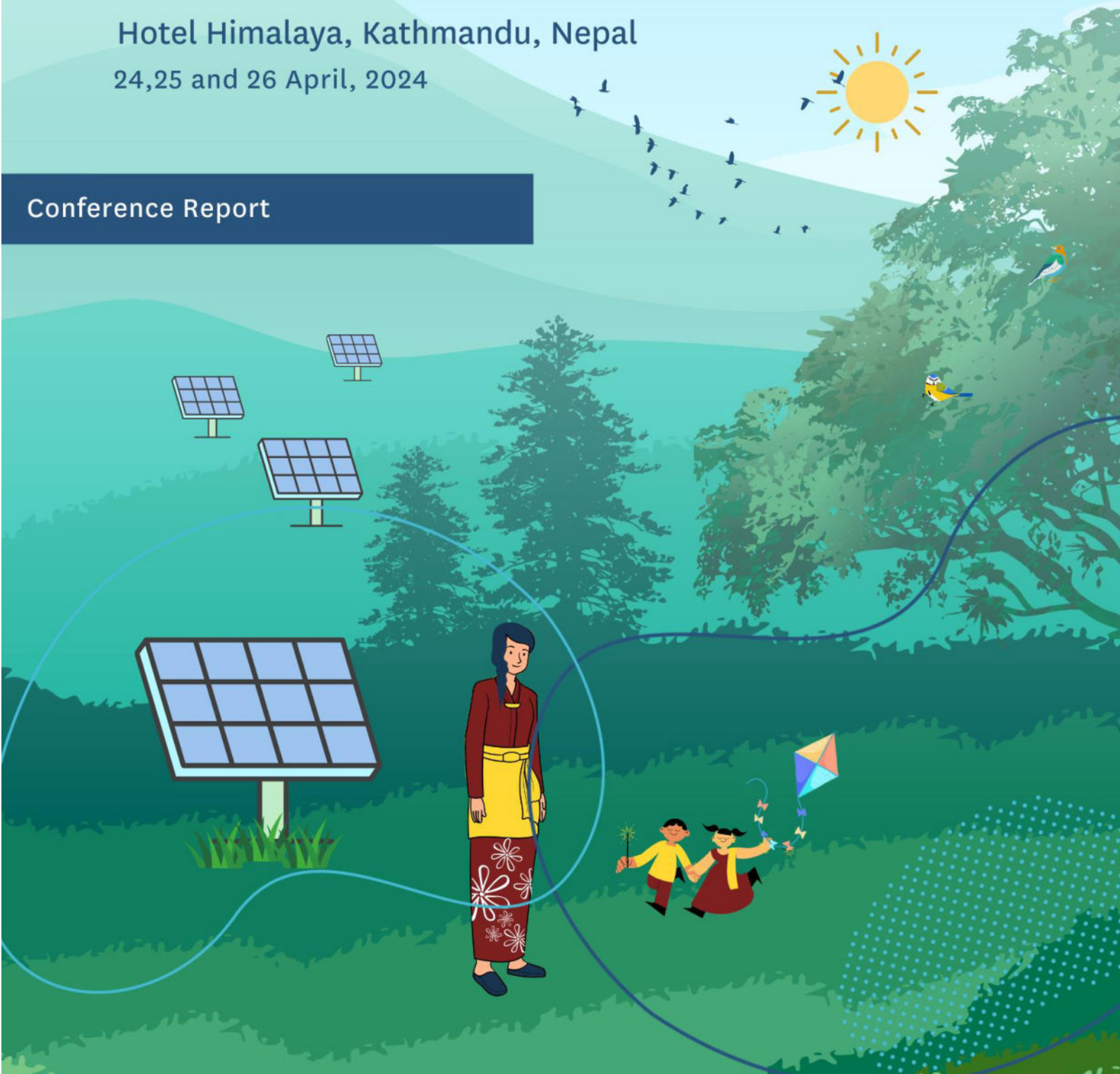
INTERNATIONAL SOLAR ALLIANCE

Global Science-Policy Forum
Socially Inclusive Solar Irrigation Systems

Hotel Himalaya, Kathmandu, Nepal

24,25 and 26 April, 2024

Conference Report



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ACKNOWLEDGMENTS

We would like to extend our deepest gratitude to all those who have contributed to the success of the Global Conference on Solar Irrigation for Agricultural Resilience in South Asia. This event was made possible through the dedicated efforts and collaboration of numerous organizations and individuals.

First and foremost, we express our sincere appreciation to the Solar Irrigation for Agricultural Resilience (SoLAR) project team and the dedicated staff at the International Water Management Institute (IWMI) for their leadership and coordination in organizing this conference. Their unwavering commitment and extensive research have been pivotal in addressing the challenges of water and land management in developing countries.

Our heartfelt thanks go to the Swiss Agency for Development and Cooperation (SDC) for their generous support and funding, which enabled the realization of this conference. The SDC's dedication to promoting sustainable development and climate resilience is deeply appreciated.

We are also grateful to the Alternative Energy Promotion Centre (AEPC), the International Solar Alliance (ISA), and the International Centre for Integrated Mountain Development (ICIMOD) for their valuable contributions and active participation. Their expertise and insights have greatly enriched the discussions and outcomes of this conference.

Special thanks to all the keynote speakers, panelists, and participants from various countries who shared their knowledge, experiences, and innovative solutions. Your engagement and enthusiasm have been instrumental in making this conference a vibrant and fruitful platform for knowledge exchange.

Finally, we acknowledge the tireless efforts of the organizing committee, volunteers, and support staff whose dedication and hard work behind the scenes ensured the smooth execution of this event.

Together, we have taken significant steps towards fostering sustainable and inclusive solar irrigation practices that will contribute to building climate-resilient agricultural systems in South Asia and beyond.

Thank you all for your unwavering support and commitment.

ABOUT THE ORGANIZATIONS

International Water Management Institute (IWMI)

IWMI is a research-for-development (R4D) organization, with offices in 14 countries and a global network of scientists operating in more than 30 countries. For over three decades, our research results have led to changes in water management that have contributed to social and economic development. IWMI's Vision, reflected in its Strategy 2019-2023, is a water-secure world. IWMI targets water and land management challenges faced by poor communities in developing countries, and through this, works towards the achievement of the Sustainable Development Goals (SDGs) of reducing poverty and hunger and maintaining a sustainable environment.

Swiss Agency for Development and Cooperation (SDC)

The SoLAR -SA project is supported by the Swiss Agency for Development and Cooperation (SDC). SDC is the agency for international cooperation of the Federal Department of Foreign Affairs (FDFA). Swiss Agency for Development and Cooperation is an integral part of the Federal Council's foreign policy and aims to contribute to a world without poverty and in peace for sustainable development. SDC, through its Global Programme 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.

Alternative Energy Promotion Centre (AEPC)

Alternative Energy Promotion Centre (AEPC) is a government institution established on November 3, 1996, under the Ministry of Science and Technology with the objective of developing and promoting renewable/alternative energy technologies in Nepal. At present, it is under the Ministry of Energy, Water Resources, and Irrigation. It functions independently and has an eleven members board with representatives from the government sector, industry sector and non-governmental organizations.

The International Solar Alliance (ISA)

ISA is an action-oriented, member-driven, collaborative platform for increased deployment of solar energy technologies as a means for bringing energy access, ensuring energy security, and driving energy transition in its member countries. The ISA strives to develop and deploy cost-effective and transformational energy solutions powered by the sun to help member countries develop low-carbon growth trajectories, with particular focus on delivering impact in countries categorized as Least Developed Countries (LDCs) and the Small Island Developing States (SIDS).

The International Centre for Integrated Mountain Development (ICIMOD)

The International Centre for Integrated Mountain Development (ICIMOD) is an intergovernmental knowledge and learning centre working on behalf of the people of the Hindu Kush Himalaya (HKH). It is based in Kathmandu, Nepal and works in and for our eight regional member countries – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. ICIMOD works to improve the lives and livelihoods of men, women, and children of the HKH and protect mountain environments and cultures

CONTEXT

Dr. Mark Smith Director General, IWMI) at the SoLAR Global Forum Photo credit: IWMI

CONTEXT

Climate change is a major challenge globally, and countries in the Global South are facing large-scale climate variability and are exposed to elevated risk due to low levels of climate readiness and high levels of fragility. Agriculture, as a sector, is particularly vulnerable due to its dependence on weather and climatic conditions. Climate change affects crop yields, livestock, soil, and water resources and in turn impacts food and livelihood security. Simultaneously, agriculture is a major source of Greenhouse Gas (GHG) emissions both directly (through on-farm emissions linked to production e.g. diesel irrigation) and indirectly (through land use change due to agricultural expansion).

Irrigation is a proven strategy to build resilience in many parts of the Global South, particularly in South Asia; it has reduced exposure to changing rainfall patterns, helped improve yields, and enabled diversification of livelihoods. However, access to irrigation particularly for women and marginalized farmers is constrained by several factors. In parts of East/West Africa and MENA, there is a lack of accessible, clean, and affordable energy for irrigation. In South Asia, irrigation is becoming increasingly energy-intensive; the proliferation of groundwater irrigation is responsible for 11-12% of the regions' agricultural emissions

Solar energy, particularly the use of Solar Irrigation Pumps (SIPs), offers a reliable alternative to erratic power supply and costly and high emitting diesel pumps. There is emerging evidence to show the transformational potential of SIPs for livelihoods, agri-food systems and recognizing the agency of women and marginalized groups in climate resilient irrigation for harnessing livelihoods opportunities. Communities that have adopted these systems report higher crop yields, extended growing seasons, and increased income generation. With consistent water supply, farmers can diversify their crops, improve food security, and enhance their economic well-being.

However, the optimism is often truncated by questions around the actual impacts on mitigation and adaptation. Issues of equity and inclusion in access to and control over SIPs remain a systemic challenge to tackle, given the prohibitive cost and capacity needed to install and operate SIPs and limited understanding of SIPs from techno-social, institutional, and political perspectives. Critically, concerns around the potential for over-extraction of groundwater in vulnerable areas remain high. The replicability and scalability of solar irrigation has therefore not achieved its full potential.

For enhanced knowledge sharing, IWMI and its partners organized a three-day Global Forum as part of its SDC funded project titled Solar Irrigation for Agricultural Resilience in South Asia (SoLAR-SA). The forum brought together more than 200 key stakeholders from across the world to discuss the growing body of work and evidence in South Asia on solar applications in agriculture, particularly bringing together key experiences, insights and promotion of south-south collaboration and scaling up of global ambitions around effective and sustainable use of solar energy in agriculture.

Using learnings from South Asia, this forum provided a platform to present unique insights on the effectiveness of solar irrigation as a strategy to sustainably manage water, energy, food, and climate (mitigation and adaptation) interlinkages. It showcased how governments are using evidence from the field to develop and deploy ambitious policies and programs on solar irrigation to address nationally determined contributions (NDC) commitments while supporting climate-resilient, gender-equitable, and socially inclusive agrarian livelihoods.

THEMES OF THE CONFERENCE

The forum was organized as a three-day conference covering plenary and parallel sessions with presentations and diverse panels under four key thematic areas:

1. Groundwater sustainability, adaptation, and mitigation
2. Business models of SIPs and scaling up of solar irrigation
3. The role of communities: Capacity building and Gender, Equity and Social Inclusion (GESI)
4. Designing effective and inclusive policies and policy tools for solar energy transitions

FORMAT OF THE CONFERENCE

The conference was organized in a hybrid format, with most of the participants (invited as speakers and panelists) participating in-person and others joining virtually. The conference sessions were divided into an inaugural session, **4** high level plenary sessions, **8** parallel sessions and a closing session spread over **3** days. All in-person attendees were given the option to join a half-day field visit either to Site 1 which was Chhahari Agriculture Single Women Firm in Sunakothi or Site 2 which was the ICIMOD Knowledge Park. During the refreshment breaks there was ample opportunity for interactions to reflect on the learnings for potential applications of the demonstrated technologies in the local context of the participants.

PARTICIPATION

The conference was attended by a total of **203** participants (**146** male and **57** female) from across **20** countries representing global institutions with a key focus on participants from Africa (MENA region), United States and South Asia. It was attended by key government officials from India, Pakistan, Egypt, Nepal, Malawi, Bhutan, Bangladesh, Uganda, Laos, etc. There were policymakers, academicians, civil society organizations, embassy officials, grassroot organizations working with communities and development banks contributing to the vibrant and engaging discussions.

SESSIONS

The conference was planned for **3** days divided into inaugural session, **4** high level plenary sessions, Day opening and closing sessions, **24** technical presentations, **8** parallel sessions including **11** panel discussions, and formal closing session followed by field visits

DAY 1 INAUGURAL SESSION

Dr. Alok Sikka (IWMI India) and Dr. Manohara Khadka (IWMI Nepal) welcoming Nawa Raj (CEO of AEPC) Photo credit: IWMI

DAY 1 INAUGURAL SESSION

24TH APRIL 2024

Welcome Remarks: Manohara Khadka (IWMI)

Dr. Manohara Khadka welcomed all participants and delegates to the Global Forum. She set the context by speaking about how climate change has led to a shift in irrigation patterns and in turn has led to the irrigation sector seeing major demand for energy for South Asia. This has spurred a need for reliable renewable energy to replace expensive fossil fuels. Hence, she focussed on how solar irrigation can support farmer's climate resilience capacity and with consistent water supply, the farmer can increase his output. She mentioned that solar irrigation must be inclusive and sustainable for optimizing benefits for all, and this forum is meant to share experiences from the South Asia. She further added as how this forum will also highlight how sustainable and cheap irrigation is closely interlinked with water, climate, and food.

Mr Shakti Bahadur Basnet, Hon'ble minister addressing the session Photo credit: IWMI

Special Address by the Chief Guest: Hon'ble Minister, Mr. Shakti Bahadur Basnet, Ministry of Energy, Water Resource and Irrigation, Nepal

Mr. Shakti Bahadur Basnet spoke about the pressing challenges of climate change and the need for climate mitigation awareness and referenced the Paris Agreement in this context. He stressed the need to end dependence on fossil fuels and move towards clean and renewable energy. He outlined that the government of Nepal was working on a roadmap to achieve 15000 MW (solar micro hydro by 2030). He also stressed that water is a vital link to food security and irrigation is crucial for food

security. Mr. Basnet mentioned that 40% of the population depends on groundwater sources and groundwater pumping constitutes 80% of the energy demand. There are smallholder farmers with no irrigation facilities and over 6 million people in Nepal are food insecure and highlighted how food insecurity affects marginalised communities more, especially women, who do not have access to land resources. Hence, this situation calls for a need for low carbon methods like solar irrigation. He also highlighted that the 2023 Nepal national policy aims for economic prosperity, climate adaptive irrigation, including solar irrigation. There was a need for technology to be made more accessible and affordable to marginal farmers including women farmers. Climate resilient and socially inclusive irrigation methods will lead to just and equitable development for all.

Presentation - Solarizing agriculture in a rapidly changing climate in South Asia: Dr. Darshini Ravindranath, Project Lead-SoLAR (IWMI)

Dr. Ravindranath in her address linked South Asia dependence on agriculture and region having solar potential of over 900 gigawatts. The major reason that can be attributed for this is year-round solar radiation in the region. She also highlighted the strong impact of ground water and solar's need to co-habit. Dr. Ravindranath emphasized on an urgent need for well-designed capacity building integration along with GESI, considering the needs and preferences of small, marginalized and women farmers for better project outcomes. She highlighted the findings of the project work, shared south-south collaborative ideas and the need to develop a roadmap for SIP policy and implementation. A short audio-visual reflecting the project progress so far in the four countries was shared at the event.

Remarks: Dr. Pema Gyamtsho, Director General, ICIMOD, Nepal

Dr. Pema Gyamtsho spoke about food insecurity and malnutrition existing in South Asia despite the land boasting of rich land and resources. He also mentioned that the region was facing unusual climate change repercussions which affected the harvesting and post-harvest activities. Adding to these, natural calamities have damaged the infrastructure and lack of water is one of the key constraints for food insecurity. He pointed out that solar water systems and irrigation was interlinked with modernising agriculture for ensuring food security. There was an inability to bring water to where it was needed and when it was needed and hence in this context, solar irrigation not only solves irrigation problems but is also a source of clean energy. He emphasized that true nature-based solutions reduce fossil fuel usage and that there are strategic ways to enhance agricultural productivity from the global forum discourse. Dr. Gyamtsho said that they have piloted successful interventions and for that the inflow of investment is necessary. He concluded by saying that South Asia does not need to be food insecure, our children do not need to go hungry and that they deserve a better start in life.

Remarks: Er. Asghar Ali Halepoto, Chief, Water Resource Section, Ministry Planning, Development & Special Initiatives, Pakistan

Er. Asghar Ali Halepoto commented that natural calamity leads to big setbacks in Pakistan. Those who have access to good irrigation systems are empowered to feed the country and increase their livelihood and improve their country's economy. In Pakistan, nearly 60-70% of energy is used for pumping groundwater for agricultural purposes and there should be a robust groundwater strategy recharge management in place. South Pakistan has high temperatures, and the groundwater

extraction is higher than the rainfall rate which is exploitative. He mentioned that strategies must be moulded to country context, for example, in Pakistan, one metre per square can produce 1 KW because of high temperatures in the country. Also, South Asia sees a lot of natural disasters and nearly 29 billion dollars of infrastructure is damaged annually. Hence, he advocated solarization of Pakistan to have the capacity to compete with the rest of the world's economy.

Remarks: Dr. Sunil Kumar Ambast, Chairman, Central Ground Water Board, Government of India

Dr. Ambast outlined the figures for the groundwater resource – out of 449 billion cubic metre, 200 billion cubic metre is extracted annually which is nearly 49% of the resource in India. This is a serious situation and is a challenge for South Asia. He stressed on the need for progressive interventions that are sustainable to ensure livelihood stability and sustainability. He outlined that out of 60% electric pumps and 40% diesel pumps in India – only 2% have 100% efficacy. Hence, the Government of India has launched the PM KUSUM scheme to replenish the inefficient pumps and introduce SIPs. Out of a total of 141 million hectare of land, approximately 21 billion irrigation pumps are there, which is 15 pumps per square kilometre, so the groundwater is declining at a rapid rate. As far as the cropping pattern of the Punjab region is concerned, the key question is what should be the threshold of the pumps? He also said that there was an apprehension that with the introduction of SIP, it will increase the groundwater exploitation, and from this global forum, he was looking forward to being educated on the various aspects of this. He also raised the question of socially inclusiveness – how do we categorise what is the population that is on the fringe? Also, 85% farmers fall in small and marginal category in India – so what is the criteria defined for being small and marginalised farmers – needs to be laid out.

Remarks: Ms. Munira Sultana, Chairman, Sustainable and Renewable Energy Development Authority (SREDA), Government of Bangladesh

Ms. Sultana thanked the organizers for addressing the issues timely and mentioned that solar irrigation is very important for the South Asian countries. She said that Bangladesh is one of the victims of climate change. The country has been generating electricity from coal-based power plants so solar is a viable alternative. In rural areas with limited access, government implemented loans to encourage farmers to adopt solar power to improve food security and reduce carbon footprint. Grid integration is an option which is acceptable to solar powered operators. Higher capacity SIPs are good on the investment returns and there are apparently only 4000 SIPs against 1,200,000 diesel pumps. To convert 45,000 SIPs from 1KW to 25KW, government has come up with a roadmap, and Asian Development Bank (ADB) estimates a cost of 6 billion dollars for the conversion. This will benefit 1.3 million farmers. Grid connections would create an electricity surplus relieving the government's pressure to provide electricity.

Special Remarks: Her Excellency Dr. Danielle Meuwly, Ambassador of Switzerland to Nepal, Embassy of Switzerland in Nepal

Dr. Danielle Meuwly emphasized that research to policy should be the aim of the global forum and should promote south-south knowledge exchange. It should also be the forum to raise policy questions. She acknowledged that there were valid concerns for groundwater stability due to SIP. Also, there was the concern of unutilised rainfall during monsoons. Maintenance and quality reassurance were critical issues in the implementation of SIPs. She spoke at length about the Swiss

supported SoLAR project and the benefits of grid-connected solar pumps. Dr. Meuwly also mentioned about how the entrepreneurs were developing low-cost micro-SIPs for women and small holder farmers. She stressed on the need for innovative technology and solutions to the challenges faced.

Remarks: Mr. Keshab Kumar Sharma, Secretary, Water and Energy Commission Secretariat, Nepal

Mr. Sharma talked about the need for optimal and sustainable solutions and mentioned that Nepal has dry spells in between harvest season, and climate change is disrupting the food security. He mentioned that agriculture accounts for 50% of the greenhouse gas emissions. This underscores the need for agricultural production and the need to adopt climate mitigation strategies. He stressed on the need for prioritizing development of technology, clean energy for groundwater extraction. He talked about the vast reserves of water resource in Nepal, but the extraction tools must be clean. Climate change has given rise to seismic hazards in Nepal so there is an urgent need to prioritize clean and renewable energy. SIPs must be installed where the government lines have not reached, therefore, co-creation of knowledge including the need for local governments and local stakeholders to promote inclusivity of solar irrigation projects is important. There is a need to bridge the gap between policy and science, where women and socio-economically disadvantaged farmers must be at the centre of planning.

Key Takeaways from the Session:

- Dr. Manohara Khadka emphasized the shift in irrigation patterns due to climate change, highlighting the need for reliable renewable energy, particularly solar irrigation, to support farmers' climate resilience and increase agricultural output in South Asia.

- Hon'ble Minister Mr. Shakti Bahadur Basnet outlined Nepal's roadmap to achieve 15,000 MW of solar and micro-hydro power by 2030. He emphasized the importance of moving away from fossil fuels to clean energy and the critical role of water and irrigation in ensuring food security.

- Dr. Darshini Ravindranath discussed South Asia's solar potential and the importance of integrating capacity building and gender equity in solar irrigation projects. She shared project findings and collaborative ideas for developing solar irrigation policies.

- Various speakers, including Dr. Pema Gyamtsho and Er. Asghar Ali Halepoto, highlighted challenges like food insecurity, climate change impacts, and the need for modernizing agriculture with solar irrigation. They emphasized the necessity of strategic investments and technology to enhance agricultural productivity and resilience.

- Remarks from Dr. Sunil Kumar Ambast, Ms. Munira Sultana, and Dr. Danielle Meuwly stressed the need for inclusive and sustainable irrigation methods, accessible technology for marginalized farmers, and bridging the gap between policy and practice to ensure equitable development and effective implementation of solar irrigation projects.

Dr. Darshini Ravindranath, Project Lead-SoLAR (IWMI) Photo credit: IWMI

DAY 1 HIGH LEVEL PLENARY SESSION 1

Title: Solar Irrigation for Agri-food Systems & the Global Strategic Landscape

Session Description: Solar irrigation technologies are rapidly emerging as transformative solutions that hold immense promise for mitigation and adaptation, co-benefits in the Global South. As these technologies become increasingly affordable and accessible, they offer significant potential for addressing pressing challenges related to water scarcity, climate change, and food insecurity. This session will delve into the multifaceted dimensions of solar irrigation for agri-food systems and will aim to identify the key strategic interventions needed for an inclusive and sustainable pathway for scaling solar irrigation technologies.

Moderator: Dr. Alok Sikka, Country Representative, IWMI India & Bangladesh

Panel Discussion

Dr. Mohamed Mostafa Elkhayat, Chairman, New and Renewable Energy Authority, Government of Egypt

Question: As far as transition to solar energy is concerned – what are the key potential challenges in the global south to the transition to solar irrigation in agri-food system in the coming decade?

Response: In transitioning to solar energy, we need to have a comprehensive vision, raise awareness about water and food scarcity, and address the fact that 30% of total energy consumption in agriculture is still non-renewable. Moreover, most users of solar energy are categorized as low-income individuals, which presents a challenge. Additionally, there's concern about job losses, and recent events like the COVID-19 pandemic and geopolitical tensions exacerbate food security issues.

Mr. Kifayat Zaman, Director General, Federal Water Management Cell, Government of Pakistan

Question: What framework and regulatory mechanisms are needed to address strategic challenges and promote sustainable solar irrigation?

Response: To promote sustainable solar irrigation, efficient distribution systems, robust policies, and heightened awareness about groundwater use are essential. With 80% of land irrigated in Pakistan, effective governance and regulatory frameworks are crucial for maximizing the benefits of solar irrigation while safeguarding water resources.

Ms. Phuntshok Chhoden, Former Executive Director, Bhutan Network for Empowering Women (BNEW) and Chair of Sabah Bhutan, the Bhutan Trust Fund for Environment Conservation (BTFEC)

Question: What is the significance of solar irrigation for women and local bodies in Bhutan?

Response: Solar irrigation in Bhutan extends beyond domestic use to include water utilization in farms, addressing gender disparities in labor and promoting community unity. With only 2.3% cultivable land and gender redundancy being high, solar irrigation presents an opportunity for women's empowerment and sustainable agricultural practices in Bhutan.

Ms. Resha Piya, Energy Adviser, British Embassy Kathmandu, Nepal

Question: What is the critical challenge in scaling solar irrigation (SI), particularly in terms of finance, and how can developing countries prioritize SI for the global development agenda?

Response: Each country needs to implement policies mandating the use of SI, aligning with national adaptation plans (NAPs). However, NAPs often overlook SI in mitigation and adaptation efforts, necessitating its highlight. Linking SI to Sustainable Development Goals (SDGs), such as SDG 2 (Zero Hunger), SDG 5 (Gender Equality), and SDG 6 (Clean Water and Sanitation), can help prioritize SI. Developing strategic programs to secure funds for SI projects and ensuring their sustainability through proper monitoring are also essential.

Mr. Jeevan Kumar Jethani, Scientist-F, Ministry of New and Renewable Energy, Government of India

Question: Could you share your experience with the KUSUM program and discuss the consequences considered in its implementation?

Response: The KUSUM scheme in India aims to replace diesel-powered irrigation pumps with solar ones, addressing issues related to freshwater scarcity and reducing the environmental impact of agriculture. With over 4.5 million pumps installed and a target of 35 GW of solar power, the scheme has significant implications for energy conservation and water resource management. Additionally, by solarizing feeders instead of individual pumps, the scheme promotes water conservation and provides daytime electricity to farmers, contributing to sustainable agricultural practices.

Mr. Md. Enamul Karim Pavel, Head of Renewable Energy, Infrastructure Development Company Limited (IDCOL), Bangladesh

Question: Subsidies for solar irrigation disproportionately support women (80-90%). How can private sector participation be increased to reduce subsidies and scale up solar irrigation programs?

Response: The government in Bangladesh has replaced diesel parts with solar components in agricultural pumps, installing 1500 pumps with a capacity of 1400MW. Despite this, around 1.2 million diesel pumps still exist in Bangladesh, costing around 6 million dollars to replace them. Providing more funds to support the transition to solar energy is essential, especially considering the potential for excess energy generated during certain months, which can be utilized for other purposes, such as powering diesel pumps.

Dr. Jonathan Demenge, Head of Cooperation, Swiss Agency for Development and Cooperation, India

Question: Can you shed light on the challenges of integrating solar technology into global agriculture and why it is crucial to do so, particularly in the context of sustainable agriculture and climate change?

Response: To provide context, it is essential to consider the growing population and changes in consumption patterns. There has been a noticeable increase in food insecurity since 2017 and 2018. Climate change exacerbates these challenges further. Agriculture remains highly dependent on fossil fuels, which are heavily subsidized, constituting a $7 trillion industry. Integrating solar technology offers a means of mitigating GHG emissions and offers substantial benefits to society, including increased access to electricity and renewable energy sources. Shifting away from fossil fuels not

only reduces subsidies and dependence on fuel imports but also benefits farmers directly. Solar irrigation, for instance, has proven effective in Gujarat farms, providing tangible benefits, and reducing reliance on market mechanisms.

Dr. Alok Sikka, Country Representative, IWMI India and Bangladesh

Dr Alok Sikka summarizing the key points in the discussion Photo credit: IWMI

Key Takeaways from the Session:

- Focus on accelerating the integration process needed.
- Emphasis on maintaining quality standards and enhancing required quality
- Need for localization of efforts highlighted for better effectiveness.
- Importance of institutionalizing the findings for long-term sustainability.
- Groundwater sustainability and associated challenges addressed.
- Interest in off-grid solutions, particularly in Bangladesh, Pakistan, and Nepal.
- Highlighted the mutual benefits for farmers when energy is returned to the grid.
- Noted the importance of partnerships and awareness in driving progress.
- Emphasized the need for capacity building to support the integration efforts.

Mr. Mohd Faiz Alam (IWMI India) and Dr. Paul Pavelic (Senior Researcher – Hydrogeology IWMI Laos) Photo credit: IWMI

DAY 1 PARALLEL SESSION 1

Theme 1: Groundwater sustainability, adaptation, and mitigation

Title: Solar Irrigation and Groundwater Sustainability - Contributing to the Global Discourse

Description: This session will present evidence from multiple countries on the impact of solar irrigation on farmers' groundwater usage. This will be followed by a panel discussion with panelists deliberating on improvements needed for upscaling solar irrigation while ensuring groundwater sustainability.

Moderator: Dr. Sunil Kumar Ambast, Chairman, Central Ground Water Board (CGWB), India

PRESENTATIONS

Impact of solar irrigation on groundwater sustainability: Evidence from India and Bangladesh: Mr. Mohd Faiz Alam, IWMI India

This study delves into the discourse surrounding existing theoretical premises regarding the impact of Solar Irrigation Pumps (SIPs) on groundwater abstraction. Through field-based observations in two distinct locales—Gujarat and Bangladesh—an endeavour is made to juxtapose usage rates and extraction practices. In Gujarat, the comparison centers on SIP versus Electric pumps, the latter being the predominant irrigation source. Conversely, in Bangladesh, the focus shifts to SIP versus diesel pumps, given diesel's prevalent usage for irrigation purposes.

Mohammad Faiz Alam presenting on the impact of solar irrigation on groundwater sustainability
Photo credit: IWM

Results of the study

- There exists no discernible discrepancy between solar and non-solar irrigation methods, with findings indicating a wide range and variance.
- The proliferation of SIP does not necessarily correlate with increased groundwater abstraction. Despite incentives provided through grid connection, farmers do not exhibit reduced pumping activities.
- Efficiency assessments, derived from estimations of water requirements vis-à-vis actual farmer application, reveal no significant differentiation between SIP and non-SIP approaches.

Policy implication

- SIP may not directly lead to over-abstraction.
- Other factors, crops, and sowing dates are critical and determine the direction of change.
- No evidence of abstraction by farmers in the grid and centralised SIP units.
- This study provides Water Energy Food (WEF) nexus an opportunity for climate change and adaptation while ensuring Ground Water (GW) sustainability.

Groundwater vulnerability index: Dr. Mohsin Hafeez, Director of Water, Food and Ecosystem, IWMI Pakistan

The methodology focuses on evaluating the vulnerability of GW resources in the Punjab region of Pakistan. The study underscores the significance of groundwater and delineates the prevailing trends in its utilization within Pakistan. Globally, Pakistan ranks fourth in groundwater usage, trailing behind India, the USA, and China. Punjab, specifically, boasts an average annual groundwater potential of 56 million acre-feet (MAF), with an annual abstraction rate amounting to 50 MAF. Notably, over 50% of irrigation activities within Punjab heavily relies on groundwater. However, the unregulated extraction of groundwater, facilitated notably through approximately 1.1 million tube wells, has precipitated a sustained decline in water table levels since the 1960s.

Approach:

The methodology for assessing groundwater vulnerability incorporates several factors:

- Depth to water tables
- Groundwater recharge rates
- Characteristics of aquifer and soil media
- Topography
- Vadose zone impact
- Drainage density
- Land use and land cover (LULC)

- Soil permeability and salinity
- Groundwater quality

A modified Frastic model is employed to develop the Groundwater Vulnerability Index.

Results & Recommendations

The population distribution in central and southern Punjab correlates with heightened vulnerability to groundwater depletion due to intensive irrigation practices, contrasting with the limited data availability hindering accurate assessments in the northern regions. Regarding the Groundwater Vulnerability Index, croplands and urban areas register notably high vulnerability levels, underscoring the significant influence of land use on groundwater susceptibility. The study delineates a comprehensive modelling protocol encompassing solar energy potential and equitable access plans. Recommendations stemming from this protocol advocate for the implementation of area-specific groundwater licensing rules aligned with the Punjab Water Act 2019, as well as the urgent addressing of critical data management gaps to enhance groundwater management effectiveness. Establishment of a robust groundwater information system, coupled with the imperative linkage of groundwater abstraction in depleted zones to mandatory management measures, is strongly advocated. Furthermore, the study underscores the need for fortified water resource management institutions to foster integrated surface and groundwater management, alongside the remapping of agro-ecological zones to harmonize with groundwater mapping for enhanced determination of cropping patterns.

Groundwater and Solar irrigation in Africa: Addressing the threats: Dr. Paul Pavelic, Senior Researcher – Hydrogeology IWMI Laos

Dr. Pavelic advocated for broader adoption of solar technology, particularly Solar Water Pumps (SWP), highlighting their application not only in irrigation but also in domestic settings. This study focuses on SWP rather than solely Surface Irrigation Pumps (SIP), emphasizing the vast solar potential across African countries. Sub-Saharan Africa, ranked 21st globally in solar potential, utilizing only 4% of replenishable groundwater for various purposes. Despite this, irrigation covers a mere 4-6% of Sub-Saharan Africa's arable land. There exists significant potential for expanding irrigation through groundwater, estimated to increase from 27 million hectares to 64 million hectares with the adoption of SIP. The current understanding of groundwater in Sub-Saharan Africa is deemed sufficient for assessing associated risks.

Methods:

- The study uses existing secondary data literature study and adopts a Risk Assessment Approach. The study establishes the likely market trends in small-scale SWP pumps that are less than one kWp. Translate projected SWP sales into GW resources used for agriculture and other consumptive uses. Relate water use (abstraction) to the replenishable stocks of GW.

Results:

- The small-scale SWP market in Sub Saharan Africa (SSA) is modest but is growing rapidly due to falling costs and rising product availability.
- Between 0.2 to 0.7 million SWP may be installed by 2030.
- GW abstraction by small SWPs for irrigation over the next decade accounts for less than 1 percent of the total available GW resources across SSA.
- Higher relative abstraction in specific countries with high sales and in more arid regions such as Southern Africa.

Q&A Session for Mohd Faiz Alam

Q1. Did you also monitor the groundwater aquifer levels to observe any impact?

Given the low scale of solar irrigation, it is not possible to distinguish the impact between solar and non-solar at the aquifer level.

Q2. Did you assess the water requirements for irrigation? Is deficit irrigation being practiced?

We compared water application to the net irrigation requirement, and we observed no difference.

Q3. Did you compare the utilization of solar energy for different irrigation methods? There are differences observed in Bangladesh.

Our area of focus was predominantly dominated by Boro paddy cultivation. In this area, we did not observe a variety of irrigation methods being applied, such as AWD. In Gujarat, however, we encountered both drip and flood irrigation methods, and we attempted to account for this variability.

Q&A Session for Dr. Mohsin Hafeez

Q1. Is the introduction of solar energy increasing the number of tube wells, or are there other factors at play? Have you observed any population dynamics regarding the demographic of people utilizing solar energy for tube wells?

Due to a lack of available data, this study focuses on the utilization of solar pumps by farmers, particularly those who rely less on surface water and resort to groundwater. Additionally, solar pumps have limitations, particularly in terms of their operational thresholds.

Q2. Did you consider the construction of the bores as one of the factors contributing to unsustainable extraction levels?

A masonry worker, often lacking proper qualifications, inadvertently contributes to unsustainable construction practices driven solely by the aim of maximizing extraction rates. Consequently, the resulting structure may exhibit a pumping efficiency typically below 30%, which is a common occurrence across most boreholes. This inefficiency makes the system more extraction-oriented, necessitating the use of higher horsepower pumps.

Q3. What is the reason for the sudden uptake of pumps?

The increase cannot be solely attributed to a sudden push. Dr. Hafeez emphasized that there is a lack of policy implementation, resulting in a significant information gap. While there is knowledge about overall trends, specific numbers and sources are not effectively known. IWMI Pakistan has initiated various methods and initiatives, such as geotagging tube wells, to address this information deficit and increase accountability in the sector.

Q&A Session for Dr Paul Pavelic

Q1. In the modeling process, are you incorporating other sectors to account for the waste generated by the increased uptake?

Dr. Pavelic provided background information on the impact of hydrogeological assessments, particularly in crystalline hard rock areas where there is a poor understanding of the appropriate depth to target for wells. Consequently, water extraction often falls short of satisfactory levels to meet community demands. He highlighted the importance of well-trained hydrogeologists and the transfer of knowledge to the community level. Regarding waste management, Dr. Pavelic mentioned that it was beyond the scope of the study. However, based on a literature review of 70 studies spanning 20 countries, groundwater emerged as the dominant water source. Nevertheless, some studies also flagged waste management as a relevant issue, particularly concerning surface water sources.

Panel Discussion

Dr Ratan Jain, Advisor, Gujarat Water Resources Development Corporation, India

Q 1. GW abstraction is inefficiently regulated and priced: given this context, what is the impact of the proliferation of solar irrigation?

Dr. Jain emphasized the substantial opportunities offered by solar irrigation, acknowledging the associated challenges. He advocated for a nuanced and balanced strategy to navigate these complexities. This entails concurrently addressing groundwater (GW) augmentation in areas lacking irrigation access while mitigating excessive extraction in regions facing overutilization. Achieving this equilibrium is imperative for sustainable water management practices.

Dr. Anwar Zahid, Director (Geology), Bangladesh Water Development Board, Bangladesh

Q 1. What are the opportunities and threats in the propagation of solar irrigation in Bangladesh, particularly in GW systems and can GW modeling play a vital role in innovation of policies?

GW modeling and monitoring are crucial, as the quality of monitoring data directly impacts the accuracy of simulation results. In Bangladesh, GW is extensively utilized for irrigation, constituting 60-70% of total usage. However, the annual renewable recharge of 21 billion cubic meters falls short of abstraction rates, exacerbating depletion in approximately two-thirds of the areas. Effectively monitoring data analysis is vital for discerning these trends.

The formulation of Solar Irrigation Policies necessitates a comprehensive assessment of current GW levels. Renewal policies advocate for stress area identification through monitoring data, enabling

precise mapping, and addressing any data gaps through modeling. Policy formulation plays a pivotal role in determining the introduction and permissible abstraction levels of GW, particularly in the context of SIP adoption. Given the high capital expenditure associated with SIPs, management strategies should prioritize aquifer recharge and GW injection initiatives.

Prof. Dr. Netra Chettri, Chair, Innovation in Global Development PhD Program, Arizona

Q 1. How do you think SIPs will influence farmers' irrigation behavior? What innovation in technology is needed for behavior change in GW abstraction?

Drawing from the field experiences, Dr. Chettri offered valuable insights:

- Farmers expressed intentions to cultivate high-value crops using SIPs, foreseeing increased profitability.
- Economic challenges prompted farmers to transition from cultivating two paddy crops to three, seeking improved income prospects.
- Dr. Chettri underscored the potential for narrative influence in altering behavior, particularly in the context of the prevailing discourse suggesting abundant groundwater supply amid rising demand.
- Consequently, he advocated for the integration of knowledge, highlighting a deficiency in behavioral understanding alongside technological expertise. Dr. Chettri emphasized the imperative for social scientists to elucidate this aspect, introducing the concept of "Science-based, evidence-led institutional innovation" to encapsulate this comprehensive approach.
- Dr. Chettri advocated for science-based policy innovations, underscoring the need for a comprehensive understanding of both technological and behavioural dimensions.

Dr. Marie-Charlotte Buisson, Research Group Leader - Economics and Impact Assessment (EcIA), IWMI

Q 1. Grid-Connected SIPs is one of the models proposed to incentivise groundwater sustainability? Can it work and if so, how should feed-in tariffs be devised to consider not only energy but also the value of groundwater?

Dr. Buisson provided insights based on ongoing and prior research endeavors. She underscored the effectiveness of cash incentives in deterring GW abstraction in Pakistan, citing the feed-in tariff mechanism as a notable example. This policy incentivizes farmers to curtail water extraction, thus reducing GW abstraction. However, Dr Buisson noted a potential counterbalancing phenomenon wherein farmers reinvest their savings into expanding irrigated areas, possibly leading to increased abstraction. This expansion may face constraints in regions with limited arable land availability, where incentives demonstrate efficacy. Conversely, in areas with fallow land, financial incentives may spur re-cultivation, potentially heightening GW abstraction risks. It is imperative to distinguish between increased water usage from existing sources and the associated risks of GW abstraction.

Moreover, Dr. Buisson emphasized the indispensable role of bridging science and policy. Science can delineate areas conducive to sustainable GW development, while policy formulation can address contextual intricacies. Regulation emerges as a critical determinant, considering the variability in SIP efficacy across regions. Notably, Bangladesh employs a distinct model ensuring equitable

distribution of irrigation benefits. This underscores the necessity of tailored regulatory frameworks to confront regional challenges and foster sustainable GW management practices.

Dr Phonevilay Sinavong, Researcher, National Agriculture and Forestry Research Institute, Ministry of Agriculture and Forestry, Vientiane, Laos

Q 1. What are the opportunities and threats you see in Southeast Asia region in expanding SIPs, and what lessons can be taken from Asia for expanding SIPs?

Ms. Phonevilay shared insights from her experience in the Southeast Asia region, emphasizing the opportunities presented by SIPs. She noted that the geographical location offers favorable conditions for SIP adoption, enabling transformative impacts on agriculture. In the context of Laos, SIPs have the potential to enhance agricultural productivity, thereby reducing the labor burden on women while generating additional income and resources. Furthermore, SIPs contribute to food security and nutritional diversity, offering inclusive technological solutions to mitigate the effects of climate change. At the community level, there is growing interest among young people in farming, facilitated by collective utilization of SIPs within groups.

Moderator Remarks

To sum up, the moderator Dr. Sunil Kumar Ambast commented on the “need for a disruptive approach rather than a continuum approach for effective water governance.”

Key Takeaways from the Session:

- Emphasis should be placed on areas necessitating GW restriction, alongside the promotionof extraction where required.
- Targeting small and marginal farmers by facilitating solar irrigation adoption to enhance irrigation accessibility.
- Implementation of cross-sectoral programs and policies to provide substantial momentum.
- Integration of SIPs with drip and sprinkler irrigation, coupled with solar pump subsidies.
- In India, where GW remains unregulated, installation of GW metering alongside solar pump deployment.
- For standalone pump systems, the integration of controllers holds paramount importance.
- Attractive feed-in tariffs for grid-connected pumps.
- Establishment of participatory GW monitoring mechanisms.
- Transcending sectoral boundaries to promote less water-intensive crops, such as millets and pulses, thereby aligning with local-level initiatives like the Integrated Child Development Services (ICDS), yielding holistic benefits in resource sustainability and nutrition.
- Direct financial incentives to incentivize water conservation practices.
- Strengthening capacity through extension services.

Mr. Archisman Mitra, Regional Researcher, IWMI India Photo credit: IWMI

DAY 1 PARALLEL SESSION 2

Theme 1: Groundwater sustainability, adaptation, and mitigation

Title: Solar Irrigation and its co-benefits: Adaptation and Mitigation, including Hills and Mountains

Description: This session will highlight co-benefits of solar irrigation, including findings from South Asia and West Africa. It will include examples of lift irrigation in hilly and mountain regions. The panel discussion that follows will offer diverse perspectives on the impacts of solar on mitigation and adaptation.

Moderator: Mr. Mewang Gyeltshen, Senior Energy Specialist, ICIMOD

PRESENTATIONS

SIPs' potential in mitigation and adaptation: Experience from South Asia: Mr. Archisman Mitra, Regional Researcher, IWMI India

Archisman Mitra in his presentation talked about how SIPs represent a distinctive agricultural adaptation and mitigation technology, offering significant advantages and minimal risks. These pumps provide a renewable energy solution that is both environmentally friendly and economically viable. By harnessing solar power, SIPs reduce reliance on fossil fuels, thereby, substantially decreasing carbon emissions. Additionally, their ease of adaptation facilitates swift integration into existing agricultural systems, leading to enhanced efficiency and productivity. Notably, the adoption of SIPs often results in decreased government subsidy requirements while concurrently bolstering revenue streams for farmers.

Building mountain community resilience with renewable energy-powered irrigation: Mr. Avishek Malla, Energy Specialist, Intervention Manager, ICIMOD, Nepal

Mr. Malla in his presentation mentioned how the hill and mountain irrigation systems typically entail greater initial investment in infrastructure and are inherently susceptible to heightened risks posed by natural disasters. Furthermore, existing subsidy frameworks often lack customization to accommodate the unique challenges faced by regions with varied topographies, such as hills and plains. In Paro, Bhutan, the implementation of solar lift irrigation has demonstrated promising results, notably reducing electromechanical costs by up to 45%. However, while SIPs offer immediate benefits, there remains a critical need for comprehensive assessments regarding their long-term sustainability. Leveraging advancements in remote sensing and artificial intelligence presents a compelling opportunity to effectively contextualize the demand for and utilization of SIPs in accordance with the specific requirements of farmers. By harnessing these technologies, policymakers and stakeholders can ensure a more targeted and sustainable approach to the adoption of SIPs, thereby maximizing their impact and resilience in agricultural practices across diverse landscapes.

Mewang Gyeltsen moderating the session on Solar Irrigation and its co-benefits: Adaptation and Mitigation, including Hills and Mountains Photo credit: IWMI

Key Takeaways from the Session:

- A comprehensive, contextual, and comprehensive approach is required for adaptation and mitigation against climate change. Migration has compounded the issue. Subsidized import tax on agriculture machinery and solar installations in Malawi were quoted. There is a need for ground level data and information to assess the situation. There is a need to learn from failure and customized solution based on location and disaster is required.
- Capacity building of farmers and technicians is also necessary. Use of impounding reservoirs to store monsoon rainfall that can be used in other seasons using lift irrigation in Pakistan needs to be promoted. These pumps are now using solar energy for running. Off-grid SIPs on the rise in Bangladesh as cost of diesel and grid electricity is high. Training for maintenance to the farmers is also provided. Bhutan wants to improve proportion of cultivable land to improve food security and conservation of agriculture practices by using Solar irrigation projects.
- Continuing subsidies to farmers remains a priority, albeit with a necessary shift towards targeted allocation. The government's strategy should include incentivizing private sector involvement by implementing tax reductions on the import of solar technologies and facilitating maintenance training for farmers. Also, organizing additional regional and global forums on a regular basis is imperative to foster the exchange of ideas and best practices.
- Leveraging remote sensing and artificial intelligence for data aggregation purposes in irrigation management represents a critical step forward. It is crucial to recognize that what proves effective on a large scale may not necessarily be readily scalable. While Sustainable Irrigation Practices (SIPs) demonstrate resilience to climate variability, their efficacy can be enhanced through integration with water-saving technologies. Collaboration among governmental bodies, local communities, and private entities is indispensable for the successful implementation of such strategies.

DAY 1 PARALLEL SESSION 3

Theme 2: Business models and scaling up (grid and off grid)

Title: Effective Grid Integration Models for Solar Irrigation

Description: The session will delve into the various modalities of grid-connected solar irrigation, focusing on learning key lessons from South Asian grid connected solar irrigation projects and identifying policy pathways for a sustainable and equitable business model. The session aims to investigate the challenges and opportunities associated with various grid-connected solar irrigation models and recommend a more scalable, financially sustainable, and inclusive approach.

Moderator: Prof. Dr. Netra Chettri, Chair, Innovation in Global Development PhD Program, Arizona

PRESENTATIONS

Experiences from Grid-connected Solar Irrigation Pilots in South Asia: Mr. Shisher Shrestha, National Researcher, IWMI Nepal

Work has spanned across a period of 4-5 years in 3 different countries with the key objective of:

- Providing extra energy to the grid
- Ground water sustainability
- Reduction in operational cost

Various projects have been introduced by the governments to kickstart and encourage the use of solar power to generate energy for grid integration and irrigation. In India Surya Shakti Kisan Yojana (SKY) was intended to provide energy to farmers for irrigation and to sell the excess energy back to the national grid, enabling them to earn an income. As per the scheme, the farmers pay only 5% of the cost upfront and the remaining cost is paid overtime by the energy redistributed to the grid. Farmers have reported an income rise of up to 38%. The farmers who signed up appeared to be farmers with large amounts of land, financial stability, and good education.

Few projects were tried in Bangladesh as well. In Bangladesh irrigation is only required for 5 months as the major crop is rice, thus, the energy was being wasted before the grid integration. Grid integration has been tried both on an individual and cluster level. Total solar energy sold to the grid is of the value of $6750.

In Nepal, the design was based on a field visit to Gujarat. Unfortunately, such systems may not work in Nepal. Input to inverter being direct from solar. Farmers store their solar pump systems in houses due to thefts. Pumps can be turned on by the push of a button. Solar power generation is extremely high in the winter season in Terai and the demand is extremely high in the monsoons for rice farming, and grid integration helps farmers to have a stable flow of essential energy.

Key takeaways

- Grid connection of solar has a remarkably high potential.
- Country specific policies are impacting integration

Lessons from Solar Photovoltaic Pumping for Agricultural Irrigation (SPPAI) Project in Bangladesh: Mr. Md. Sakil Ibne Sayeed, Project Director SPPAI Project, Bangladesh Rural Electrification Board (BREB), Bangladesh

Solar integration is working in Bangladesh since 2018 and the project has evolved overtime. Initially the project was designed for off-grid areas with no provision for grid integration. The government trusted them with the integration of 2,000 solar pumps. At the start of the project, farmers did not want solar pumps because they distrusted the ability of solar pumps to provide enough power. The program started supplying power during the irrigation season. There are 4.5 million pumps in operation in Bangladesh and this project was designed with ADB in partnership. The grant is 65% from the farmer. The model has evolved over time to integrate grid power. The farmers pay 10% initially and the remaining 90% is paid within 10 years.

SIPs have a 5-year warranty on the main parts. Farmers earn primarily from selling water and can generate additional revenue by selling electricity to the grid during the off-season. In Bangladesh, pumps are used for about 120 days annually and for the remaining time, the pump stays idle. In those days, electricity could be supplied to the grid for revenue. When the pump is running, the surplus power is delivered to the grid and when the pump is not running, the entire power is supplied to the grid. At present, 3980 solar pumps are running, and their installed capacity is 65,45MWp. All the farmers will be owners after paying all the instalments. A roadmap has been designed until 2031 and there is a plan to replace more diesel pumps and make the pumps entirely run on solar power instead of using grid power of diesel power and integration to grid for power generation. Grants are essential for this project to be viable. The cost of irrigation should not be upon the farmer but should be subsidized by the government.

Challenges and Opportunities – Grid Connected Solar Pumps in Nepal: Mr. Suyesh Prajapati, Energy Expert, MinErgy Pvt Ltd

Mr. Prajapati set the context by examining if solar lift irrigation system is sustainable. He mentioned that at least 70% of the total energy generated is wasted and most communities with SIP rely on grid electricity or diesel generator to pump water during overcast days and the winter period. He also said that 27% of Solar lift irrigation system installed within the last five years in mid-hills are non-functional. Mr. Prajapati elaborated on the Bagmati Saurya Urja Irrigation project which MinErgy with funding support from WWF Nepal and 20% contribution from the local government installed 14.4 KW solar irrigation system. This was done to install a community based solar irrigation plant to provide access to year-round irrigation facility and to demonstrate grid connected solar irrigation plant with net metering and remote monitoring.

Some of the lessons learnt included a need for post-installation support to ensure proper knowledge transfer of operation and maintenance. There was a need for social engineering support for dispute management and financial and operational management. Unlocking the potential to monetize feed-in tariff presents a promising opportunity and doing so, could establish a sustainable income stream for numerous SLIs. Exploring the potential for selling surplus energy from SLIs opens doors for new

Mr. Shisher Shrestha, National Researcher, IWMI Nepal Photo credit: IWMI

Question for the Panel: What is the current state of grid integration in your region and what are some of the biggest challenges in grid integration of solar apart from the variability in generation of power across the different periods of the year?

Panelists and Responses :

Asha Khanal

The main challenge at present is the cost of grid integration, and the cost is picked up by the authorities themselves. The power from solar is 6-10% of the total energy and will not be a big problem in terms of energy flow for grid integration. The SIPs are quite far away from the grid and the owners of the SIPs expect the government to pay the full cost for integration.

Wakil Ahmed Arnob

IDCOL has been providing financial aid for infrastructure and renewable energy projects. There are 9 grid integration sites in Bangladesh and 6 are funded by IDCOL. Existing SIPs are not grid integrated. The vast transmission lines across Bangladesh will help to integrate the solar power into the grid.

Dr. Youssef Brouziyne

For context in the MENA region, there is 50% of global reserves of oil and 40% of global gas reserves. Renewable energy share was 1% in 2008 and is 9% as of now. MENA has a good record in solar energy and grid integration. Speaking of the market situation, countries prefer to outsource their power in MENA and estimation suggests that Morocco and Tunisia can provide 50-70% of energy to Europe. Priority is given to renewable energy in terms of the access of grid. Morocco is picking up on medium to high PV plants. Unfortunately, only two well-oiled mechanisms exist in Egypt and Nigeria. This needs to be increased.

Elizabeth Kaijuka Okwenje

The current situation in Uganda is there exists a major problem of oversupply of electricity on the grid of 2 GW with energy usage being only 900MW. The energy policy identifies PV use of energy and 70% of the rural farmers are off grid and have no choice but to use solar power for irrigation. When talking of productive use of energy mini grids, there are areas quite far from the grids and geographically difficult to establish. The mini grid can be connected to the grid. However, the energy infrastructure is currently not ready to handle a two-way flow of electricity. A policy was introduced in 2020 for this but this has not yet been implemented to an extent where it can produce tangible results. This problem is uniform across Africa.

Dr. Deepak Varshney

The target is to connect 1.5 million SIPs to the grid. The loan repayment period for the SKY scheme was 7 years. If the loan repayment period is longer then the installments become smaller. The farmers welfare point is whether to go for a one-time subsidy or opt for a longer time plan. In Gujarat, the farmers who are exporting more energy are doing better financially. The adoption was by larger scale farmers and not by smaller or medium scale farmers due to financial constraints. The upfront cost needs to be tailored in a way to make it more attractive for farmers. Farmers need to be more aware of their consumption and distribution. Farmers recover 40% of their total investment in the first two years and the government recovers one-third of the costs.

Question for the Panel: What are the solutions being pursued for more effective solar power integration into the grid?

Panelists and Responses :

Asha Khanal

In South Asia we are trying to catch up with the developed world instead of focusing on localization. Proper techno economic assessment is needed. Ignoring grid integration can cause failure of the project. The system should be remotely regulated and automated. Socially marginalized communities need to be highlighted and small-scale SIPs need to be integrated. She emphasized the need to go through the aggregation process.

Wakil Ahmed Arnob

For the grid integration and SIPs to be sustainable, we cannot be heavily reliant on subsidies. The advancement in technology will result in the cost of materials decreasing eventually.

Elizabeth Kaijuka Okwenje

The success stories from South Asia are very wonderful to see and lessons learned from here should be applied in Uganda.

Dr. Netra Chettri

The challenges are localized, and the solutions will also have to be localized to have a business model to sustain the grid integration of solar.

Panelists and speakers at the parallel session 3 Photo credit: IWMI

Key Takeaways from the Session:

- Potential and Impact of Grid-Connected Solar Irrigation:
  Grid-connected solar irrigation has significant potential to enhance energy supply, reduce operational costs, and promote groundwater sustainability. Successful projects in South Asia demonstrate that integrating solar power with the grid can provide farmers with additional income through selling surplus energy.

- Challenges and Lessons Learned:
  Country-specific policies and socio-economic factors influence the success of solar irrigation projects. For instance, in India, financially stable farmers with larger landholdings benefit more from schemes like SKY, while in Nepal, theft and seasonal demand pose challenges. Bangladesh's model evolved from off-grid to grid-connected to address energy wastage during off-seasons.

- Financial Models and Government Support:
  Effective financial models involve significant government support and subsidies. For example, Bangladesh's SPPAI project involves a 65% grant with farmers paying the rest over 10 years. However, reliance on subsidies is not sustainable in the long term, and future models need to reduce this dependency.

- Technological and Operational Considerations:
  Ensuring the sustainability of solar lift irrigation systems requires post-installation support, social engineering, and monetizing feed-in tariffs. Combining solar irrigation with other energy-consuming activities can enhance efficiency and value.

- Regional Variations and Localization:
  Grid integration strategies must be localized to address specific challenges in different regions. For example, South Asia focuses on catching up with developed countries but needs to consider localized techno-economic assessments. In MENA, the focus is on increasing renewable energy share and exporting energy to Europe, while in Uganda, infrastructure readiness for two-way energy flow is a major challenge.

Dr. Deepak Varshney, Regional Researcher, IWMI India Photo credit: IWMI

DAY 1 PARALLEL SESSION 4

Theme 2: Business models and scaling up (grid and off grid)

Title: Establishing Sustainable Business Models for Off-grid SIPs

Description: The objective of the session is to identify policy pathways for a sustainable and equitable business model to scale solar energy in off-grid areas. Panelists are expected to reflect on the presentations and share their experiences working with SIP business models from different parts of the world. The goal is to identify the challenges and opportunities of various business models and determine necessary improvements for an equitable, scalable, and financially sustainable mode.

Moderator: Mr. Shilp Verma, Deputy Country Representative, IWMI

PRESENTATIONS

Off-grid business models in South Asia: Learnings from SoLAR: Mr. Archisman Mitra, Regional Researcher, IWMI India

Mr. Mitra spoke about the off-grid business models in South Asia: Learnings from SoLAR operational in the four countries. He mentioned that there was a rapid growth of solar grid power pumps: 90% in India and rest in Bangladesh (nascent stage); 3000 pumps each in Nepal and India. He then spoke about the two models - Model 1: Reduce diesel use to meet mitigation targets and Model 2: Affordable and reliable irrigation access compared to diesel. There were important benefits available but was not picking up mainly due to financial constraints: high upfront cost. He then went into the details about the different models:

1. Fee for Service Model

- Sponsors or private companies take grants (50%) and loans; target the sponsors who are the ISPs.
- Grid connected solar pumps given to farmers.

2. Community-managed: Bangladesh

3. Individual pump ownership: Bangladesh

4. Fully subsidized: AEPC, Nepal

Models differ based on:

1. Service provider
2. Individual user: for self-use

SIP financial viability: A challenge in Nepal and Bangladesh

- Would not survive without subsidies
- Imported from outside; therefore, the high cost

- Profit-driven model

High CAPEX is a constraint on scaling

- Liquidity constraints

Equitable access to SIPs

- High upfront costs are exclusionary
- If market driven, then won't reach the poorest parts of the group; subsidies lead to elite capture tendencies.
- Small and marginalized farmers are less likely to apply for it.

Low-capacity utilization challenge for all off-grid models

- Limited scope to take it to the middle of the field; it is more successful near the roads.
- Grid integration is a promising alternative.

Scaling for decentralization of SIPs

- Substantial transaction costs
- Smaller pumps targeting small farmers
- Operation and maintenance difficult

Therefore,

- Target carefully
- Equitable access is still a challenge.

Scaling solar pumps through viable business models – experience from West Africa: Ms. Abena Ofosu, Senior Research Officer, IWMI Ghana

Ms. Ofosu spoke about Solar based bundles and the state of irrigation in 17 countries in Africa. The irrigation potential is 57% only in 3 (Ghana, Nigeria, and Syria) out of 17 countries. The groundwater access is still a challenge and water pumps have become increasingly popular, but the floor costs are also rising. Adaptive Scaling Approach is available, but it takes time. Also, she spoke about solar bundles since only solar pumps are not enough for the farmers.

Services that go with the irrigation: Different farmer groups require different things and broadly can be categorized into 5 groups.

Policy implications:

- A single solution for all farmers is not true; farmers differ based on their context and capacity and hence the solutions need to be customized.
- Solar pumps cannot be promoted in isolation.
- Need to combine products and services that make farming suitable.

- Partnerships critical so that farmers aren't required to visit several service providers/vendors, e.g. forums could be a platform.
- How can we de-risk private sector investment to improve participation in scaling it up?

Experience of off-grid solar models in India: Mr. Siddharth Gahoi, Program Manager, Social Alpha, India

Mr. Gahoi set the context by comparing the map: potential vs the actual number of pumps. In the Northern part of India, there were more diesel pumps, and, in the South, there were more grid connected pumps. The aspirations of the small farmers were to cope up with the income of neighbouring farmers those who want to send their children to good schools and buy two-wheelers. Different technologies can be plugged into the agricultural ecosystem. Different technologies used to make products that are marketable in nature.

DRE solutions in India include:

- Working with grassroot organizations who have a good presence and experience working in the area with good context.
- Combination of microentrepreneurs
- DRE is expensive; therefore, there should be a thrust to build an ecosystem of microentrepreneurs for this to be market-driven (this will scale it up).

Northern India: 5 HP pumps, rainfall dependency, diesel dependency = increases risks to farmers

SIPs integrated with grip, mulch, pipelines; 25000-40000/farmer

Portable pumps: transportable

Water level good = service models acceptable

Best case scenario = 2.4-3 years of payback periods; but instances of not being able to do so is also there. Business planning with organizations.

Optimal utilization:

- Excess energy from pumps used at livelihood centres.

Pumps getting installed but maintenance remains a challenge; issues show up within a year and there is no provision to even replace a switch.

There are gaps in end-user financing, so a good approach is to try working with financing agencies.

Smaller capacity pumps attract 50-60% of the end users.

Ms. Abena Ofosu, Senior Research Officer, IWMI Ghana Photo credit: IWMI

Question and Answers:

Question: How does off-grid solar business models interact with PM KUSUM scale?

Siddharth Gahoi

It is critical that investors see returns on their investment and this is possible only when collaboration between government and private sector is initiated. KUSUM schemes are a part of the overall approach and how can the pumps be made more efficient is where the focus area of work is.

Question: As a business model, is it building on the Government's subsidies schemes? Is it the primary resource? How much does an individual small pump cost?

Siddharth Gahoi

The subsidy is a small part that we are trying to tap into and at the cluster level, need to bridge the gap between demand and supply. It also depends on the ecosystem/model and less than 1 HP pump costs INR 50-70k and the pipeline and drip (3 HP) costs Rs 500,000.

Panel discussions

Ms. Sharon Yeti, Co-founder & CEO, Powerlive, Zimbabwe

- What is happening in Zimbabwe that could be brought to South Asia?
- Need and demand for SIP is high but the main challenge is affordability.
- Families that depend on cash crops have little savings.
- Little income = low quality seeds = low yields = low income
- Business model: Pay Deposit model.
- Still expensive for them

Lessons:

- Long-lasting relationships with customers critical; need to make sure about how we can support them in the long-term and ensure higher yields.

Ms. Laxmi Sharma, Research Consultant, IWMI India

She mentioned that the initiative(SE4RL) was running in 3 states of Jharkhand, Bihar and Uttar Pradesh which were diesel dominated areas. Ms. Sharma said that the utilization of SIPs was low there. Bihar has a well-developed groundwater market and through the Chakhaji model, there was an attempt to replace diesel-owned pumps by bringing in a bio-friendly and competitive market. As an experiment, 6-7 solar pumps were provided to self-help group of women entrepreneurs. In Jharkhand, she recounted that the market was not well developed and hence, the same business models will not work. The FPO model runs the entire irrigation business and enables production hub and since there is a profit, other SIPs can be deployed as well.

In Uttar Pradesh, a price variable experiment was run and URJA as a social enterprise was started. The main challenge was that the SIPs are underutilized, and the farmers are not willing to buy water from the URJA pumps. If the price of the water pumps is equal to the diesel pumps, the only incentive remains the ease of use. The project was trying to reduce the price from Rs 4 to Rs 2 per unit to see if

they will try and adopt the SIPs instead. The early results have come in and shows that more farmers are joining in and will switch over to more productive crops since the marginal returns are higher.

Mr. Shadman bin Zahir, Manager (Investment), Renewable Energy, IDCOL, Bangladesh

The main question was for the fee for service model, how has IDCOL managed to scale it up? Bangladesh's economy is highly dependent on agriculture and the diesel-run irrigation pumps are high in number. Quoting the success rate of IDCOL, he said that they provide clean energy, which has reduced the carbon emissions by 0.4 million tonnes of CO2 till date. Also, the tariff is lower than the diesel tariff by nearly 25%. There are 2 key players in operation, and the supplier is responsible for the after-sales service. IDCOL has an independent technical standard committee to assess if the controller is compatible. The financial modality is 50% grant, 35% debt (10 years loan tenure with 6-7% interest rate) remaining. The Central Bank sets the guidelines for the loan and there is an unconditional bank guarantee. The bank guarantee states that if they are not able to repay, then they have this as the back-up.

The main challenge is that the SIP operates for 5-7 months a year, and the excess energy can be fed into the national grid. The financial viability of the project is questionable. For example, the farmers might cultivate paddy or Boro, the market trend might change, and they start producing maize instead. Also, when one component gets lower, then it affects the revenue model and the electric pumps also pose a challenge, since it affects the land coverage.

Mr. Hafiz Qaisar Yasin, Directorate General Agriculture, Water Management, Pakistan

The demand for pumps is more than what was initially anticipated in Pakistan. There were different models being implemented in Punjab. There were 1.2 million tubewells, out of which 85% are diesel tubewells and the rest are electric. Drip irrigation and cultivation of fruits and vegetables is a must. He mentioned about currently implementing a megaproject with the World Bank, Punjab where they are promoting 1000 solar systems and pumps to farmers. Farmers have their own models, nearly 50,000 tubewells have been converted at farmer's own cost. The main challenge is that groundwater sustainability is decreasing and since sustainability of groundwater is a major priority hence, the government has decided to couple it with high efficiency irrigation systems.

Mr. Aklavya Sharan, Director, Decentralised Energy Systems, DESI Power

How to tackle affordability issues and target marginalized communities? He mentioned that linkages of energy, water, agriculture, and jobs are crucial for a village development program and there is a need to look at the intertwined aspects. The current supply and equipment schemes do not meet the access to energy goals and said that profitability to investors is crucial. He also mentioned about the innovation fund grantees and outlined the different solutions that have been done by them. He listed out some of the important points – a) solar PV only for irrigation is counterproductive b) women's role is important c) access to finance d) water conservation e) solid business models f) round the clock reliable power supply is critical g) the solar needs to be run for longer hours for better profitability h) need to look at hybridization (example: microgrid models) i) contextualized solutions for different locations is critical j) critical to develop data-collection models k) data-driven modelling to optimize solutions l) energy-efficiency models a must for the programs m) community-driven models are successful and water sharing is an important factor n) promote further business

opportunities that can be linked with agriculture models o) new crop patterns driven by technology – less water requirement p) training and capacity building: installation and ownership for efficient management.

Ms. Resha Piya, Energy Adviser, British Embassy Kathmandu, Nepal

How to tackle affordability issues and target marginalized communities?

She mentioned that when there was no transport of vegetables or fuel, people started looking for alternatives. The domestic demand for food was high but they were not able to scale it up and as such, solar lift irrigation came into place. 30 farmers from Chitwan demanded SIPs and despite less subsidy, they went for it. This was aided by the fact that the cost of diesel was increasing. As far as gender equality and mitigation of emissions was concerned, solar irrigation contributes to all the priorities of the development partners. The primary bottlenecks were – a) subsidies should be provided to introduce technology in the market but if we want it to scale up, subsidies need to be removed b) affordable financial schemes with less risk available means, farmers will opt for it c) at present, it is a risky venture to invest in SIPs, vendors only want to sell products and don't want to sell the service d) present government systems only focus on the installation; output comes from the services that farmers get.

Question for the Panel: As a minister, what is the one thing that you would do?

Sharon Yeti

She said that the primary aim would be to reduce costs by 15-20%.

Laxmi Sharma

In Bihar, encourage institutional self-help groups like JIVICA that provide financial support since they have better capacities at deploying these SIPs.

Shadman bin Zahir

Reduce the grid integration bulk tariff which is at 6.3 taka/hr to 4.63 taka/hr.

Hafiz Qaisar Yasin

There is a need for groundwater regulation which is at present unregulated. Right now, anyone can install the bore and access water. Water Act has been introduced recently in Pakistan to enforce groundwater regulation to ensure sustainability. There is also a need for proper licensing of pumps.

Aklavya Sharan

He mentioned that there is a need for a top-down model, bottom-up approach to tweak policies and different subsidies are being run by different departments – this needs to be synchronised. Fund utilization should be done in a way that it pays back for further development of the program.

Resha Piya

There is a need for a long-term incentive policy package for the private sector, for example, power purchase package. If there is profit, sustainability changes are high; also, there is a need for sustainable use of technology and SIPs.

Shilp Verrma moderating the session on Establishing Sustainable Business Models for Off-grid SIPs
Photo credit: IWMI

Key Takeaways from the Session:

- Off-grid solar irrigation pumps (SIPs) face financial constraints, with high capital expenditure (CAPEX) being a significant barrier to scaling up. Many models are not financially viable without subsidies, making equitable access challenging for small and marginalized farmers.

- Different farmer groups have varying needs, and a one-size-fits-all solution is ineffective. Customizing solutions and forming partnerships with multiple service providers are crucial to making solar pumps effective and accessible.

- Maintenance issues often arise within a year of installation, and there are gaps in end-user financing. Ensuring optimal utilization of SIPs is critical, as excess energy can be used for other livelihood activities, but the current models face challenges in providing consistent support and maintenance.

- Government policies play a crucial role in the success of SIP business models. Reducing reliance on subsidies, implementing long-term incentive policies, and ensuring proper groundwater regulation are essential for sustainable development. Effective collaboration between government and private sectors can improve financial returns and project sustainability.

- Innovative solutions like portable pumps, community-driven models, and hybrid energy systems (e.g., microgrids) show promise. Solutions need to be context-specific, considering factors like groundwater availability, regional needs, and economic conditions. Training and capacity building for efficient management and installation are also vital for the success of SIP projects.

Up Next: DAY 2 OPENING SESSION

A guest going through SoLAR IF Grantee Case studies Photo credit: IWMI

DAY 2 OPENING SESSION

Dr. Govinda Prasad Sharma, Secretary, Ministry of Agriculture and Livestock Development, Nepal

Dr. Sharma outlined various facets of Nepal's agricultural landscape and the challenges it faces, underscoring the critical importance of initiatives like this forum. He began by expressing gratitude to the organizers for providing this platform to address pressing issues. Highlighting hunger as a global challenge, particularly acute in developing countries, Dr. Sharma pointed out that Nepal has 4.6 million food-insecure individuals, especially in remote areas where agriculture is a primary livelihood. Over the past decade Nepal has improved in this sector with suitable structures, development of the private sector, and support of development partners. Nepal's global hunger index has also declined between 2000 and 2020 and overall, production has increased.

Despite improvements in the agricultural sector over the past decade, including the development of suitable structures and private sector involvement with the support of development partners, challenges persist. These challenges include unstable food production, poorly managed irrigation systems, and the need for year-round irrigation to enhance efficiency. Market access, rural-to-urban youth migration for employment, and the impacts of climate change further compound these challenges.

Dr. Sharma emphasized the agriculture sector's potential as one of Nepal's highest exports but noted the necessity for non-farm employment due to most families' inability to depend solely on their own agricultural production. Stability and sustainability are paramount for food security, with better utilization of household resources for nutrition crucial. Dr. Sharma highlighted the significant loss incurred due to untimely rainfall last year and the impact of drought on rainfed agriculture. Groundwater irrigated area has increased to 42% in Nepal, but diesel pumps contribute significantly to emissions. Hydel power offers renewable energy sources, but it faces significant seismic and climate change related risks. Emphasizing the need for alternative solutions, he recognised the potential of solar irrigation to offer a gender-friendly, clean, and small-holder-friendly solutions. He mentioned the government's recent efforts including the increased focus on expanding reliable year-round irrigation through conjunctive irrigation, implementing over 80 solar irrigation projects over 19,000 hectares of land, regular repair, and maintenance of tubewells and canals, and empowering women in agriculture through the 2015-2035 Agriculture Plan which has a focus on women farmers.

Sharma concluded by expressing hope that the forum would yield tangible outcomes for policy feedback, emphasizing the importance of collaboration and integration across water, food, and energy sectors to address Nepal's agricultural challenges effectively.

Dr Govinda Prasad Sharma, Secretary Ministry of Agriculture and Livestock Development giving his remarks Photo credit: IWMI

Mr. Jan Erik Studsrød, Counsellor, Energy, Climate and Food security, Royal Norwegian Embassy Kathmandu

In his speech, Mr. Studsrød highlighted the significant advancements in solar technology and its potential to address pressing challenges, contrasting this with the past when solar energy was confined to niche experts due to underdeveloped technology. Focusing on the challenges faced by the region, including groundwater depletion, climate change impacts, glacier retreat, and erratic seasons in South Asia, he underscored the critical role of irrigation in mitigating these issues. Mr. Studsrød pointed out Norway's support for initiatives of the International Centre for Integrated Mountain Development (ICIMOD) and the Alternative Energy Promotion Centre (AEPC) in Nepal, particularly in green energy management. He highlighted ICIMOD's development of a tool for integrating renewable energy in agriculture, which has been transferred to AEPC for scaling and implementation.

Furthermore, Mr. Studsrød discussed agricultural practices in Nepal, including crop residue burning, excessive tillage, and high chemical use, which have led to a decline in soil organic content and quality. He advocated for optimizing water use rather than maximizing it, suggesting that this approach could help reduce chemical inputs. He proposed innovative solutions such as constructing check dams to intercept water downstream and redirecting it for uphill irrigation, allowing for efficient utilization of water resources, and requiring energy solutions such as solar energy for such water lifting.

Overall, Mr. Studsrød's speech emphasized the importance of leveraging technological advancements, international partnerships, and sustainable agricultural practices to address the complex challenges facing the region.

Dr. Madhusudan Adhikari, Former Executive Director, Alternative Energy Promotion Center, Nepal

In his speech, Dr. Adhikari delved into the complex challenge of balancing energy, water, and air resources in the context of mechanization and food insecurity. He emphasized the growing concern over water security, noting that while per capita water availability may be high, its distribution has become uneven due to the impacts of climate change, which is adversely affecting food production. Dr. Adhikari posed a crucial question regarding how human activities can be sustained without further deteriorating the climate and basic resources essential for human well-being.

Renewable energy irrigation systems can offer a more sustainable integration of food, water, and energy, particularly emphasizing the increasing affordability and cleanliness of solar technology. Dr. Adhikari discussed efforts to incorporate solar energy into various aspects of daily life, highlighting the challenge of efficiently storing solar energy, for example, through hydrogen and batteries. He noted the promotion of multiple uses of solar energy by the AEPC and described the recent experimentation with smallholder irrigation systems. Despite challenges such as limited investment capacity among smallholder farmers, the AEPC successfully implemented a project to set up over 1300 smallholder pumps in the first year, with the IWMI evaluating their impact.

He highlighted the evolution of these initiatives towards community-based irrigation systems, with over 3000 systems established in three years, with more than 60% benefiting marginalized farmers. He emphasized the importance of context-appropriate solutions for Nepal, advocating for a focus on small-scale irrigation systems and scaling models for marginalized communities. He outlined the respective focuses of the AEPC and the Government of Energy, with the former concentrating on smallholder and community-based systems and the latter on larger grid-connected projects. Dr. Adhikari concluded by expressing his wishes for the success of the conference and emphasized the timeliness of the dialogue, as Nepal is currently preparing its budget, underscoring the importance of securing resources for similar efforts in the future.

Key Takeaways from the Session:

- Challenges in Nepal's Agricultural Sector:
  Dr. Govinda Prasad Sharma highlighted ongoing issues like food insecurity, unstable production, poor irrigation, market access, rural-to-urban migration, and climate change impacts.
- Importance of Year-Round Irrigation and Solar Solutions:
  Reliable, year-round irrigation is crucial. Solar irrigation, a clean and gender-friendly alternative to diesel pumps, was emphasized.
- Advancements in Solar Technology and Sustainable Practices:
  Mr. Jan Erik Studsrød discussed solar technology's potential to address groundwater depletion and climate change, proposing solutions like check dams and uphill irrigation.
- Integration of Renewable Energy in Agriculture:
  Dr. Madhusudan Adhikari stressed integrating solar energy into agriculture, highlighting sustainable solutions like hydrogen and batteries for storage, benefiting marginalized farmers.
- Collaboration and Policy Feedback:
  International partnerships and policy integration across water, food, and energy sectors are vital. Dr. Sharma and Dr. Adhikari emphasized collaboration and timely dialogue for successful initiatives and resource security.

Up Next: DAY 2 HIGH LEVEL PLENARY SESSION 2

Dr. Manohara Khadka (IWMI) handing out a Token of Appreciation to Mr. Jan Erik Studsrød (Royal Norwegian Embassy Kathmandu) Photo credit: IWMI

DAY 2 HIGH LEVEL PLENARY SESSION 2

Title: Barriers and Opportunities for Financing and Scaling Technology and Innovation for Promoting Solarized Agri-Food Systems

Session Description: The panel discussion aims to identify and address barriers hindering the financing and scaling of technology for solarized agri-food systems. It will explore financing mechanisms, assess technological innovations, and evaluate sustainability implications. The goal is to foster collaboration and knowledge sharing among stakeholders to promote scalable and efficient solar-powered solutions for agricultural sustainability and food security.

Moderator: Dr. Mohsin Hafeez, Director of Water, Food and Ecosystems, IWMI Pakistan

Panel Discussion

Dr. Mohsin Hafeez, Director of Water, Food and Ecosystems, IWMI Pakistan

Dr Hafeez mentioned that this session would focus on cross learning from each other, while looking into barriers as well as opportunities with regards to solar technology. In this way, South Asia can unfold its full potential as each country has its own systems in place and trajectory of solar irrigation adoption.

Dr. Ram P. Dhital, Former Executive Director, Alternative Energy Promotion Center (AEPC), Nepal

Question: What role can PPP investments & partnerships along with government incentives play in sustainable adoption of solar irrigation?

Response: PPP is important for the government to supplement its resources, improve efficiency of program delivery, and share the risks involved.

The govt. can support and enable the private sector through smart and focused policy regulations. Also, develop smart policy mechanisms through quota, net-metering, subsidized tariffs, and feed-in-tariffs.

Capital costs are high so the government can improve access for small farmers via direct support through subsidies and via indirect support through tax and duty exemptions for solar technology and associated machinery.

Ms. Ghazala Channar, Deputy Chief, Water Resources Section, Ministry Planning, Development and Special Initiatives, Pakistan

Question: How implications and risks of solar irrigation on agri-food systems can be managed to ensure food security especially in context of 100,000 tubewells policy of the provincial government?

Response: To offset adverse implications of unsustainable adoption of solar irrigation, regulatory framework and well-integrated interventions are most important. Continuous and unregulated extraction has hydrological, social, and ecological threats i.e., subsidence of land in Quetta areas due to over-abstraction. Over-abstraction can lead to salination of groundwater and drying of open wells leaving diminished availability of drinking water.

For mitigation measures - safe groundwater zones need to be identified in terms of quantity and quality of groundwater for solar irrigation, proper distancing of SIPs is important, water rights of landless needs to be protected for domestic and drinking purposes.

Dr. Nazmun Nahar Karim, Member Director (CC) (Livestock) and Chief Scientific Officer (Agri. Eng.), Bangladesh Agricultural Research Council (BARC), Bangladesh

Question: What role can solar technology play at a wider scale in livestock and agriculture beyond irrigation? How its challenges can be associated?

Response: There are numerous challenges with respect to use of solar technology in agriculture.

- Shrinking landholdings with increasing population.
- Dependability is the question mark with seasonal variation in energy production of solar. There is no storage capacity.
- Sources of power – 72% groundwater is used for agricultural purposes. Groundwater is depleting and out of suction limits of tubewells.
- Initial investment cost is a big challenge.
- Technical expertise and knowledge gap in designing, sizing, and maintenance of solar pumps
- Policy and regulatory framework – lack of coordination among departments.

Solar technology provides numerous opportunities.

- Mitigate greenhouse gas emissions.
- Independence from unreliable grid and solar technology provides alternate income streams to the farmer.

Government can support solar innovative use in livestock, post-harvest processing, and value addition through targeted subsidies and financial schemes.

Mr. Omrane Derhy, R&D Electrical Engineer, Institut de Recherche en Énergie Solaire et Énergies Nouvelles (IRESEN), Morocco

Question: What are your views on the strategies to overcome barriers in solar irrigation systems adoption?

Response: Governmental ownership is pivotal. It is a top priority as water scarcity is a major threat. Moroccan govt. acknowledges the importance of solar technology and is committed to enhance SIP adoption through financial incentives i.e., subsidies and grants, infrastructure development, and collaboration with private sector for leveraging the expertise. IRESEN is a key player in supporting the national strategy under PPP to transform greenhouses into sustainable ones by integrating solar systems.

Ms. Khusbu Bisen, Executive at Professional Assistance for Development Action (PRADAN), India

Question: How innovative models of financing can better target small landholders and women farmers to improve community wide involvement?

Response: A holistic approach is needed. Different initiatives have different advantages, which are outlined below:

- Group financing approach provides community credit linkages for women farmers and reduces financial burden on single farmer.
- Micro-finance institutions – small loans at low interest rates.
- There is a need for increasing women accessibility to state government schemes like PM-KUSUM.

Systematic barriers from gender lens: landownership is a pre-requisite condition for accessing loans – 80% of women participate in agriculture but only 14% have landownership access in India. An affidavit from a landowner can replace land ownership condition for women. Capacity building training for women is also important for participation in solar promoting schemes. Partnership between govt. and private sector entities is important for creating a conducive environment by promoting competition amongst suppliers.

The pay as you go model provides flexibility, but it still needs to focus on socio-economic aspects while expanding such initiatives.

Ms Cindy Shigoli, Head of ESG, SunCulture, Kenya

Question: What are the challenges and opportunities of solar in off-grid systems?

Response: SunCulture provides innovative solutions of solar usage to small farmers as it provides guarantee to save costs with zero operational costs. Solar when coupled with drip irrigation enhances food security and water conservation through promotion of precision irrigation (drip). Partnership with farmers and SunCulture: improvement of 17 hours per week which can be used for doing other chores by farmers; solving problem of affordability is most needed as people are sensitive to cost. So, the subsidy program offered by SunCulture is two-tiered – couple business income with subsidy and carbon emission-based subsidy.

Question for all panelists: What can be the single most pivotal intervention that can be done?

Panelists and Responses :

Mr. Omrane Derhy

PPP mode ensuring capacity building and extending financial support to farmers for creating good market for people to adopt solar technologies and sustainable practices.

Ms. Khusbu Bisen

Government should provide incentives to private sector to design community-based projects and communities should be involved for monitoring of industries.

Ms. Ghazala Channar

Disintegrate groundwater rights with land rights so that no one is left behind especially marginal and landless farmers.

Dr. Nazmun Nahar Karim

Grid connected SIP can supplement farmer income and food security can be achieved

Ms Cindy Shigoli

Policy interventions (tax exemptions, permit exemptions) – enabling environment, robust policies, subsidies are critical for sustainable use of solar.

Dr Ram P Dhital

Dedicated fund for renewable energy to prioritize solar systems and encourage local organizations/governments demonstrate solar models and IWMI to partner for evidence-based policy generations to upscale the demonstrations

Question and Answer Session

Question: How Sunculture is accessing the carbon market?

Ms Cindy Shigoli: Approach farmers to sell our products while offsetting the use of diesel pumps, depending upon the use of that diesel pump we calculate the carbon emissions reduced.

Question: How is integration taking place in terms of ensuring PPP for financial assistance and capacity building initiatives?

Ms. Khusbu Bisen: There are MoUs signed of state government entities with private entities. Private companies are working on capacity building of poor farmers in remote areas.

Question: Solar pumps are pumping groundwater mostly. How can the solar pumping be moved to surface water or rainwater?

Dr. Nazmun Nahar Karim: Government is emphasizing the use of surface water and rainwater harvesting for solar technologies.

Question: How many pumps will be installed by 2030? Is there any central repository for pumps and their usage/analysis?

Ms Cindy Shigoli: 45,000 pumps have been installed so far and the data for the pumps have been collected; however, the data is not made public yet.

Key Takeaways from the Session:

- Silos exist between government departments. To offset adverse implications of unsustainable adoption of solar irrigation, a regulatory framework and well-integrated interventions are most important.
- Hybrid use of SIPs for domestic purpose apart from irrigation, can improve sustainability and community adoption.
- Coordination among public and private sector can lead to innovation that can be upscaled and for creating a conducive environment by promoting competition amongst suppliers.
- 80% of women participate in agriculture, only 14% have land ownership access in India. Limitation of landholding among women and lack of skills are two barriers that women face against participation in solar promoting schemes.

Panelists engaged in discussion at the session Photo credit: IWMI

Up Next: DAY 2 PARALLEL SESSION 5

Ms Cindy Shigoli (SunCulture, Kenya) during a Question and Answer Session
Photo credit: IWMI

DAY 2 PARALLEL SESSION 5

Title: Designing Effective Capacity Building Strategies for Solarizing Agriculture

Session Description: The objective of this session is to gather insights on designing effective capacity-building strategies for solarizing agriculture across three key domains. Firstly, discussions will focus on capacity-building interventions for implementation agencies, exploring strategies to enhance knowledge, skills, and resources of entities responsible for executing solar irrigation pump projects. Secondly, attention will shift to capacity-building interventions for the adopters of solar irrigation pumps, with a focus on smallholder and women farmers to adopt and utilize these technologies. Lastly, the session will delve into the implementation of innovative technologies for better governance in solar irrigation projects.

Moderator: Atul Dhir, Objective Lead - South Asia Regional Energy Partnership (SAREP), USAID

PRESENTATIONS

Design and Impact of Gender-Inclusive Capacity Building Interventions for solar farmers and technicians: Dr. Deepak Varshney, Regional Researcher, IWMI India

Climate change presents a formidable challenge to rain-fed agriculture due to erratic rainfall patterns, prompting a shift towards irrigated agriculture for more reliable water access. In India, with approximately 9 million diesel-powered pumps and 17 million electric pumps predominantly reliant on fossil fuels, the adoption of solar-powered irrigation pumps has surged significantly, from 11,626 in 2013-14 to 272,700 in 2020-21. However, key issues such as lack of awareness and knowledge, ineffective utilization, and concerns related to disadoption persist.

Recognizing the pivotal role of capacity-building initiatives, efforts are underway to address these challenges and drive improvements in awareness, efficiency, and the sustainable deployment of solar irrigation technologies.

Implementation Program

The Government of Gujarat introduced the Surya Shakti Kisan Yojana (SKY) in 2018, aimed at providing farmers with clean daytime energy for groundwater pumping in agriculture and generating additional income by selling surplus solar energy to the grid. Under the technical model, each farmer receives solar panels with a capacity 1.25 times greater than the contracted load of the pump. SKY farmers benefit from 12 hours of daytime power, while non-SKY farmers receive 8 hours. Additionally, a mobile app allows farmers to monitor their energy generation and consumption. The financial model includes a 5% upfront cost, with 65% covered by a loan guaranteed by the Government of Gujarat and 30% subsidized by the central government. Loans have a 7-year repayment period at 6% interest per annum, with a 25-year feed-in tariff set by DISCOM at Rs. 3.50 per kWh. Furthermore, the government provides evacuation-based incentives for the first 7 years, offering Rs. 3.50 per kWh up to a maximum of 1,000 kWh per year per horsepower.

In the evaluation approach, Randomized Control Trials (RCT) were conducted involving 43 feeders to assess the impact of the intervention. The implementation of the training program occurred in two phases: Pilot and Main. During the Pilot phase, training was administered across 7 pilot batches conducted at 5 feeders. Subsequently, the Main phase consisted of 59 training batches held at 41 different feeders across Gujarat, resulting in a total of 1723 farmers trained.

Result

The outcomes of the program include a 7% increase in solar energy generation, accounting for 10% of total energy consumption, with a net evacuation rate of 23%. Additionally, the training initiative resulted in a notable increase in farmers' income by Rs. 14,000 per year. Importantly, the return on investment from the training program was recovered entirely through the enhanced income generated by farmers within a single year.

Overall Learnings/Policy Implications across locations:

Bangladesh: Capacity building on sustainable water use is critical as solar use is scaled up, but only training is unlikely to be sufficient and needs to be complemented through incentives on sustainable water use.

Pakistan: Capacity building must be carried out for the future policy makers (i.e. students, faculty), private sector (i.e. vendors and technicians), farmers (both male and female) and finally for the water professionals and policy makers. This has been the approach followed by the Solar Pakistan component.

India: Significant returns on investment in capacity-building interventions, targeting poor-performing farmers yield better returns and there is a huge demand for such training programs.

Nepal: There is a huge demand for local technicians to support farmers in taking care of the SIP and has the potential for income/employment generation for them. The local technician could significantly reduce the O&M period for the farmers.

Overall, integrating capacity-building efforts for solar farmers, technicians, and government officials into solar programs and schemes should be a part of a strategy to enhance the success and sustainability of solar initiatives in the region.

Dr Deepak Varshney presenting on Design and Impact of Gender-Inclusive Capacity Building Interventions for solar farmers and technicians Photo credit: IWMI

Constraints in the capacity of the Government sector professionals to initiate effective public sector programs/schemes: Dr. Muhammad Ashraf, Assistant Professor, KFUEIT University, Pakistan

Dr. Ashraf set the context for the discussion by outlining the capacity constraints of govt officials in implementing public sector schemes. As far as capacity building components were concerned - knowledge, skills and attitude of stakeholders mattered significantly.

Methods:

Identified the primary stakeholders which included **farmers** (awareness, laser land grading and irrigation methods, operation of SIP systems, alternative use of Solar energy), **technicians** (On of SIP, design of SIP systems), **academicians and policymakers** (improvements in curriculum, students and policymakers to equip skills).

Field experiments:

Installation of SIP along with field trails, water productivity, and experimentation with different irrigation methods.

CB sessions and consultation workshops: precision surface irrigation, setting laser grading, solar system design for GW pumping, Role of IoT in flow rate measurements, sensors were deployed for flow rate analysis.

Results:

Higher water productivity seen using Precision Surface Irrigation Methods

Exposure visits and training sessions for farmers can help achieve sustainable groundwater use and adoption of the latest tools and technologies

Knowledge development for efficient design and irrigation application SIP

Skills development for efficient O&M

Resources Provision for timely and robust research activities

Learnings:

Successful SIP systems execution under conventional irrigation

Capacity building programs for the professionals working in public sector institutes for successful implementation of the SIP system

Capacity-building programs should include women's participation.

When we provide sensor technology to farmers, water productivity can be further enhanced.

Institutional and human capacity development for renewable energy programs: Mr. Seth Agbeve Mahu, Deputy Director, Renewable Energy, Ministry of Energy, National Focal Point (NFP) to ISA Ghana

He set the context by saying that the estimated solar installed capacity was 106 GWp and the goal was to reach 10 percent of energy from renewable energy by 2030, which is currently at 3.5 percent.

Approach of Implementation

Utility-scale renewable energy.

Distributed Renewable Energy (Net-metering, SIPs)

Off-grid SIP units.

Financing RE.

Design of Implementation

Step 1: Conduct a needs assessment, compile a list of stakeholders for consultation, and develop a framework for Capacity Building (CB).

Step 2: Conduct situational analysis through stakeholder consultations.

Step 3: Identify training institutions, develop curriculums and certification regime, Set up demo facilities for training.

Step 4: Conduct capacity building and short and medium-term training.

Step 5: Conduct tests and exams for the capacity building assessment, certify and license those who pass the examination, and License scheme for solar pump companies.

Results

34 facilitators, 165 experts trained in solar powered irrigation systems (SPIS) with 3 universities (KŇUST, UNER, HTU)

44 SPIS installed under Result Based Finance

Licensing scheme developed by Energy Commission

Project owners supported in renewable energy business development. Relevant technical performance standards on solar pumps and accessories identified and adopted as national standards for Ghana

Better regulation of the activities of solar pump installers.

Increased confidence in the solar pumping technology, leading to increased adoption.

Learnings/Policy Implications

Improved learning and education in decentralised RE

Licensing regime developed and operationalised for SPIS in Ghana

Mainstream the Public sustainable action plan.

Gender is key to the process of curriculum development and practical training; hence, gender aspects are inputs into curricula development and during practical training.

Specialised centres of excellence and solar technology resource centres were established.

Improvement in the need for energy in cost to subscribe, as well as increasing yields and SIPs, have shown.

Premium pricing for products to farmers is an incentive.

Questions

Q1. Most capacity-building programs focus on farmers, academia, and technicians, but often overlook agriculture service providers—who bridge the gap between technical experts and farmers—Is there any program that specifically addresses this aspect?

Q2. Which kind of flow measurement equipment have you used?

Q3. What are the implications of excess energy use, typically utilized for singular purposes, in the context of solar irrigation pumps? How can we explore allied uses to maximize energy efficiency and optimize resource utilization?

Dr. Deepak Varshney: Response

In the context of agriculture advisory, Dr Varshney emphasized how the efforts were directed towards collaboration with Krishi Vigyan Kendras (KVKs) to integrate agricultural extension agents and enhance their knowledge of solar technologies. The objective was to effectively disseminate this knowledge and scale up its adoption among farmers. However, a potential challenge lies in disadoption, in cases where farmers face financial concerns related to solar adoption. To address this, practical aspects such as financial considerations must be carefully examined alongside providing appropriate training, as farmers who receive adequate training are less likely to disadopt technological innovations such as solar solutions.

Dr. Muhammad Ashraf: Response

In the Pakistani context, individuals involved in providing technical guidance possess a strong technical background. However, to effectively enhance capacity building in this domain, there is a pressing need for integrated training program that not only focus on the technical aspects of system design but also emphasize practical usage. There are existing guidelines for designing Solar Irrigation (SI) systems, which are expected to ensure that stakeholders acquire the comprehensive knowledge and skills necessary for successful implementation and operation of solar irrigation systems. Additionally, in Pakistan, ultrasonic sensors were utilized for measuring flow rates, albeit calibrated in laboratory settings. This highlights the importance of ensuring accurate calibration procedures to maintain the reliability and efficiency of flow measurement instruments in real-world applications.

Panel discussion

Question: Based on experience, what critical gaps exist between stakeholders and farmers, and how can digital tools facilitate bridging these gaps?

Dr. Biswajit Roy Chowdhary, Director General, Gujarat Energy Research and Management Institute (GERMI), India: Response

The experience in Gujarat underscores the pivotal role played by capacity-building initiatives in agricultural electrification. With over 10,202 agricultural feeders established, including separate feeders for agricultural and non-agricultural purposes, GERMI's endeavour has reached approximately 97 feeders, benefitting over 4,500 farmers. Initially, farmers exhibited reluctance, necessitating active engagement from local panchayats to catalyse participation. Moreover, a notable barrier surfaced as many farmers lacked essential knowledge regarding solar infrastructure,

including shading and maintenance. To address this, GERMI incorporated digital solutions, leveraging platforms like the Unified Payments Interface (UPI) to develop an application disseminating informative videos featuring fellow farmers. The initiative yielded substantial dividends, with farmers witnessing a significant increase in income, averaging around ₹25,000 per month after loan repayment. Notably, the separation of feeders has mitigated inefficiencies associated with night-time electricity availability, thereby promoting judicious irrigation practices. This systemic transformation underscores the indispensable role of local communities and governance structures in fostering sustainable agricultural electrification initiatives. He also emphasized the role of local community and local governments in technology penetration.

Question: What role can the local government play in capacity building for farmers?

Mr. Surat Kumar Bam, Secretary, Ministry of Physical Infrastructure Development, Sudurpaschim Province, Nepal: Response

He mentioned that local governments play a pivotal role in capacity-building initiatives, particularly in the context of Sustainable Irrigation Practices (SIP). Operational and maintenance challenges often confront SIP projects, underscoring the critical need for effective local governance. Understanding the federalization of Nepal, project design should involve local government structures to foster a sense of ownership and to ensure project sustainability. Local governments serve as the foundation for establishing networks of SIP units, facilitating knowledge exchange, training, and awareness campaigns. Through asset mapping of SIP projects and the provision of licensing and regulation, local governments contribute to evidence-based planning, thereby enhancing project efficacy.

Local governments can also establish dedicated service providers to offer support and drive project implementation. However, the absence of a policy and regulatory framework for SIP projects poses a significant challenge, necessitating the formulation of sustainable and implementable policies within the context of the Water-Food-Energy nexus. Addressing these challenges requires dedicated mechanisms for water-food-energy security, necessitating comprehensive governmental efforts to bolster agricultural resilience. Emphasizing operational and management challenges underscores the focal point of capacity-building initiatives, where local governments play a crucial role in framing performance metrics, monitoring, and maintenance plans to ensure project sustainability and efficacy.

Question: How can extension services be integrated for farmers, and what is the role of women in capacity building?

Mr. Ashok Kumar Biswas, Deputy Project Director (SIP), Department of Agricultural Extension, Bangladesh

Mr. Biswas emphasized how integrating extension services into targeted Sustainable Irrigation Practices (SIP) within the current agricultural framework is essential for promoting sustainable agricultural development. He spoke about how women extension agents can play a crucial role in this integration by leveraging their unique perspectives and skillsets. Emphasizing SIP at every level of the executive body and engaging stakeholders in solar water pumping solutions is imperative. Developing a dedicated platform for executing extension services tailored to SIP is paramount, facilitating smooth technology adoption.

Drawing from Bangladesh's perspective, where extensive extension services have significantly enhanced crop production, integrating technical training with practical demonstrations is crucial. Extension services should be integrated with farmers' field schools, providing regular sessions to enhance skills and knowledge. Organizing motivational tours for continuous learning further enhances the effectiveness of extension services. Women extension workers can contribute significantly by focusing on areas like fruit and vegetable production, health, and nutrition, while also being trained in solar-related tasks such as cleaning and maintenance, thereby ensuring their active involvement in promoting sustainable agricultural practices.

Question: How can conventional knowledge sharing techniques be adapted for different groups (men/women/youth)?

Dr. Ruchi Badola, School of Ecodevelopment Planning and Participatory Management, Wildlife Institute of India: Response

Dr. Badola spoke about how traditional knowledge-sharing mechanisms such as women's groups and Self-Help Groups (SHGs) hold significant potential for enhancing awareness and capacity-building, yet effective delivery necessitates a clear understanding of the end objectives. In the case of SIP, resilience and economic well-being serve as primary goals. Identifying recipients and appropriate training methods are essential components of achieving these objectives. While the training predominantly targets male farmers, it's imperative to recognize that a substantial portion of rural farming is carried out by women, particularly marginal and smallholder farmers. Involving women in these programs not only humanizes the technology but also ensures household-level conversations and enhances acceptability. Leveraging existing networks such as cooperatives, NGOs, and local administrative bodies is crucial for widespread dissemination and adoption. Integration with existing systems promotes efficiency and avoids the need for creating new platforms. Furthermore, convergence between ministries and sectors is essential to bridge sectoral boundaries to achieve sustainability and resilience goals. Youth involvement and inclusivity in design and capacity-building processes are integral for scaling up efforts and ensuring long-term viability and equity within communities.

Question: What collaborative approaches and partnerships are needed between government, financial institutions, and the private sector?

Ms. Marwa Mejdoub, Energy Climate and Environment Lead, North Africa, Foreign Commonwealth and Development Office (FCDO), UK Government, Tunisia

She emphasized how the demand for capacity building should originate from those who require it, ensuring the success of initiatives. Local authorities hold significant importance in coordinating the efforts of various stakeholders, including technology providers, farmers, regulators, and decision-makers, to achieve collective goals. Clarity of objectives and effective moderation are essential for realizing these goals, even in the absence of expertise or ownership. Commitment, strategy formulation, and coordination suffice to attract international partnerships for financial support. Establishing working groups comprising stakeholders facilitates coordination and better synergy to sync different efforts. Project design should be tailored to local contexts rather than blindly adopting solutions from other nations' plans. Instituting mechanisms for data sharing enhances the sustainability of processes. Also, emphasis on building strategic pathways for financing is vital for scaling up Sustainable Irrigation Practices (SIP) effectively.

Summary Remarks

Addressing the challenges of operation and maintenance is crucial for the performance and scalability of sustainable irrigation systems. Local bodies and civil communities play a vital role in targeting these challenges effectively. The goal is to design inclusive strategies for both the design and implementation phases which includes building strategic approaches for financing to scale SIP effectively. By engaging local bodies and civil communities, not only can the operational and maintenance challenges be tackled more efficiently, but also the long-term sustainability and adaptability of these systems can be ensured. Strategic planning for financing is essential to overcome barriers to scalability and to establish robust mechanisms for the widespread adoption of SIP.

Panelists engrossed in key discussions on overcoming challenges for scalability of sustainable irrigation systems Photo credit: IWMI

Key Takeaways from the Session:

- Gender-Inclusive Capacity Building:
  Dr. Deepak Varshney emphasized the importance of gender-inclusive capacity-building interventions. Programs designed to include women farmers and technicians led to increased adoption of solar irrigation pumps (SIPs) and improved farmers' income. Training initiatives enhanced knowledge, skills, and efficiency in utilizing solar technologies, resulting in higher solar energy generation and economic benefits for farmers.

- Role of Local Governments and Communities:
  The involvement of local governments and communities is critical in implementing sustainable irrigation practices. Local authorities can facilitate knowledge exchange, training, and awareness campaigns, ensuring project ownership and sustainability. Effective governance structures are essential for promoting judicious irrigation practices and mitigating operational and maintenance challenges.

- Collaborative Approaches and Partnerships:
  Collaboration between government, financial institutions, and the private sector is vital for successful capacity-building initiatives. Local authorities play a key role in coordinating efforts and attracting international partnerships for financial support. Establishing working groups and tailored project designs for local contexts enhance coordination and sustainability.

- Incorporating Digital Tools:
  Digital solutions can bridge the knowledge gap between stakeholders and farmers. Platforms like mobile apps and digital payment interfaces help disseminate information and practical training to farmers, increasing their engagement and income. Digital tools facilitate better governance and monitoring of solar energy projects, enhancing overall efficiency and sustainability.

- Specialized Training and Licensing:
  Specialized training programs and licensing schemes for solar pump installers and technicians are essential. Training institutions, curricula development, and certification regimes ensure stakeholders acquire comprehensive knowledge and skills for successful implementation and operation of solar irrigation systems. Licensing schemes regulate the activities of installers, increasing confidence in solar technology and promoting wider adoption.

DAY 2 PARALLEL SESSION 6

Title: The Challenges of Considering Gender Equity and Social Inclusion

Session Description: To take stock of challenges encountered in policy and dissemination of alternative energy models (solar in particular) in the region. And to identify ways forward. Reflect on generic policy and methodology issues around GESI and Solar, as well as include a thought model for future solar work South Asia.

Moderator: Dr Darshan Karki/Dr Marlene Buchy, IWMI

PRESENTATIONS

Building capacity for GESI, but whose capacity? Dr. Marlene Buchy, IWMI Nepal

Dr. Buchy set the context for the session by saying that the time that women save - they don't utilize this time to make additional income. If they were aware of this, they would embrace the technology. The reality is different and there is a big gap between theory and on-field experiences. There are hundreds of projects focused on GESI though for a "GESI component syndrome"; only an additional aspect of the bigger project as opposed to being the objective.

The project design does not allow one to go back to GESI if it is not one of the laid-out objectives. These projects are designed by people who are based elsewhere, and the implementation is outsourced to a project team that tries to develop activities and they in turn rely on service providers. This leads to delays and there is a need for farmers to be trained.

There are two issues here – the training is only focused on the issues. The training is never about how to break down the hierarchy or how to challenge the system. The training almost always trains men and when women are targeted then also, the men come along because they want to know what is being talked about or what is being told to her. They want to control the narrative. The review of capacity development literatures suggests that across the globe, there is a problem with capacity development. A process is externalized, and decision is made for revealing what they don't know, and then decide what we are going to tell them, and how we are going to teach them, and it is most often designed by men who are based in urban areas. The idea is to ask uneasy questions – like what needs to change? Do we even know if they want what we're offering? What about the context in which capacity building programs are delivered? The technology transfer – context in which it is being transferred is the focus.

For example, in Surkhet – a solar panel was vandalized. Why would they do that? Was it due to conflicts within the communities. It is always important to understand the context. So, when are we going to shift our focus? When are we going to say we are interested in the effectiveness of solar irrigation as a human development strategy? Typically, we are leaving people out and then we ask ourselves how to bring them in. This is when GESI experts are brought in at the last minute. Also, there is a need to think about the user's theory of change and examine, what do they want to change?

Dr. Marlene Buchy making a presentation on Building capacity for GESI, but whose capacity? Photo credit: IWMI

Building capacity for GESI, but whose capacity? Ms. Angel Konthoujam, IWMI India

She set the context by asking some hard-hitting questions. So, how do we avoid gender blindness in program design – specifically regarding renewable energy access? What are the prerequisites to reduce gender inequalities? How do we promote equal participation of men and women as decision makers. The focus is on women's participation but there is very little focus on gender equality. We focus on women beneficiaries and giving them the tools to do better; however, we are not being able to provide them the space that they require to implement these tools.

There is a need for multi-sectoral engagements; the fee for service model gives 13% equity. Lack of finance is a major barrier, and the other barriers include access to land, and socio-cultural barriers. Also, there are service provider barriers and addressing this is a low-hanging fruit. There is a unanimous agreement that there were no socio-economic issues in the men's Focus Group Discussions (FGD), yet the women need to seek permission for out of house and finance-related decision. Also, there is no equal pay for the same amount of agriculture work done by men and women. The more economically advanced a household becomes, the challenges for women increased. Women had more financial autonomy when male members migrated to other parts of the country/world.

Also, social network plays a very important role. Out of the 5 slots which were taken, the women who got those slots had a strong social network. Almost all of them handed over their earnings to their husbands. The decision-making power is inversely proportional to the household decision making power. The other barriers included economic access, socio-cultural barriers and lack of sex-disaggregated data, female extension workers, land resource data, etc.

Panel Discussion

Ms. Shula Kasongamulilo, GESI and WASH expert, EU's Nexus Energy Water Programme, Zambia

Speaking on the service provider barrier, she said that service providers typically focussed on profitability and the human rights approach adopted was a waste of time. Typically, the women's group is not homogenous, all are women but there are differences that need to be factored in and solutions customized according to context.

Dr. Bharat Pokharel, GREAT International, Nepal

Dr Pokharel built the context by speaking about the way that they have been brought up which includes natural resource scientists and academic institutions that plan a positivism within their students. Science becomes a big political weapon, and this is neither well recognized nor challenged. Also, the dogmatic behaviour of the scientists is a huge issue. Another issue is data and the idea of GESI is limited to intrahousehold power relations in "powerful" and "powerless" terms. The real issue of intrahousehold dynamics needs to be considered as an important conceptual framework. Also, there is a layer of hypocrisy involved where powerful jargons camouflage the change agent. There is a need for a political and GESI lens to examine the natural resource projects: solar isn't a solar power irrigation system development so how do we use this as an entry point for the bigger goal of GESI?

Dr. Seira Tamang, Independent Researcher & Political Economist, Nepal

Dr. Tamang spoke about the need to go back to basics since project development does not happen in a blank slate. New interventions happen in a social context that is already controlled by other interventions. It is critical to understand this context and in terms of GESI, it becomes even more critical. For Water user group coordination committees – we need capacity building, and we are not being able to unify this. The chair of the committee for 30 years is from an elite group, middle-caste biggest landowners in the terai region who are influential in a certain way. So, there is a need to understand the role of power.

Ms. Shreya Chakraborty, Researcher, IWMI India

She spoke about how the social context is the mould of the project and it always fits into this mould. This needs to be acknowledged right from the beginning. Also, she mentioned that needs assessment is more of a checkbox list – however what needs to be done is more than just a list. There is a need to ask - what can you change and what can you not? Do you want to be responsive to this context or do you want to be transformative?

As far as women beneficiaries are concerned, women are not there in the farms a lot, so a conscious decision was made to take solar to them instead of forcing them into our pre-decided moulds. The need of the hour is to design an approach that brings them to the farm, understand the current context and then examine, what needs to be changed?

Dr. Novaira Junaid, Economist, IWMI Pakistan

She raised a pertinent question as to the need to define what is active participation in terms of GESI? In Pakistan, the current definition is limited to domestic chores as an informal employment since most of the day is spent on household chores. Feminization of agriculture is a reality. However, gender equality as a dimension of solar comes in the end. To capture the role performed by females, both inside and outside homes, it is imperative to refine the present definition of employed and unemployed females as provided in the official documents. The definition considers female's domestic chores as part of the augmented labour force, thereby subsidizing their efficient role in the labour force. Therefore, such home-based tasks should be listed amongst other industry divisions for counting their actual participation and people should be capacitated to understand this significant contribution to the society.

Mr. William Ponela, CEO, Zonful Energy, Zimbabwe

At the outset, he mentioned how most of gender-related issues stems from how the programs are designed right from the beginning. Access to energy affects people differently even within the same household. As far as irrigation is concerned, only water access does not help women because they still need to travel a lot to provide water for the kitchen. There is a need for a call on demand where women can ask for service and it should be available in different languages. Also, there is a need to do resource mapping before coming to a solution. He also mentioned that one of the issues is we know what we need to do but we are not doing it since we do not advocate for co-creation. The better process is when beneficiaries come together to co-create a project. Also, he mentioned that the world is changing very fast, and the needs of women today is very different to what it was 5 years back. The co-creation process incorporates the possibilities of these changes.

Question to the Panel: Solution and Recommendation to Donors and Colleagues

Panelists and Responses :

Shula Kasongamulilo

The culture is upheld in rural areas especially in low literacy areas hence, it is critical to understand power relations. Once the power equations are clear, since gatekeepers feel like they will lose their power if they allow for certain things to happen, it is important to shed light on what these gatekeepers will also gain. Declaring one's income to their husband is important in this regard. For example, the rural provinces local authorities were informed about the intention of the research aimed for disabled people and as such, the representatives showed up. The community feels like they need to be represented, and there is a need to be tactful in our approaches and to bring different skills at play. It is important to get to the bottom and understand why things are a certain way. The fundings make it difficult and buy-ins need to be challenged. Hence, it is important to find a point of intersection where we can identify what we want and what the community wants.

Bharat Pokharel

Dr. Pokharel mentioned that there is a need to disaggregate, since there are many champions in different areas, particularly at political and bureaucratic levels but we tend to keep all of them in a common basket. Hence, it is important to identify champions (from grassroots to higher levels) to build an alliance as an agent of change and it is important to take cognizance of the demand and supply side of governance.

Seira Tamang

She rued the fact that most development organizations work in a tunnel vision making alliances that are temporary. She quoted the examples of 2002 Abortion rights and the equal inheritance rights that came into operation recently. Donors working strategically to align their projects to support these initiatives even when their projects were not focused on the issue – an example of how alliances can work.

Shreya Chakraborty

She spoke about two major issues - Hierarchy and finances. Hierarchy is a major issue, both disciplinary and sectoral hierarchy. Also, there is a lot of talk about co-creation, but it does not happen. One form of science is considered superior to others and therein lies the problem. There is a need to talk of capacity building as opposed to capacity sharing. As far as finances is concerned, these are some of the issues - Are we trying to understand why something is happening? Do we just want to change the overlying indicators? Or do you want to limit women to being beneficiaries as opposed to being partners? Also, there are underlying limitations to how deep a project can go. Do we just focus on systemic issues?

Novaira Junaid

She mentioned that the lopsidedness of the current universal economics owes its existence to the fault line as in truth and projections, economics has not been able to incorporate the very understanding of humane dispensation. Therefore, the need of the hour is to undertake interventions that are culturally sensitive and responsive to local needs. Additionally, she talked about the need to integrate gender-responsive budgeting practices to ensure that resources are allocated equitably and effectively to address the needs of men, women, and marginalized groups. This also involves analysing budget allocations to identify any gender disparities and reallocating resources as needed.

William Ponela

He spoke about how gatekeepers are also beneficiaries and decision makers (they also have additional roles). Merely making smartphones accessible to women means access to digital services, hence, there is a need to have plans that are more suitable for women.

Question from the audience

There are many challenges related to political activism: so, who is our audience and what is our limitation in that regard?

Consulting with communities – isn't there a risk of existing inequality to influence?

Response

There is a need to think politically. Gatekeepers in development – from HQ to the village level who gatekeep information need to be scrutinized. The discussion centred around behavioural issues. Markets have transformed and how pilots have led to value chain frameworks and how are markets incentivizing it? Most products designed are not made in relation to gender equity, especially irrigation and solar home systems. There is a resistance from family to buy that because at the time when the father has gone for leisurely activities, who will look after the solar system? This was an issue for them so there is a need to ensure that the host community benefits from them.

Within program structures, there is a talk about gatekeeping and how it is perceived to be at the community level; frontline team most exposed; what has been achieved through various research or data. Program design gaps exist but what about the policy gaps? E.g. PM KUSUM: entire country is to be solarized so the question is how to bring in women to policies that are already existing. For GESI to be at the core as opposed to being the add-on: same as the situation back in 80s/90s still. Patriarchy and hypocrisy; feminization of agriculture – concern that burden shifting to women – additional responsibility; new technology for women – additional burden; patriarchal view – all this needs to change. Solar irrigation system as a tool to position and empower women (societal view) to transforming into a technology that can reinforce their autonomy is yet to be seen. For this, women need to be targeted in the policy design.

Moderator Remarks

"There is a need to understand the context: Many years we have been working on this so what is it that we don't know, what is it about us that keeps reproducing this? Gender transformation burden is still left on GESI practitioners and experts. E.g. Access to land is tied to political laws, but we don't even consider that when we think about GESI. Our incentives are completely based on irrelevant criteria in relation to community development and GESI.

Key Takeaways from the Session:

- Most of the projects suffer from "GESI component syndrome"; where GESI is only an additional aspect as opposed to being at the heart of the project. As a result, it is difficult to come back to it later and there is no real space for it to be addressed. The gender transformation burden is often left on GESI practitioners and experts.
- Often blanket terms are used - women, youth, disabled, etc. It is critical to consider that each of these groups further have their own diversities and complexities.
- Project development does not happen on a blank slate. New interventions occur in a social context that is already controlled by other interventions; therefore, it is critical to understand the socio-political context of the targeted area, especially in relation to power relations while developing a project.
- Most development organizations work with a tunnel vision; Making alliances that are temporary for a longer role rarely comes into being; Strategic alliances are critical to leverage legislative and political changes.
- Hierarchy – both disciplinary and sectoral hierarchy are major issues. Some forms of sciences are superior to others. Therefore, we keep talking about co-creation, but we are not doing it. Dogmatic behaviour of the scientists a huge issue.
- Science a big political weapon. This is not well recognized and challenged
- Need to externalize the process of project development – we tell the targeted beneficiaries what they don't know, and we decide what we are going to tell them, and how we are going to teach them. We need to consider whom we are talking to within the communities; Does it really reflect the real needs and issues? (Gatekeeping)

DAY 2 PARALLEL SESSION 7

Dr. Azeem Shah (IWMI) handing out a Token of Appreciation to Mr. Kifayat Zaman (Federal Water Management Cell, Pakistan) Photo credit: IWMI

DAY 2 PARALLEL SESSION 7

Title: Scaling-up Solar Irrigation: Lessons from Policy

Session Description: The objective of the session is to identify policy pathways for sustainably scaling up solar irrigation while protecting our groundwater aquifers. The session will have three keynote presentations highlighting government initiatives in Nepal, Pakistan and India followed by panel discussion of the learned delegates from multiple regions.

Moderator: Dr. Azeem Shah, International Researcher, IWMI Pakistan

PRESENTATIONS

Prime Minister's National Programme for Solarization of Agriculture Tubewells in Pakistan: Mr. Kifayat Zaman, Director General, Federal Water Management Cell, Pakistan

Mr Zaman set the context by speaking about the huge protests and greater demand from farmers to solarize the tubewells. He spoke about Pakistan having one of the largest contiguous irrigation systems in the world, though the canal water meets only half of the requirements at the farm level. As such, there is a plan to train 200,000 farmers to operate solar irrigation technology. Along with that, there are plans afoot to have carbon credit facilities with the help of the federal govt. There will be steering committees for monitoring these projects. The main objective of these projects is to reduce cost of crops. This was taken seriously because of people's movement that happened recently. There is an aim to reduce fuel oil import bill as a direct consequence of these projects. There is a prediction to reduce oil demand by 1.7billion kwh per year saving around $71 billion. He also talked about 30% input costs and frequent electricity shortfalls. The outcomes of solarization of tubewells led to electric power demand reduction by 1.7 billion Kwh/year (0.78 million tonnes; expected carbon credit = USD 15 million/year).

Scaling-up solar irrigation for inclusive livelihoods and food security: Lessons from GESI review of policies: Dr. Manohara Khadka, Country Representative, IWMI Nepal

She spoke about how SIPs were emerging as a promising technology solution in solarizing agriculture. She emphasized on women as being key actors in the adoption and scaling of SIPs. Dr Khadka took cognizance of the inequalities and knowledge gaps at present. She also mentioned that without enabling environments, it was difficult to reach smallholder farmers and women. First, there's a need to look at the constitutional national framework and then the sectoral policies. She also questioned if the water policies were truly gender-transformative (gold standard)?

She also talked about the gender continuum scales, limited understanding of GESI and mentioned that constitutional and national policies talk about inclusion; however, sectoral policies need more work. Agricultural policies are GESI-responsive but the energy policy (Bangladesh, Pakistan): GESI missing though it was there in Nepal. A major focus is on the physical resources. GESI understood only as "women" and not looking at women as an agency. Criteria is not gender-responsive since there are citizenship issues, land ownership issues, and there were only 22% women recipients in Nepal.

PM-KUSUM: Key achievements and lessons learnt: Dr. Deepak Varshney, Regional Researcher, IWMI India

He quoted the statistics that 9 million out of 26 million water pumps in India are diesel-powered and SIPs could reduce CO2 emissions by 26 million tonnes. Implementation of 5 million SIPs in the country. Out of 26 million water pumps in India, 9 million are diesel-powered, and 17 million operate on electricity, primarily from fossil fuels. In India, there has been a significant increase in solar-powered irrigation pumps (SIPs), rising from 11,626 units in 2013-14 to 272,700 units by 2020-21. Replacing five million diesel pumps in India with SIPs could reduce CO2 emissions by an estimated 26 million tons (Agrawal and Jain, 2018).

Adoption of SIPs in agriculture has the potential to decrease demand for subsidized power, offering an opportunity to reduce recurring subsidies to utilities. Under the mission, the promotion of solar irrigation pumps has been done under two schemes, namely, the Solar Pumping Program for Irrigation and Drinking Water (capital subsidy of 30% from central government with an equal share of state government) and Capital Subsidy Scheme for Solar PV Water Pumping Systems for Irrigation Purpose (a minimum of 20% contribution to be eligible for assistance).

Talking about the PM KUSUM scheme, he said that it was demand-driven and open for all farmers of the country for implementation as per guidelines issued for the Scheme. All components of the scheme aim to add a Solar capacity of about 34,800 MW by March 2026 with a total Central Financial support of 2 34,422 crore. Off-Grid SIPs: Installation of 1.4 million Stand-alone Solar Pumps in off-grid areas. On-Grid SIPs: Solarisation of 3.5 million Grid Connected Agriculture Pumps through Individual Pump Solarisation and Feeder Level Solarisation. The beneficiaries could be individual farmers, Water User Associations, Primary Agriculture Credit Societies, and Communities/Cluster Irrigation Systems.

Financial assistance under PM KUSUM.

1. Individual pump solarisation under off- and on-grid

CFA of 30% of the benchmark cost issued by MNRE or the prices of the systems discovered in the tender, whichever is lower is provided. In addition, the respective state/UT has to provide at least 30% financial support. Balance cost is to be contributed by the beneficiary.

2. Agriculture feeder solarisation

For agriculture feeder solarization, a CFA of Rs 1.05 Crore per MW is provided. There is no mandatory requirement for financial support from the participating State/UT. More than 60k SIPs installed under PM KUSUM in Rajasthan. 13639 out of 45778 villages reached.

Key Implications

- Feeder-level solarization is the preferred choice for achieving large-scale solarization of existing electric pumps. However, this approach lacks a direct incentive for saving energy and water.
- Individual grid connected SIPs help boost farmers income by selling excess energy back to the grid
- Off-grid SIPs serve a vital purpose in remote areas where establishing electricity connections is challenging.

Question for Panelists:

What are the pathways through which governments and stakeholders can build a favorable environment for the market-driven scaling up of SIPs, leading to widespread adoption of SIPs?

Mr. Sanjeeb Baral, Director General, Department of Water Resource and Irrigation, Nepal: Response

- SIPs should be integrated with solar pumping systems; not just water management
- Supply side: Energy policy: Where are we installing it? In the higher Himalayan region, where electricity supply is difficult and bringing diesel pumps is difficult. Electricity cost very high. Solar very efficient here.
- Demand side: For marginal agricultural lands in remote areas: bringing new agriculture practices is vital to stop migration from rural to urban areas. Such technologies need to be pushed here.
- Integrated energy and water management project: What kind of subsidies are available here? Are they appropriate, sufficient?
- Agriculture side: recently approved irrigation policy - to provide reliable irrigation in such areas: 450,000 hectares of land identified.
- Areas of reliable electricity; hydropower and water potential huge in Nepal; solar might not be viable. Electric pumps last longer than solar pumps.
- Terai region: GW resources enough: what kind of regulatory framework exists? We do not have a regulatory framework to control GW installations and over-extraction of GW.
- Capacity: Important for installation as well as operations. Remote areas: who will replace it?

Question: We have seen in Pakistan that the groundwater share for irrigation has been increased to more than 50%. With solar, it is further expected to increase. How can we sustainably promote solar in Pakistan provided we have all off-grid pumps? So, the question is how can we ensure current model works?

Dr. Muhammad Ashraf, Ex-Chairperson, Pakistan Council of Research in Water Resources (PCRWR), Pakistan: Response

- Solar energy is termed to be indefinite; which will ultimately lead to groundwater depletion is an ongoing debate.
- Solar runs for 1-1.5 hrs; summer season: 8 hrs; winter: 3 hrs
- Concept of intermittent pumping: IWMI provided evidence that it will ensure there is no GW depletion; promotes GW replenishment;
- Vulnerability index: Hotspots; whether to install a solar pump; role of GW regulatory policies comes in
- Our policies: water, cc, any policy - talks about management of GW sources
- Regulatory framework well implemented as we do not require separate policies.
- No evidence yet if SIPs are leading to GW depletion.

Question: Looking at the rapid expansion of the SIP technology, how can India promote SIPs in a sustainable manner?

Dr. Priyabrata Santra, Head, ICAR-CAZRI, India: Response

- Recounted the difficulties faced by farmers and quoted the successful programs ongoing in Rajasthan
- Science paradox: Limitation of energy and water: both inversely related; energy available = water limited;
- Solar energy plentiful; in drylands this availability is high;
- Solar SIPs installation in high areas of water;
- Solar IP system: an integration of several things; pumping, irrigation, water efficiency technologies: all included in one system; for proper out-scaling - important to capacitate farmers.
- Follow-up after installation of SIP systems; what irrigation methodologies do we adopt; what is the income being generated
- Breakeven period can be lowered
- Installer forgets; single difficulty comes - issues with ownership; only if company people come, they will rectify the issue; farmers always wait for them.

Question: What is your experience of SIP adoption in Africa? Do you see any barriers and policy pathways to help promote SIPs?

Dr. Frehiwot Woldehanna, ISA Focal Point for Ethiopia and Head, Center of Biomedical Engineering, AAiT-AAU, Ethiopia: Response

- No single comprehensive policy that covers all aspects of solar irrigation pumping
- Tax exemption policies: most solar technologies are tax-free now, and that is very encouraging.
- Excess energy utilization: connect to grid; feed-in tariff; but no such policies present yet.
- Access to finance a challenge; not only for the private sector but also for the farmers; a proper mechanism to take in this
- Solar lighting systems fail in a short time; a bad image; damage is more serious
- O&M capacity building: should also be supported by the community itself; sufficient community members required to maintain it.
- Awareness creation across all stakeholders.

Question: How do you see Bangladesh sustainably promoting solar based irrigation and which policy instruments are required to support this transition?

Mr. KM Ali Azam, Deputy Director, Renewable Energy (SoLAR), Sustainable and Renewable Energy Development Authority (SREDA), Bangladesh: Response

- 50% grant for SIP: competitive with diesel pumps now but not with electric pumps;
- Access to energy in Bangladesh is at 100%; end-users more interested in getting electric pumps

- Business models should be lucrative to the end-users. Should access carbon credit facilities for farmers.
- Only 4 months; 8 months: alternative use of water use and electricity
- GRID integration guideline for SIPs.
- Access to finance important; subsidies help but farmers are still struggling with upfront cost
- O&M: Interested only in installation; we forget about operation costs
- Capacity building: A must to acquire knowledge.
- We need effective policies; techno-advancement important for us
- Financial Innovation

Question to the Panel: What are the major considerations from the donor perspective for supporting SIPs promotion in different regions?

Panelists and Responses :

Divya Sharma

We look at SIPS through an energy transformative perspective. SDC is not prescriptive about technologies; instead, the technology is decided by the partners based on what works in their context. SDC aims to look at various options and help partners make informed decisions. Inclusion is critical. The principle of "Do no harm" should be followed, meaning the technologies should not cause damage to the ecosystem, country, or communities. There is a strong emphasis on never promoting a particular technology for its own sake; there must be demand, interest, and viability.

Sanjeeb Baral

The focus should be on the demand side, specifically expanding irrigation requirements for agriculture in areas without service water sources to increase agricultural productivity. It is important to consider the existing cropping patterns in these areas and how farmers will benefit from using solar pumps, which could help increase the market for solar pumps. SIPs should be built in a hybrid mode to serve other household uses. It is crucial that farmers are willing to invest in and maintain the SIPs.

Muhammad Ashraf

At the federal and provincial levels, and among donors, there is a concern about low-quality materials being used for the installation of SIPs, with 27% of the installed units being non-functional. There is a need to standardize the equipment, and it is the government's responsibility to ensure proper quality. Capacity building is essential; while farmers can be trained, they cannot handle troubleshooting. Therefore, a service provider with the necessary knowledge, skills, and spare parts should be in place. Priyabrata Santra

Priyabrata Santra

When installing SIPs, it is important to consider ecosystem balances. SIPs should benefit farmers without affecting the ecosystem balance. The quantity and quality of groundwater resources need to be considered, and feasibility studies should be conducted. The installation of isolated microgrids in remote areas is planned, with a model that includes SIPs. Off-time utilization of SIPs, including the power generated from these pumps and value addition, should be explored, and farmers should be provided with subsidies.

Frehiwot Woldehanna

The goal is to develop sustainable and equitable use of groundwater resources. The government is committed to installing over 3600 SIPs under one of the programs, with feasibility studies ongoing. However, continuing this momentum without a comprehensive water use policy could pose issues in the future.

K.M. Ali Azam

There are twelve lakh diesel irrigation pumps, but only 4000 SIPs have been established, with 1500 of these by IDCOL. The SIPs range from 35-35KW, indicating that a significant intervention is required to transform diesel irrigation pumps to SIPs. By 2030, an additional 15,000 SIPs will be installed. The aim is to reduce the import of fossil fuels, considering the high population. As a result, rooftop net meter solar is a priority for Bangladesh.

Divya Sharma

Afghanistan has the most SIPs in the world and does not provide subsidies. Without electricity, SIPs are the only option. In Pakistan, 80% of SIPs came from the market, and 20% from subsidies. Policies should not be prescriptive but should provide broader direction. The energy outlook continues to drive SIPs, which are not only for climate benefits but also for food, livelihoods, and social benefits. Various business models are available, with countries transitioning from 100% subsidies to 60%, indicating a gradual shift.

Audience Discussions

Project has been designed with several layers of mitigation. Sites with groundwater recharge selected. Decline in GW was due to electric power. Proper system designed as per the data. We have assigned the provinces to work out the depth of the water withdrawn as well as the pumping mechanisms. Sites being selected according to the data.

Subsidies based on reserved seats. Should subsidy be encouraged for the adoption of SIPs. What about other aspects of the value chain?

Business model that focuses on need for subsidy for farmers, state, public and private actors need to be accounted for. Subsidies is critical since it is dedicated to enable single-holder farmers over shared cropping basis. Subsidies should not entirely be replaced by markets.

Rajasthan - Jaisalmer adopting the highest water availability; synthesis of the use case of the pumps; scenario. Overall cost modelling; irrigated areas have lesser adoption of pumps - interesting. Planning a field visit to better understand this.

Every department has their own goals and objectives backed by policies. Missing link is when we talk about formulation and implementation of the policies. What needs to be done? Always a challenge: a common point - all policies talk about groundwater management and the establishment of a GW regulatory framework. This will address multiple issues. Where to install it? What size? What gaps are we addressing?

Automate water quality issues hence, multiple policies need to be explored and how the silos can be broken; for all kinds of development not just SIPs; things are happening; How can we now take it even further and broaden this engagement? World Bank, Asian Development Bank, Green Climate Fund

(GCF) still reluctant to come into this business. What should be done to bring more evidence to them?

Important to also talk about co-benefits; livelihood benefits; food security and access to water/energy to strengthen our arguments. Viability: how will we be able to decrease subsidies? Green credit: interesting yet challenging

Farmers: are they really benefitting from SIPs? Are there any policies or requirements such as price guarantee that can make the SIPs more viable in the future?

Dr Azeem Ali Shah moderating the session with the panelists Photo credit: IWMI

Key Takeaways:

- Access to Finance: Access to finance remains a significant challenge for both the private sector and farmers. A proper mechanism to ensure increased access to finance should be established. While subsidies are helpful, farmers still struggle with the upfront costs.
- Capacity Building: There is a notable absence of specific solar policies. Capacity building is essential, but farmers cannot be solely relied upon for troubleshooting. A service provider with the necessary knowledge, skills, and spare parts should be in place to support ongoing operations and maintenance.
- Groundwater Regulation: Regulatory frameworks play a critical role in controlling SIP installations and preventing the over-extraction of groundwater. Although there is no evidence to date that SIPs lead to groundwater depletion, intermittent pumping has been shown to promote groundwater replenishment.
- Operations and Maintenance (O&M) Capacity Building: O&M should be supported by the community itself, with sufficient community members trained to maintain the systems. There is often a focus on installation, but the costs and logistics of ongoing operations are frequently overlooked.

Ms. Divya Sharma (SDC) during a Panel Discussion Photo credit: IWMI

DAY 2 PARALLEL SESSION 8

Title: Sizing Solar Irrigation Pumps – A Simple Tool for Nepal

Session Description: This session will launch a new solar irrigation pump sizing tool jointly developed by IWMI and the Indian Council for Agricultural Research (ICAR) with support from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and as part of the collaborative initiative SE4RL (Solar Energy for Rural Livelihoods). The new tool, designed specifically for use by the Alternative Energy Promotion Centre (AEPC) and provincial governments in Nepal will be presented and demonstrated.

Moderator: Shilp Verma, Deputy Country Representative, IWMI India

PRESENTATIONS

Lift Irrigation Potential and Need of Solar Powered Irrigation System (SPIS) Design Tool in Nepal: Mr. Manoj Pantha (Under Secretary, MoEWRI, Nepal)

Mr Manoj highlighted the potential of lift irrigation and why there is a need for solar water pump sizing tool. Solar energy and irrigation requirement are synchronizing each other in Nepal. Considering the geography of Nepal, it has huge potential to scale up Solar Lift Irrigation. More than 120,000 Ha of land in Hilly area is suitable for solar lift irrigation. But due to lack of system sizing and planning tool, an allocated budget for solar lift irrigation system is either too low or too high. Lack of knowledge in design and cost estimation are the additional challenges. Hence, there was a need to have a comprehensive Solar Powered Irrigation System Design tool for Nepal.

Solar Water Pump (SWP) Sizing Tool for Nepal: Mr. Kushal Gautam (GIZ POSTED)

Kushal Gautam presented the technical details of SWP tool. SWP tool is an excel-based tool prepared with integrated crop water requirement tool. The tool is specifically designed for the use of AEPC officials to know the appropriate size of pump required and cost for the installation at field level. AEPC will guide all levels of the government which can use this tool for planning. The tool requires minimum input data such as, beneficiary and system designer information, crops, system head, balance of system and any additional components. The limitation of the tool is that it is not a detailed design tool. Its design philosophy is to help its user estimate SWP costs for budget planning with as little user input as possible.

After the technical presentation of SWP tool, Dr. Santosh Mali (ICAR) demonstrated the excel based tool. He noted that the tool is user friendly and is used with minimum data requirements. Grid-wise data is incorporated to estimate crop water requirement. Ground reality-based cost of pump can be estimated using the tool. More than 200 market available pumps dataset is used on the backside for precise estimation of pump size.

Session Chair Remark: Dr. Laxman Prasad Ghimire (AEPC, Nepal)

Mr. Laxman Ghimire in his remarks said that the tool will assist AEPC for planning and managing the large demand of solar irrigation pumps and is more relevant for smaller size of system. AEPC provides subsidy to smaller system. There is already an existing demand of 2000 SWP's. After the complete development, the tool will be populated on the AEPC website for use of local government. We will work together in the future as well. The session was very productive session for AEPC officials.

Key Takeaways from the Session:

- Nepal has a huge potential in lift irrigation system as the 120 thousand ha irrigable area found to be suitable for solar lift irrigation. But to plan a budget, there is lack of system sizing and planning tools because of which allocated budget for solar lift irrigation system is either too low or too high. Hence, there is an urgent need for a simple but robust solar water pump sizing and planning tool.
- In the session, the beta version of an excel based 'Solar Water Pump Planning Tool for Nepal' collaboratively developed by IWMI, ICAR and GIZ as part of the Solar Energy for Rural Livelihoods (SE4RL) initiative was introduced. The tool was officially launched for use by the AEPC and Provincial governments in Nepal. The simple and user-friendly tool will help local government and other stakeholders to quickly estimate the system costs for budget planning.
- Feedback and suggestions for further development were invited and discussed. Some of the suggestions included - improving provision for determining multi-stage pumping systems, inclusion of scenarios for deficit irrigation, building-in design of multiple use solar pumping systems and incorporating estimation of surplus energy available.
- In the session Chair's concluding remarks, AEPC appreciated the developers' efforts and lauded the productive session and discussions. As the demand for solar water pumps is growing, such a tool can help plan for decentralized solar systems. After incorporating the suggestions received, the tool will be field tested and validated with the help of AEPC and local government.
- Once finalized, the tool will be hosted on the AEPC website. The tool will also be bilingual (Nepali + English) and with help from IWMI and ICAR, a user manual will be developed for AEPC and all other users.

DAY 2 HIGH LEVEL PLENARY SESSION 3

Title: Opportunities South-South Learning and Cooperation

Moderator: Dr. Henry Roman, Country Representative, IWMI -Southern Africa

PRESENTATIONS

Solarization of agriculture: A global synthesis on progress, lessons, and opportunities: Mr. Shilp Verma, Deputy Country Representative, IWMI India

Mr Verma spoke about South Asia being discussed at the forum but mentioned about the tremendous potential in North Africa. IWMI has been tracking data on what's happening with top solar countries and what's happening with solar pumps specifically solar pumps deployed for use in agriculture. Data tracking has been done up until 2019 which is just before IWMI took off in India. The total global installation of SIP deployed for use in agriculture was only 13 megawatt and most of it was still in India and Bangladesh was next, the whole of Africa had less than one megawatt. The most recent data available is for 2022 where we have crossed one gigawatt, one gigawatt in India by 2021, Bangladesh has already reached almost 15 megawatts. Africa, which was less than one megawatt earlier, has already gone up to 26 megawatt and most of it has happened over the last 4 or 5 years.

He quoted examples of Egypt and Namibia which are examples of two-star solar countries in Africa which are almost clearing one megawatt of installation. This is almost as much as what the entire Africa had in 2019. Bangladesh is dominated by diesel but Pakistan is denoted by bigger dots because the average pump size in Pakistan is 20-25 HP whereas the average Indian or Bangladeshi Pump is 5HP.

Mr Verma mentioned doing a study for ISA, where a very rough-cut estimate for what would be the size of the solar market for the entire region to be solarized needed to be arrived at and quoted figures of $20,000,000. There is much to learn in South Asia from each other but there is also potential to look beyond this region for the big picture.

He also explained the situation for India - out of 26 million water pumps in India, 9 million operates on diesel and 17 million operates on electricity. From 2013-14 to 2020-21 the number of solar pumps in India has increased from 11,626 to 272,700. Replacing 5 million diesel pumps in India can reduce CO2 emissions by an estimated 26 million tons. Farmers can use SIPs to reduce irrigation cost and to sell surplus electricity to the national grid and promote ground water sustainability.

India can use the advantage of cost effectiveness of solar to meet its target of 450GW of renewable energy by 2030. PM KUSUM is one of the many schemes put forward by the government to incentivize the farmers to switch to solar power.

Moderator Remarks:

Solar energy is an excellent renewable energy source, and it has the potential to act as the major power source for irrigation in remote and rural places of the African continent.

Panel Discussion

Question: What is the situation of solar irrigation in Africa in comparison to South Asia?

Ms. Divya Sharma, Deputy Head of Cooperation, Swiss Agency for Development & Cooperation (SDC): Response

The South Asian region has taken initiative to develop solar irrigation infrastructure however Africa is yet to do so. It is important to create a global platform for widening the outlook of involved personnel and sharing knowledge. Collection of data and statistics is also important to consider during policymaking of the countries. She said that there is a lot to learn also from the South-South cooperation in terms of what business models, which approaches, strategies – these learnings need to be curated in a knowledge platform. Also, consider what are the positives and challenges, this will lead to helping and learning from each other especially regarding the transition trajectory for the different countries, as well as evidence from their own country context and use that to support policy or guideline or framework development.

Question: How has been the experience been up to now and how do you see the future?

Ms. Prerna Sharma, Energy Advisor, GIZ India: Response

She said that in South-South collaboration, one thing to be proud of is that we have created that decision to support solarization. In Nepal, the government has customised what will work for the state and is trying to customize it further based on their requirements. SIP as a tool is flexible and based on the need, it can be modified. Community based model based on MSME policy have allocated different subsidies for group-based models. In the eastern and northeastern plot of India where the states are more renewable energy rich and water rich, this makes sense, there is an effort to test whether these models will be scalable or not. An additional layer of integrating women as entrepreneur is being done so these women who are part of these FPOs, go and demonstrate the benefits of these micro solar water pumps and then try to sell it as a tool to increase income. More research is being done to see how the bankers can see the tools and make informed decisions about the sizing to limit loan rejection.

Question: What are Egypt's plans for solarization of agriculture?

Eng. Mohamed Ramadan El Sayed, Director, Ministry of Electricity & Renewable Energy, Government of Egypt: Response

Egypt is rich in solar energy, and it is estimated that up to 100GW of electricity can be produced using solar. Egypt has set up a strategy to reach to large number of people for solarization of agriculture. As per that strategy more than 40000 sq.km is allocated for SIPs.

Question: How much of the situation in South Asia is relevant in Bhutan?

Mr. Thinley Gyamtsho, Department of Agriculture, Royal Government of Bhutan: Response

He said that Bhutan was very rich in water resources, and it is estimated that it will take up to say 200 years to reach absolute water scarcity. He talked about the 100,000 irrigation schemes in

operation which in terms of solarization of irrigation would not mean transition to solar pumps. At present, there is rig operated irrigation, but farmers are not running these operations because of high costs. Also, in terms of capacity, Bhutan has limited capacity to implement these projects, not in terms of replacing the existing processes but to expand the irrigated area. The land is very fertile but the lack of access to water is what is stopping farmers to increase production. Also, there are technical capacity constraints, though there are a few solar projects that are run through the support of ICIMOD. He talked about the economic water scarcity prevalent in Bhutan. The potential for solarization is high in Bhutan and there's a definite government push for such schemes.

Question: How has the progress in Uganda been in terms of solarization of Agriculture?

Eng. Elizabeth Kaijuka Okwenje, Principal Energy Officer in the Department of Renewable Energy, Uganda: Response

He spoke about the past focus of solar energy for household use and the new focus of solar power is on irrigation. Seventy percent of the population is involved in agriculture with 25% of GDP coming from the agricultural sector. Mainly small-scale farmers work on the land with 1-2 hectares of land ownership on an average. Women are the primary farm workers. Climate change has severely impacted the agriculture sector. Uganda has the largest freshwater lake in the world and only 1% of it is used for irrigation. 20MW of off grid solar irrigation exists in Africa and only less than 1% of it is in Uganda, in terms of solarization of irrigation it would not mean transition to solar pumps.

Question: What has been the progress so far and how can Ethiopia learn from solar experiences around the world?

Dr. Kebede Teshome, Director Irrigation and Drainage ACC, Ethiopian Agricultural Transformation Institute (EATI): Response

He said that there was a huge amount of ground and surface water present in Ethiopia with high potential for use in irrigation. Only 15-16 million hectares of farmland has been utilized so far. Ethiopia is an International Solar Alliance founding country, and it is supported by ISA to increase SIPs. Hence, it is necessary to prioritize collaboration and develop a roadmap for solarization. There is hope for more support from ISA. It is necessary to have a sustainable plan for utilization of ground water; proper training and influencing farmers through co-creation and co-learning is necessary. He also added that Ethiopia can learn from the South Asian context, especially in terms of access of finance to farmers, etc.

Question to the panel What are some of the themes around which South-South learning will be fruitful?

Panelists and Responses :

Dr. Kebede Teshome

There is a need for a strong development for multi-country development plan between Africa and South Asia and the need to capitalize on each other's learnings.

Elizabeth Kaijuka Okwenje

Innovative business models need to be piloted in Uganda. The South-South learning will be on the African side but there are enough natural resources for application of such learnings.

Thinley Gyamtsho

He emphasized on the necessity to formulate some kind of forum for bilateral learning between nations.

Mohamed Ramadan El Sayed

He mentioned that no one can work alone so there is need for co-operation between Asia and Africa. It is necessary to calculate data from irrigation agricultural and technology ministries to create a nationwide policy for implementation.

Prerna Sharma

She spoke for the need for policies to be easy for digitalization.

Divya Sharma

She spoke about the need to set up a suitable solar analogy matrix so that developers can see which method and model works.

Moderator Remarks:

He mentioned that south-south rarely gets it right so there is a need to make a multi stakeholder platform work.

Dr Henry Roman moderating the session with the panelists Photo credit: IWMI

Key Takeaways from the Session:

- Solarization Progress and Potential: Mr. Shilp Verma highlighted the significant growth in solar irrigation pumps (SIPs) in India and Bangladesh, with Africa showing promising progress, particularly in Egypt and Namibia.

- South-South Learning: Ms. Divya Sharma emphasized the importance of creating a global platform for sharing knowledge and business models to enhance solar irrigation infrastructure in Africa, learning from South Asia's experiences.

- Customized Approaches: Ms. Prerna Sharma discussed the flexibility of SIPs and the need for customized solutions based on regional requirements, with a focus on integrating women entrepreneurs and testing scalable models in India.

- Strategic Plans and Challenges: Eng. Mohamed Ramadan El Sayed and Mr. Thinley Gyamtsho shared their countries' strategies and challenges in solarizing agriculture, highlighting the need for technical capacity and economic feasibility.

- Collaboration and Roadmaps: Dr. Kebede Teshome and other panelists stressed the necessity of multi-country development plans, innovative business models, and strong cooperation between Africa and South Asia to capitalize on each other's learnings and resources.

PLENARY SESSION – DAY 2 CLOSING

Speakers:

Dr. Henry Roman, Country Representative, IWMI -Southern Africa

Dr. Youssef Brouziyne – IWMI Representative and CGIAR Water Systems Lead - MENA

PRESENTATIONS

Dr. Henry Roman, Country Representative, IWMI-Southern Africa

He spoke about how global climate change is essentially water change; with change in climate, water use must be changed. Also, there is impact on economic growth due to water scarcity. He spoke about the need to adopt Farmer-led irrigation development (FLID). It is a process where farmers assume a driving role in improving their water use for agriculture by bringing about changes in knowledge production, technology use, investment patterns and market linkages, and the governance of land and water. He went on to explain the process which relies on influencing neighbouring farmers, agro-dealers and traders, craftspeople, agriculture extension agents and irrigation engineers, administrative authorities, local and national policymakers, civil society and development aid agents. The innovation bundles to catalyse FLID involves individual and collective investment, financing mechanisms for SMEs, targeting investments, multi-stakeholder dialogues, institutional capacity and private and public sector scaling partnerships. There is a need to develop technical assistance support toolkit for scaling partnerships. As far as multi-actor partnerships for scaling solar-based FLID is concerned, there is a need for PPP model. He also mentioned the innovation bundles in each critical sector of water (technologies, weather forecasting), financing (grants, loans pay-as-you own), agriculture (extension, agronomy, fertilizers, etc). He emphasised that anticipatory action is required to tackle climate change.

Reflection about MENA, prospects of south-south collaboration, opportunities and challenges at MENA: Dr. Youssef Brouziyne – IWMI Representative and CGIAR Water Systems Lead - MENA

Dr Brouziyne gave an overview of the situation by talking about how 10 out of 17 countries in the MENA region are extremely high baseline water-stress countries. Ground Water is important in the MENA region since it gives insurance against dryness, which is more prevalent in MENA. GW provides both environmental and economic insurance. He also warned that most of the MENA region will experience significant water stress in the coming years. The water use in agriculture is high, around 70-90 percent in the MENA countries and even in countries with high surface water irrigation, groundwater plays a key role as an insurance against dryness and arid weather.

He mentioned that there was a huge yield gap in irrigated and rainfed regions in the MENA region. Hence, agri-food systems need irrigation technology investment and SIPs can play a major role in this regard.

Speaking about renewable energy in the MENA region – PV occupies around 60 percent of the RE tech shares. The MENA RE target is very active and ambitious with Egypt targeting around 42 percent by 2035 and Morocco targeting around 100 percent by 2050. As far as the SIP in MENA is concerned, it is an uneven situation, but there is good experience in Jordan, Egypt, Morocco and Tunisia.

The drivers for uptake of SIPs - cost is a major driver since it is cheaper. In MENA there is almost 100 percent electrification, so grid SIP is not the driver. There is a significate role of SMEs in SIP deployment in MENA.

The major technical challenges include SIP design with overcapacity leading to farmers pumping much more water than is needed to irrigate fields. The institutional and policy challenges include lack of excessive players and low support due to fear of over abstraction of GW. The financial/economic challenges include weak incentives, inappropriate business models and weak grid connection. The primary social challenges include inequitable access to finance or solutions.

The areas where GRID connection can help includes most farmers in MENA resort to over abstraction than what is needed and store in reservoirs, so grid connection can support farmers. The major climate change impact is that the crop requirement is changing due to climate change, hence dynamic design of SIPs is a necessity.

Dr Youssef Brouziyne presenting on Reflection about MENA, prospects of south-south collaboration, opportunities and challenges at MENA Photo credit: IWMI

Key Takeaways from the Session:

- South-South collaboration: Two way south to south collaborations needed and learnings from south Asia will benefit the rest.
- Experience in large solar projects needs to be studied carefully.
- Digitization and employment in data management of SIP to bring about youth employment
- R&D in water and climate is essential.

DAY 3 HIGH LEVEL PLENARY SESSION 4

Dr Jonathan Demenge (SDC) moderating the session Photo credit: IWMI

DAY 3 HIGH LEVEL PLENARY SESSION 4

Title: Sector Outlook - The Future of SoLAR Irrigation

Session Description: This session will summarize discussions from the forum thus far and look towards the future of solar irrigation in South Asia and beyond. The focus will be on exploring key opportunities and challenges and addressing barriers to adoption in different contexts.

Moderator: Dr. Jonathan Demenge, Head of Cooperation, Swiss Agency for Development & Cooperation (SDC)

Panel Discussion

Ms. Marwa Majdoub, Energy, Climate and Environment Lead for North Africa, FCDO, Tunisia

Ms. Majdoub provided insightful perspectives on the role of solar irrigation in North Africa's food security and livelihoods. She highlighted the region's heavy reliance on food imports and the consequent need to address irrigation challenges effectively. Solar irrigation emerges as a cost-effective solution, particularly given the price and subsidy conditions for diesel in the region. Ms. Majdoub also pointed out the prevalence of innovation hubs and startups in North Africa focused on optimizing water use for different crops, crucial for adapting to climatic uncertainties. The inclusion of solar irrigation strategies in the Nationally Determined Contributions (NDCs) for 2030-2035 across North African countries reflects a significant interest in the sector and facilitates access to climate finance, encouraging investments in solar irrigation initiatives. In terms of policy and financial support, she highlighted various initiatives in North African countries. For instance, Morocco offers incentives for farmers to transition from diesel to solar, while Egypt benefits from the International Finance Corporation's assistance in accessing funding from banks for solar pumps. Emphasizing the importance of regional collaboration for the growth of solar irrigation, Ms. Majdoub underscored water's critical role in diplomacy and security among water-scarce nations in the region. She advocated for knowledge sharing, the development of common infrastructure, and collaborative efforts to mobilize international funding, all essential for promoting peace and security in the region.

Her takeaways emphasized the need for making solar pumping more cost-effective through mechanisms such as tax breaks and low-rate funding. She also stressed the importance of proper management of solar irrigation systems and the necessity of fostering collaboration between countries in the region. Overall, her contributions underscored the potential of solar irrigation to address food security challenges in North Africa while highlighting the critical role of cooperation and innovation in achieving sustainable water management practices.

Mr. Tazmilur Rahman, Deputy Director, KfW Development Bank, Bangladesh

Mr. Rahman's panel contribution addressed the pressing need to diversify funding sources for incentivizing solar irrigation, particularly focusing on the role of climate finance in this endeavour. Despite years of support from organizations like KfW, solar pumps remain commercially unviable, posing significant challenges to widespread adoption. He identified several key challenges contributing to this situation, including low efficiency and utilization of solar pumps, high transaction

costs for grid-connected systems, and intense competition with electric and diesel pumps, resulting in the need to keep water prices low in the market.

To address these challenges, Mr. Rahman proposed a range of solutions. These include exploring alternative uses for solar irrigation pumps, providing government incentives for the import of solar technology, promoting family entrepreneurship in solar irrigation, and diversifying crops to reduce water extraction. He also emphasized the importance of research from rice research institutes to develop low-water-intensive varieties and highlighted the need for farmers' cooperatives with women's representation to optimize the benefits of solar irrigation. Additionally, he stressed the importance of safe disposal of solar PV, bundling crop insurance with solar irrigation, and developing roadmaps for finance that gradually reduce subsidies and focus on revenue generation from pumps, thus establishing a sustainable scaling model. Bangladesh, he noted, has already developed such a roadmap, providing a potential blueprint for other countries facing similar challenges. Through these measures, Mr. Rahman highlighted the potential for innovative financing solutions and collaborative efforts to promote the widespread adoption of solar irrigation and address pressing agricultural and environmental challenges.

Dr. Sunil Kumar Ambast, Chairman, Central Ground Water Board (CGWB), India

Dr. Ambast elaborated on the risks of groundwater overextraction and provided recommendations regarding the suitability of solar irrigation in addressing this challenge. He emphasized the need to prioritize green energy solutions, acknowledging the environmental impact of producing photovoltaic (PV) cells but highlighting the significant emissions savings compared to conventional energy sources. Dr. Ambast noted that in India, historical irrigation development focused on crop-saving practices, but the green revolution led to increased irrigation intensity, resulting in groundwater overextraction regardless of the energy source.

To mitigate this, he advocated for bundling solar irrigation with micro-irrigation systems. However, recent publications have shown that micro-irrigation can paradoxically increase irrigation area and intensity, despite reducing water application. Hence, solar irrigation should be bundled with groundwater regulation measures to ensure sustainability.

Dr. Ambast also highlighted the mismanagement of available water resources in urban and peri-urban areas to meet the demands of megacities, necessitating a different prioritization in overexploited and safe groundwater blocks. He emphasized the importance of understanding farmers' responses and changes in water extraction practices and behaviors. In terms of a roadmap, he noted that regulations exist but are only implemented in certain areas, indicating a need for broader enforcement and effective management strategies to address groundwater overextraction comprehensively. Overall, his recommendations underscored the complexity of managing groundwater resources and the importance of integrating solar irrigation with regulatory measures to ensure sustainability and mitigate risks associated with overextraction.

Mr. Bishal Thapa, Senior Director, CLASP, India

Mr. Thapa offered insights into the potential of solar energy in the future, stressing its increasing relevance beyond remote areas. He highlighted that off-grid solutions should be based on the specific needs of end-users rather than solely on geographical remoteness. However, he noted that affordability remains a significant barrier, as solar pumps may not be financially viable for all farmers.

To address these challenges, Mr. Thapa proposed a three-dimensional approach to improving solar irrigation. Firstly, he emphasized the need for technology quality standardization, including testing methods for small water pumps and energy labelling for solar energy products. Secondly, he advocated for the creation of market finance models, as the scale of solar technology is currently too dispersed to make economic sense for the market. Aggregated models could help overcome this barrier. Thirdly, Mr. Thapa discussed the provision of subsidies, noting that while they are necessary, they can also lead to market distortions. He suggested moving away from incentivizing the technology itself and instead focusing incentives on the end-use, ensuring that technology investments are more closely aligned with the needs of users. Furthermore, Mr. Thapa addressed the narrative surrounding groundwater sustainability and solar irrigation. He argued that while solar irrigation can provide crucial irrigation access to marginalized communities, it is important to recognize that small farmers did not create the groundwater sustainability problem. Therefore, removing solar irrigation entirely would unfairly penalize these marginalized farmers. He stressed the importance of focusing on managing and regulating solar energy based on end-use rather than solely on the infrastructure itself.

In terms of takeaways, Mr. Thapa emphasized the need to defend solar pumps against the groundwater sustainability narrative and to identify beneficiaries in a more inclusive manner. He called for integrated thinking about solar irrigation, moving away from binary distinctions between grid and off-grid solutions and instead integrating solar energy planning with end-use objectives, particularly in the context of irrigation planning. This approach would ensure that solar irrigation solutions are tailored to the specific needs of users and contribute effectively to sustainable agricultural development.

Ms. Sharon Yeti, CEO, Powerlive, Zimbabwe

Ms. Yeti highlighted the support needed from the private sector to promote solar irrigation technologies effectively. Firstly, she emphasized the importance of financial subsidies and incentives to encourage private sector investment in solar irrigation initiatives. These incentives can help offset the initial costs associated with adopting new technologies, making them more financially viable for businesses. Secondly, Ms. Yeti underscored the necessity of enabling policy and regulatory frameworks that support the deployment of solar irrigation solutions. Clear and supportive policies can create a conducive environment for private sector involvement and innovation in this field. Moreover, Ms. Yeti stressed the significance of raising awareness and undertaking capacity building efforts. This includes targeted trainings for farmers and other stakeholders to familiarize them with solar irrigation technologies and overcome hesitations about adopting new techniques. Additionally, she highlighted the importance of providing training for those involved in policy formulation to ensure that regulatory frameworks effectively support solar irrigation initiatives.

In terms of a roadmap for promoting solar irrigation technologies, Ms. Yeti proposed several key initiatives. Firstly, she suggested enhancing the role of women in the sector and providing targeted training programs to empower them to participate in solar irrigation projects. Secondly, she emphasized the need for technical support for operations and maintenance (O&M) activities, including the availability of skilled technicians at the local level to ensure the proper functioning of solar irrigation systems. Finally, Ms. Yeti advocated for initiatives aimed at lowering the costs associated with solar irrigation, such as through technological innovations and economies of scale. By addressing these key areas of support, the private sector can play a vital role in driving the widespread adoption and success of solar irrigation technologies.

Dr. Muhammad Ashraf, Ex-Chairperson, Pakistan Council of Research in Water Resources (PCRWR), Pakistan

Dr. Ashraf addressed several key points regarding solar irrigation systems and the challenges associated with their adoption. He noted that over the past decade, there has been ongoing debate surrounding solar irrigation systems, particularly regarding concerns about their potential to deplete groundwater resources due to the perception of free and indefinite energy. Dr. Ashraf highlighted that this conception exists at both policy and practitioner levels, contributing to resistance from provincial governments towards national government initiatives promoting solar irrigation. However, Dr. Ashraf emphasized that there is insufficient scientific evidence at present to support these concerns, highlighting the need for rigorous scientific research to inform policy decisions accurately. He stressed the necessity of developing a groundwater regulatory framework bundled with solar irrigation, with scientific evidence providing the operational strategy for such regulations. Furthermore, Dr. Ashraf underscored the importance of standardizing equipment to ensure optimal performance, noting that low-quality equipment hampers the potential benefits of solar irrigation systems. He suggested conducting performance evaluations for existing systems to identify areas for improvement.

Additionally, Dr. Ashraf addressed the issue of land availability for solar panel installation and the associated opportunity cost. He emphasized the need for further research in this area to better understand the implications of solar irrigation systems on land use. As part of a roadmap for addressing these challenges, Dr. Ashraf proposed bundling solar irrigation initiatives with groundwater regulation, emphasizing the importance of capacity building for farmers and service providers. He suggested starting from smaller farmers who tend to use water more efficiently and are more likely to work with smaller-scale systems, allowing for a more gradual and manageable transition towards widespread adoption of solar irrigation technologies. Overall, Dr. Ashraf's response highlighted the complexities surrounding solar irrigation systems and emphasized the importance of evidence-based policymaking and capacity building to address these challenges effectively.

Question & Answer Session

Question: There are many strong laws in groundwater policies in Bangladesh regulating many aspects on paper, but implementation is a struggle. Subsidies cannot sustain indefinitely. But many commercial banks are willing to provide loans...how do you think this will affect the take up of solar irrigation?

Response: There is a gradual need to shift from grants to reflecting of actual costs and loans

Question: Rented and moveable solar systems are becoming more popular and this makes them difficult to regulate. Do you think some groundwater markets can be developed in a more regulated way by the private sector?

Response: This appears to be an interesting innovation, but this should be done in safe groundwater areas not in high depletion areas. While groundwater markets already exist in many parts of south Asia, they need to be regulated.

Question: End-user incentive costs: elaborate and explain the transaction costs involved.

Response: End-use incentives are aimed towards behaviour change in areas of water efficiency, diversification of costs, uptake of conservative agricultural practices. Focusing on these end-uses and outcomes can help to mobilise finance from banks since it brings out the actual on-ground benefits of an investment. Solutions to water extraction need not come only from water solutions but should be considered from agriculture sector as well.

Dr Jonathan Demenge moderating the session Photo credit: IWMI

Key Takeaways from the Session:

- Regional Collaboration: Ms. Marwa Majdoub highlighted the need for regional cooperation and innovation hubs to optimize water use and promote solar irrigation in North Africa.
- Diversified Funding: Mr. Tazmilur Rahman emphasized the importance of climate finance and government incentives to make solar irrigation commercially viable.
- Groundwater Management: Dr. Sunil Kumar Ambast stressed integrating solar irrigation with groundwater regulation to prevent overextraction.
- Technology Standardization: Mr. Bishal Thapa called for quality standardization and market finance models to improve the affordability and effectiveness of solar pumps.
- Private Sector Support: Ms. Sharon Yeti highlighted the need for financial subsidies, enabling policies, and capacity building to encourage private sector investment in solar irrigation.

DAY 3 FORUM CLOSING SESSION

Dr. Mark Smith, Director General, IWMI

Dr. Smith set the context for the discussion by talking about solar irrigation being a threat to water security, which was a mainstream outlook but offering remarkable potential. He added that the focus should be on ways to make it more sustainable. Talking about the idea of sustainable development being slow and a jargon- transforming systems, he said that the forum genuinely prioritized discussion on transformation of energy and resources: food-land-and-water systems.

There were multiple challenges and opportunities in the task of transforming systems which was complex. As such, use of knowledge, building capacity, mobilization and ensuring inclusion and accessibility of disadvantaged groups and the importance of research and innovation could not be overemphasized. He also spoke about the importance of shared commitments and alliances for the common goal of improving solar energy sustainability and inclusion. Dr Smith emphasized the importance of cross-learning and knowledge sharing, demonstration of results and testing of business models. Approaching the cusp of implementation of transformation, this forum was only a springboard to collectively moving forward.

Dr. Jonathan Demenge, Head of Cooperation, Swiss Agency for Development & Cooperation (SDC)

Dr Demenge praised the forum for bringing together engineers, economists, policy makers, activists, bankers, researchers from various countries spanning three continents. He tried to summarize very complex ideas and findings into key messages and one such key message was the GESI. He said that it was necessary to understand the socio-economic and political context of areas where interventions and projects are to be implemented. The key takeaways are learning from each other since South Asia was a huge region and, lessons from progress made in the African countries need to be considered. He acknowledged that solar irrigation was complex due to geology, existing technical capacities, capacity building/sharing, finance, business models, socio-economic context. There was a need for solar energy to be democratized and hence, there should be a push for localization of knowledge and technology.

Mr. P C Sharma, Director, International Solar Alliance (ISA)

He spoke about the need for effective implementation of policies and providing incentives, which is why private sector involvement is a must. Capacity building in this context is important and training of farmers, stakeholders, service providers, particularly women was important. Also, there was a need to push for development of various business models and linking solar energy with the grid. The South-south learning shared with member countries/ delegates in African countries and beyond will benefit the solar sector.

Dr. Alok Sikka, Country Representative, IWMI India & Bangladesh

Dr Sikka spoke about diverse representation, engaging deliberations and exchange of ideas/ practices at the Global Forum. There was a general sense of realization regarding the scope and

importance of solar technology and awareness of enhanced accessibility, co-benefits, mitigation/adaptation. He said that the key takeaways include consensus of importance of SIPs as a sustainable alternative, focus of integration of energy with agri-food systems, rural agriculture/agri-foods, prioritize optimization, not maximization of the energy and the social value produced, push for south-south collaboration and this forum is a good starting point for a multi-stakeholder platform to address these issues.

Mr. Nawa Raj Dhakal, Executive Director, Alternative Energy Promotion Centre (AEPC), Nepal

Mr Dhakal said that the forum was a good place to reflect on learning and knowledge sharing since there was involvement in decision making processes at the highest level. It provided the space for learning by doing and putting things in perspective and led to globalizing national and international knowledge sharing. He also stressed the importance of social inclusion and the need for collaboration and extensive participation.

Dr Darshini Ravindranath, IWMI, India

She closed the session by extending thanks to all participants, organizers, logistics managers, volunteers and stakeholders.

Dr Mark Smith delivering the closing remarks Photo credit: IWMI

Group photo of all the participants at the Global Forum Photo credit: IWMI

Chhahari field visit Photo credit: IWMI

Chhahari single firm women Photo credit: IWMI

ICIMOD Lab field visit Photo Credit: IWMI

ICIMOD Lab field visit Photo Credit: IWMI

COVERAGE

- Social Media

(1) IWMI on X: "Wrapped up #SoLARGlobalForum last week in Kathmandu, Nepal. IWMI is thankful to all the esteemed guests, panelists, and participants for taking part in the forum and contributing significantly at the three-day discussion! Thanks to @SwissDevCoop @icimod @isolaralliance #AEPC https://t.co/9HdlIdieOW" / X (twitter.com)

(1) IWMI on X: ""This forum has given actors from various dimensions, an assurance that we're making progress, sharing commitments, and working together on a common goal of sustainability, and inclusive scaling of solar irrigation." IWMI DG @DMSmifffy at the #SoLARGlobalForum. #OneCGIAR https://t.co/J5vmpB3kf5" / X (twitter.com)

"This forum has given actors from various dimensions, an assurance that we're making progress, sharing commitments, and working together on a common goal of sustainability, and inclusive scaling of solar irrigation." IWMI DG @DMSmifffy at the #SoLARGlobalForum.

#OneCGIAR

(1) IWMI on X: "Important discussions on **Day 2** of #SoLARGlobalForum covered various topics related to solar energy, including community empowerment, gender equality, and inclusive policies for sustainable energy. Below are a few highlights from the event 🗣 https://t.co/AGzZMqXKn4" / X (twitter.com)

(1) IWMI on X: "Most of **Day one** at the #SoLAR global forum featured engaging presentations from speakers & five insightful panel discussions on Solar irrigation & Groundwater Sustainability in the global strategic landscape. @SwissDevCoop @isolaralliance @shilpv #SoLARGlobalForum https://t.co/6Ze2Ox01mS" / X (twitter.com)

Most of **Day one** at the #SoLAR global forum featured engaging presentations from speakers & five insightful panel discussions on Solar irrigation & Groundwater Sustainability in the global strategic landscape.

@SwissDevCoop @isolaralliance @shilpv

#SoLARGlobalForum

Mohammad Faiz Alam and 7 others

IWMI reposted

Embassy of Switzerland to India and Bh @SwissEmbassyII · Apr 23

150+ stakeholders gather in Kathmandu to strategize on inclusive & sustainable solar irrigation. The 3 day Global Science-Policy Forum is being organized under @SwissDevCoop supported project "Solar Irrigation for Agricultural Resilience in South Asia" solar.iwmi.org

3 9 613

IWMI @IWMI_ · Apr 24

IWMI's #SoLAR Global Science-Policy Forum begins in Kathmandu, Nepal today, inaugurated by Hon'ble Minister, Mr. Shakti Bahadur Basnet, Ministry of Energy, Water Resource and Irrigation, Nepal.

The 3-day forum has more than 200 participants from around the globe.

#GlobalForum

ICIMOD and 7 others

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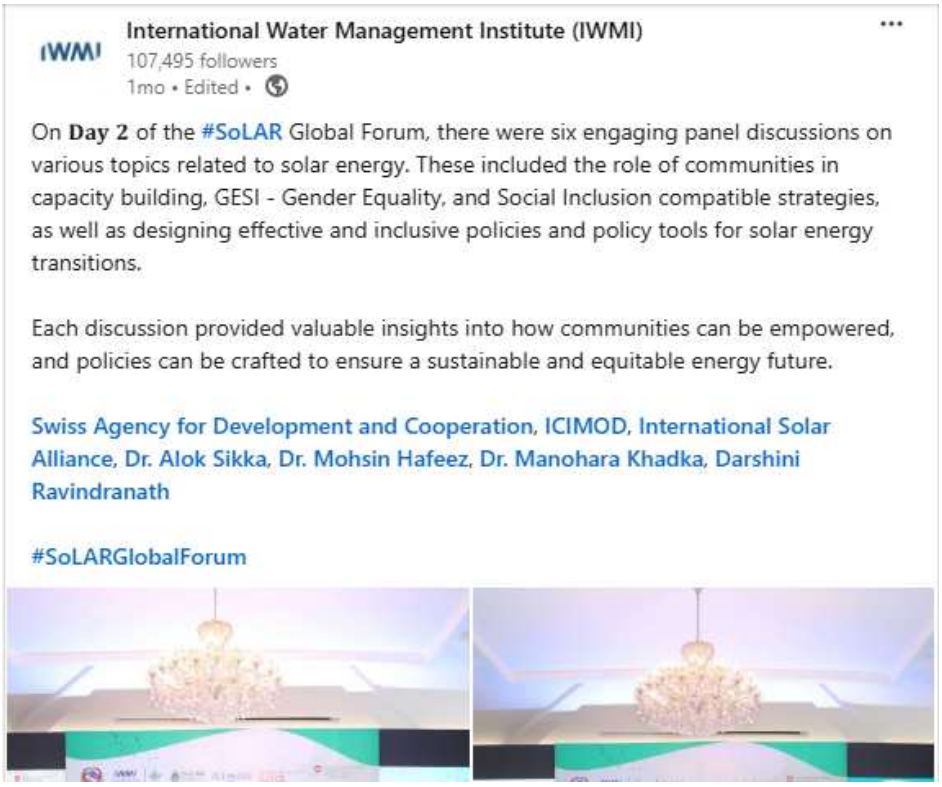

(2) International Water Management Institute (IWMI): Posts | LinkedIn

(2) International Water Management Institute (IWMI): Posts | LinkedIn

- **Newspaper Coverage**

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AGENDA

Link to website

Solar Irrigation for Agricultural Resilience (SoLAR) - Home Page (iwmi.org)

Acronyms

AEPC	Alternative Energy Promotion Centre
BADC	Bangladesh Agricultural Development Corporation
BNEW	Bhutan Network for Empowering Women
BREB	Bangladesh Rural Electrification Board
BTFEC	Bhutan Trust Fund for Environment Conservation
BARC	Bangladesh Agricultural Research Council
BWDB	Bangladesh Water Development Board
CGWB	Central Ground Water Board
DFIs	Development Financial Institutions
EATI	Ethiopian Agricultural Transformation Institute
FCDO	The Foreign Commonwealth and Development Office
FDFA	Federal Department of Foreign Affairs
FLID	Farmer-led irrigation development
GERMI	Gujarat Energy Research and Management Institute
GESI	Gender and Social Inclusion
GHGs	Green House Gases
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GPCCE	Global Programme Climate Change and Environment
GW	Ground water
HKH	Hindu Kush Himalaya
ICAR	Indian Council for Agricultural Research
ICDS	Integrated Child Development Services
ICIMOD	International Centre for Integrated Mountain Development
IDCOL	Infrastructure Development Company Limited
IRESEN	Institut de Recherche en Énergie Solaire et Énergies Nouvelles
ISA	International Solar Alliance
IWMI	International Water Management Institute
KVKs	Krishi Vigyan Kendras
LDC	Least Developed Countries

MDBs	Multilateral Development Banks
MSME	Micro Small and Medium Enterprises
NDC	Nationally Determined Contributions
NAPs	National Adaptation Plans
O&M	Operations and Maintenance
PCRWR	Pakistan Council of Research in Water Resources
PRADAN	Professional Assistance for Development Action
PM-KUSUM	Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan
PV	Photo voltaic
SDC	Swiss Agency for Development and Cooperation
SDGs	Sustainable Development Goals
SAREP	South Asia Regional Energy Partnership
SI	Solar Irrigation
SE4RL	Solar Energy for Rural Livelihoods
SKY	Surya Shakti Kisan Yojana
SIDS	Small Island Developing States
SIPs	Solar Irrigation Pumps
SoLAR-SA	Solar Irrigation for Agricultural Resilience in South Asia
SREDA	Sustainable and Renewable Energy Development Authority
Solar Water Pump	SWP
WEF	Water Energy Food

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