



2nd National Forum, Pakistan



The Real Potential of Solar-Based Irrigation in Pakistan

Summary Report

6 December 2021

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List of abbreviations

CGIAR	Consultative Group on International Agricultural Research
NGO	Non-Governmental Organisation
NWP-18	National Water Policy 2018
HEIS	High Efficiency Irrigation Systems
IWMI	International Water Management Institute
SIPs	Solar Irrigation Pumps
SKY	Suryashakti Kisan Yojana
SpaRC	Solar Power as Remunerative Crop
KwH	Kilo Watt Hour
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
GDP	Gross Domestic Product
HHDs	Households
MNFS&R	Ministry of National Food Security and Research

The National Forum for the year 2021, supported by the Solar Irrigation for Agricultural Resilience project was organized as part of the Pakistan Water Week 2021. The event attracted participation from all the major donors, government ministries, academics, private institutions and civil society. The theme of the session was 'The Real Potential of Solar-Based Irrigation in Pakistan'.

Pakistan Water Week 2021

The Ministry of Science and Technology, through the Pakistan Council of Research in Water Resources (PCRWR), in collaboration with the International Water Management Institute (IWMI) Pakistan and 'CGIAR's Water, Land and Ecosystems Program, jointly organized the Pakistan Water Week 2021 International Conference from 6-9 December 2021 in Islamabad, Pakistan. The theme for the event was *Needs for Sustainable Water Management in Climate Crisis for Indus Basin*.

Pakistan had a relatively abundant water supply in 1980, but by 2000, the country had already become water stressed. It has been predicted that by 2035, Pakistan will become water scarce. However, climate change and Covid-19 have only exacerbated Pakistan's problems and its use of water.

Pakistan Water Week 2021 was the first-ever event that aimed to bring together academicians, government officials, NGOs and policy experts from the country and abroad to discuss the larger problems plaguing Pakistan today. For example, the lack of access to reliable, accurate and action-oriented data is a major problem. Another issue is over-extraction and depletion of groundwater resources and disparate policies in the various sectors of water, food security and climate change, making its implementation very difficult.

While identifying problems, however, Pakistan Water Week 2021 also focused on climate-resilient solutions, digital innovations along with nature-based solutions. In addition, the role of media and leadership of women were some of the themes that were explored in the context of water. Ultimately, the goal of this mega event was to figure out strategies to meet the competing water needs of different sectors, design a research plan that will guide investments in applied research and development, identify sustainable water management strategies that will take climate into account. Moreover, Pakistan Water Week 2021 identified gaps in policies and practices that needed better scientific understanding.

The Pakistan Water Week 2021 also incorporated public awareness campaigns, which included the importance of social media to advocate change, exhibitions highlighting the coordination between the private water sector with the academic and public sectors, a poster competition for university students, and the use of games and debate competitions to raise awareness among younger students.

Introduction to Theme of National Forum 2021

Solar pumping technology has emerged as an alternative to diesel and electric pumps in the recent past. Water professionals in Pakistan are concerned that converting pumps to solar will result in indiscriminate pumping and eventually lead to further groundwater depletion. While Pakistan does not have a specific policy on solar technology for groundwater pumping in agriculture, it does have several policies that have a bearing on it.

The National Water Policy 2018 (NWP-18) makes several references to groundwater pumping to regulate groundwater withdrawals to curb over-abstraction and promote aquifer recharge. It also aims to develop hydropower to increase the share of renewable energy. As per the 18th Amendment of the Constitution,

governance and management of water resources have developed in the provinces. Each province has embarked on different paths to deliver on the NWP-18. All the provincial governments have planned or have launched subsidized solar irrigation pump plans, mostly coupled with High-Efficiency Irrigation Systems (HEIS), especially in Punjab and Sindh. At this point, only the Punjab province has succeeded in implementing its program to some extent, whereas in the Khyber Pakhtunkhwa and Sindh provinces, the programs are at pilot stages, and in Baluchistan, the programs have not been implemented at all.

Experts from different backgrounds discussed the real potential of solar-based irrigation in Pakistan as part of the national forum during the Pakistan Water Week 2021. Almost 20 participants attended the session in person, and others attended virtually on Zoom.

Opening remarks by IWMI Director-General

In his opening remarks, Mark Smith, Director General, IWMI spoke about the increase in groundwater pumping due to a rise in the number of tube wells in the last few decades, which has led to a decrease in groundwater levels. SIPs can address this issue, but the government authorities are of the view that SIPs remove the constraint of diesel/ electricity bills; thus, SIPs may lead to indiscriminate groundwater pumping. Data-backed evidence is required to address this concern, leading to policies supporting sustainable irrigation practices. He added that with SIPs, there is no going back; we need to make sure that SIPs are managed to ensure sustainable and equitable groundwater pumping.

Keynote Presentation I

Topic: “Solar Pumps and Energy-Water Nexus in Gujarat: Assessing 'World's Largest Pilot on Grid-connected Solar Irrigation Pumps (SKY)’”.

Presenter: *Dr Tushaar Shah, Emeritus Scientist IWMI*

Summary of the Presentation

The key driver of solar irrigation in India was subsidies on farm supplies. In 2015, IWMI piloted the Dhundi model in Gujarat with Solar Power as Remunerative Crop (SPaRC). A 25-year contract was formulated under SPaRC to buy surplus solar power from farmers at Rs 4.63/kWh. Data from January 2016 up till December-2020 showed that the overall solar energy (in kWh) sold to the grid increased relative to the solar energy used in irrigation declined, and income earned through the sale of surplus power continuously increased.

In 2018, the Government of Gujarat launched a scheme named Suryashakti Kisan Yojana (SKY). Under this scheme, farmers already connected to the grid were provided with the grid-connected PV system. The scheme targeted 33 districts and 12000 tube wells with 136 feeders. At least 70 per cent of the farmers must sign up for a feeder to qualify for the SKY scheme. Farmers pay 5 per cent up-front cost; 65 per cent over a seven-year period from the evacuation-based incentive of Rs. 3.50/kWh from 'Gujarat government.

Under this scheme, less than 20 per cent of unmetered tube wells got connected to SKY feeders. There were only 12 SKY feeders that were solarised; until 2018; consumption increased across all the feeders during 2019 but declined in 2020 after the first payment for energy sale was released. Technical and commercial losses of power declined from 26 per cent to 5 per cent.

In conclusion, the SKY scheme succeeded in eliminating electricity subsidy, incentivizing energy-water conservation, with full utilization of solar generation, and encouraging farmers to participate in solar investment. Though SKY could not stimulate private industry to participate in solar investment, yet, according to Dr Tushaar Shah, the SKY model can work better and grow in Pakistan compared to India as diesel tube wells dominate Pakistan's groundwater economy.

Keynote Presentation II

Topic: “Economic and environmental costs of solar irrigation pumps (SIPs): Examples from Baluchistan and Punjab.”

Presenter: *Dr Stephen Davies, IFPRI*

Summary of the Presentation

The presentation began with a brief introduction about increasing groundwater scarcity in Baluchistan. Water tables are declining annually by up to 30-40 feet. Reasons for this persistent decline in groundwater include scanty rainfalls, persistent droughts, flat-rate subsidies on agricultural electric tube-wells to farmers, leading to a massive increase in installed pumps, agricultural intensification and switching to high-value, water-intensive crops.

A small group of farmers in Baluchistan were asked in a survey about the reasons for groundwater depletion. The results from the survey showed that most of the farmers choose lower than normal rainfall and lack of dams as prime reasons for groundwater depletion but did not consider an increase in number of tube wells as the primary cause for groundwater depletion. On the other hand, due to a binding agreement with the IMF to phase out electric subsidy, when Baluchistan government tried to withdraw subsidies with some alternatives, farmers protested. As a result, there is a proposal to remove the subsidy on electric tube wells and provide 30,000 solar pumps to farmers in its place.

In IFPRI Discussion Paper 02013, simulations were run to test the impact of different policy options to reduce the impact of groundwater depletion in Baluchistan province. Results showed that shifting water to the non-agricultural sector yields the highest benefit of 5.4% on GDP and subsequently all types of households (HHDs) benefit, i.e., all farm HHDs, rural non-farm HHDs, and urban HHDs.

Choice experiments were conducted to measure valuation and aspirations for drip irrigation in the Punjab province. Results from the choice experiment showed that farmers value subsidy on drip irrigation more as compared to an equal amount of reduction in installation cost of drip irrigation. Additionally, because of the drip irrigation system, farmers indicated to be interested in growing vegetables and melons compared to cereals.

Panel Discussion

Panellists:

- Ms Divya Sharma (Swiss Agency for Development and Cooperation)
- Engr. Nasir Jamal (Rabail Technologies)
- Mr Tahir Anwar, National Coordinator - MNFS&R
- Ms Afia Salam, Climate & Environmental Journalist

Moderator

- Dr Azeem Ali Shah (International Water Management Institute)

Key points discussed during the panel discussion are as under:

Nasir Jamal

- The subsidy program of SIPs coupled with the drip irrigation system in Punjab could not turn out to be completely successful. Farmers only participated in the program to avail 80% subsidy. As soon as the government program was completed, the majority of farmers sold the drip irrigation system. Farmers in the rain-fed areas made good use of SIPs coupled with HEIS because of genuine water scarcity.
- It is also important to ensure that farmers receive good quality SIP components, i.e., solar panels. Quality-wise, prices of solar panels should be available so the farmer can make an informed decision while installing SIPs. The farmer should know how long specific quality solar panel will last to make an informed investment.
- Most farmers in rain-fed areas should be targeted for SIP subsidy programs because farmers are willing to install technology, i.e., many of the farmers contacted me to ask about the rain gun.
- Daylight will be a limiting factor in over-exploitation through SIPs. In Baluchistan, maximum daylight time is 7 hours, and in Punjab, it is 5 to 6 hours. The water abstraction ability of SIPs is not linear even within a day, instead, it follows a hyperbolic path, i.e., increasing till noon then falling till sunset.

Tahir Anwar

- HEIS will not be successful in areas of Punjab where water is sufficient rather, water-scarce areas of Baluchistan and Sindh can be targeted. Overall, a farmer's journey towards technology should not be abrupt but rather a gradual one. Techniques like different field configuration settings, i.e., bed and furrow and technologies like precision surface irrigation, can be introduced first before making a push towards HEIS.

Afia Salam

- Small and marginal farmers should be targeted in rain-fed areas to promote sustainable practice. In this way, their livelihoods will be safeguarded.
- The situation in Pakistan requires leapfrog steps rather than abrupt adoption of sustainable practice. We need to concentrate our efforts on effective advocacy campaigns and highlighting success stories on mainstream media.

Divya Sharma

- We should promote groundwater awareness and socially inclusive solarisation in the agriculture sector. Unfortunately, there is no single recipe for the whole region; rather the priorities change as per the context and availability of surface and groundwater.
- She provided examples of Gujarat and Rajasthan, where different models have worked. For example, in Gujarat, grid-connected subsidized solar scheme has worked very well, while in Rajasthan, solar

pumps connected with HEIS systems have promoted high-value crops, improving the livelihoods of the farmers.

- In areas with abundant groundwater supplies, switching from diesel to solar saves a lot of cost and farmers provide sufficient irrigation to meet crop water requirement, increasing crop yields.
- As the energy prices go up, proliferation of solar will certainly increase. We need to promote relevant policies which sustainably benefit the farmer livelihood.

Key Takeaways from the session

Takeaway 1:

Schemes to promote SIP should be targeted as per the area-specific requirements. This transition should be gradual, and there is no one size fits all in the case of SIP promotions. For high-value agriculture, SIPs coupled with HEIS systems make a lot of sense. For regular crops, other techniques like precision surface irrigation have a lot of potential. Solar technology is going to become very common so the effort should be to devise policies for sustainable use of groundwater to improve the livelihood of farmers.

Takeaway 2:

The quality of the solar pumping system matters a lot while making investments in this technology. Farmers should be made aware of the proper selection of panels while making their investments. The life of the installed system is directly related to the quality of the system.

Takeaway 3:

There is a lot of potential for grid-connected SIPs in Pakistan. There are successful case studies from India which provide evidence of their adoption in the context of Pakistan. Once farmers know the potential of extra earning by selling electricity to the grid, they rationally use groundwater to exploit the extra potential.

Appendix A: Session Agenda

Thematic Area 3	Thematic Area 3: Technologies and Innovations - Responding to the Challenges	
Title	The Real Potential of Solar-Based Irrigation in Pakistan	
Date:	Day 1: Monday - 6December 2021	
Time	16:00 - 17:30	
Venue	Ambassador Hall III	
Zoom Link	https://us02web.zoom.us/webinar/register/WN_qNtpvusCR9WHehwxHSGmUw	
Summary	<p>In the recent past, solar pumping technology has emerged as an alternative to diesel and electric pumps. Water professionals in Pakistan are concerned that converting pumps to solar will result in indiscriminate pumping and eventually lead to further groundwater depletion. While Pakistan does not have a specific policy on solar technology for groundwater pumping in agriculture, it does have several policies that have a bearing on it.</p> <p>The National Water Policy 2018 (NWP-18) makes several references to groundwater pumping, with the goal of regulating groundwater withdrawals in order to curb over-abstraction and promote aquifer recharge. It also aims to develop hydropower to increase the share of renewable energy. As per the 18th Amendment of the Constitution, governance and management of water resources have devolved to the provinces. Each province has embarked on different paths to deliver on the NWP-18. All the provincial governments have planned and/or have launched subsidized solar irrigation pump plans, mostly coupled with High-Efficiency Irrigation Systems (HEIS), especially in Punjab and Sindh. At this point, only the Punjab province has succeeded in implementing its program to some extent, whereas in the Khyber Pakhtunkhwa and Sindh provinces, the programs are at pilot stages, and in Baluchistan, the programs have not been implemented at all.</p>	
Panellists	<ol style="list-style-type: none"> 1. Ms Divya Sharma, SDC 2. Engr. Nasir Jamal, Rabial Technologies 3. Mr Tahir Anwar, National Coordinator - MNFS&R 4. Ms Afia Salam, Climate & Environmental Journalist 	
	Agenda	
	Moderator: Dr Azeem Ali Shah, IWMI	Rapporteur: Mr. Muhammad Zain Akbar
16:00-16:05	Setting the Scene: Dr Azeem Ali Shah, IWMI	
16:05- 16:10	Opening Remarks: Dr Mark Smith, Director General, IWMI	
16:10- 16:25	Keynote Speaker: Dr Tushaar Shah, Emeritus Scientist IWMI	
16:25- 16:40	Keynote Speaker: Dr Stephen Davies, IFPRI: Economic and environmental dimensions of solar irrigation pumps (SIPs): Examples from Balochistan and Punjab	
16:40- 17:10	Questions from Panelists	

17:10- 17:25	Questions and Answers from Audience
17:25- 17:30	Closing Remarks

Appendix B: Photo Gallery



Afia Salam, climate & environment journalist (left) and Nasir Jama, Rabail Technologies (right) speaking at the Pakistan Water Week

Photo: IWMI Pakistan



Azeem Ali Shah moderating a session at the Pakistan Water Week

Photo: IWMI Pakistan



*A few participants during a session at the Pakistan Water Week
Photo: IWMI Pakistan*

