Review of solar pumping practices in the Punjab province to inform agri-water- energy reform- Pakistan

Stakeholder Consultation on Solar Irrigation Islamabad

Summary Report

IWMI
International Water Management Institute

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Contents

Review of solar pumping practices in the Punjab province to inform agriculture-water-energy reform – Pakistan

The Government of Punjab is undertaking a legislative and policy shift towards improved groundwater management. This is illustrated by Government's Punjab Water Policy (2018), the Punjab Water Act 2019, and the Punjab Groundwater Management Plan (under preparation). As part of the World Bank's Programmatic Agriculture Sector Review (PASA - P175667) for Pakistan, this review study is carried out to estimate the economic, climatic, and environmental effects of solar groundwater extraction infrastructure, and identify the expected trade-offs in shifting from existing systems to lower-emissions and higher-sustainability systems.

The overall objective of this study is to provide the government of Punjab with actionable recommendations that can enable the continued and sustainable abstraction of groundwater for irrigated agriculture with lower GHG emissions and reduced harm to natural resources. This study will identify reforms and intervention designs that can pave the way to a low-carbon and sustainable groundwater use in agriculture, especially for downstream and more vulnerable areas and users. Current knowledge of changes in surface and groundwater interactions between upstream and downstream canal areas will also be leveraged to identify zones where higher levels of pumping are sustainable and are therefore appropriate for promotion of solar tube wells. It will also identify opportunities to align a potential tube well solarization program with the Government of Punjab's ongoing legislative and policy shift towards improved groundwater management.

Introduction to Stakeholder Consultation on Solar Irrigation

Stakeholder consultation on Solar Irrigation was conducted in collaboration Marriot Hotel, Islamabad. Different stakeholders from government and private sector participated in this event. The objective of this consultation was to conduct a stakeholder mapping to understand the policy and institutional landscape and the needs and motivations of different stakeholders. Additionally, this event helped in assessing how different stakeholders are affected by current water management and pumping practices. Lastly, this consultation along with other consultation events to be conducted in other district will help in paving the way for the government to promote solar technology resulting sustainable groundwater abstraction.

Introduction by Dr Mohsin Hafeez (Country Representative – IWMI)

Dr Mohsin Hafeez gave opening remarks and explained the objectives of the workshop. For the background of the workshop, he explained that World Bank is funding an upcoming Punjab government's subsidy scheme of drip system and solar pumps (PRIAT) as a continuation of Punjab Irrigated-Agriculture Productivity Improvement Project (PIPIP). In his opening remarks he explained the importance of sustainable use of groundwater in terms of conjunctive use with surface water and water-energy-food nexus. Dr. Mohsin highlighted that generally there are lack of guidelines for renewable energy and specifically there is no standardization for the equipment of SIPs. Lastly, for the purpose of workshop we can also look beyond the drip system for High Efficiency Irrigation Systems (HEIS) coupled Solar Irrigation Pumps (SIPs).

Remarks by Dr Ghulam Muhammad Ali (Chairman – PARC)

He spoke about the importance of the workshop in terms of establishing collaboration among different stakeholders and raising awareness. He highlighted the importance of building small and large dams which will help in rainwater harvest and conserve excess water in Indus River. To manage groundwater abstraction, linking rainwater harvesting, drip system, sprinkler and rain-gun

technology with SIPs can be a way forward. In addition to this, drought tolerant crop varieties and mulching technique can help preserve water.

Session 1: Keynote Presentation

Topic: ***The potential of Solar irrigation for Pakistan***

Presenter: Dr. Azeem Ali Shah, International Water Management Institute (Pakistan)

Summary of the presentation

There are different points of view about solarizing the agriculture sector, on one hand Solar Irrigation Pumps (SIPs) can lead to decrease in carbon emissions while on the other hand it can lead to over abstraction of groundwater. There is no feed-in-tariff and farmers have not converted to net metering system in agriculture sector of Pakistan.

Salient features of pumping practices in Punjab include exponential increase in diesel tube wells overtime which has led to increase in carbon emissions, increase in cropping intensity that is supported by conjunctive use of groundwater with canal water. This has led to fall in groundwater levels in many areas. Lack of implementation of groundwater management policies has resulted in unsustainable groundwater abstraction.

Models of solar irrigation implemented in India, Bangladesh and Nepal can be examined at three levels i.e., microscale, mesoscale, and macroscale. Microscale model of solar irrigation in India 5 to 8 KWH pumps given to union of farmers. In Pakistan, individual investment is more prevalent as compared to collective ownership of pump. Mesoscale model of solar irrigation includes 30 to 50 KWP SIPs. SIP farmers can distribute electricity back to grid. Macroscale model of solar irrigation include large SIPs grids.

While designing new subsidy scheme for SIPs government must decide on factors like models, approaches, risk & market development, and regulatory practices. Net metering and feed-in-tariff can help in extending vision of agri-solarization in Punjab in sustainable manner. Finally, we also need to think about coupling SIPs with HEIS irrigation systems (should not only stick to drip but sprinklers (rain guns), centre pivot systems also provide promising alternatives) and which areas and which types of crops are suitable for such systems.

Session 2: Panel Discussion

1st Topic: *What should be the pre-requisites of promoting SIPs and what are the gaps in research of promoting SIPs in context of Pakistan?*

Dr. Abdul Majeed (ICARDA)

To promote SIPs, we need to do zoning on basis of climate and groundwater levels. Zoning on basis of climate would entail identifying rainfed, canal irrigated and sandy desert areas. In addition to this we areas with shallow and deep groundwater also need to be identified. It has been seen that areas with abundant water SIPs are used with conventional crops.

Dr. Bashir Ahmad (PARC)

He agreed with Dr Majeed and told that in PARC they are conducting research on zonation for SIPs. Focus of the research is on areas with fresh abundant groundwater where field crops are grown and areas where drip system is coupled with SIP. Research results will come out in June.

2nd Topic: *For subsidy what pump size/ pump type is appropriate for subsidy scheme?*

Dr. Muhammad Iqbal (OFWM)

With sprinkler and drip system most appropriate pump size/type is 5 -10 hp/submersible pump. Where groundwater is sufficient SIP is directly installed on groundwater where it is sufficient otherwise water storage pond is built.

There has been a dual check on service providers (installation companies) one is of OFWM and other id of 3rd party consultants (NESPAK engineers).

Abdul Wajid Rana (IFPRI)

Is there any enforcement mechanism on SIP farmers in Baluchistan where groundwater level is going deep, and pump size is increasing up to 25 hp?

Dr Muhammad Iqbal (OFWM)

There is no check on farmers installing SIPs privately but under subsidy scheme design of the system is finalized as a first step. Then service providers have 2 years contract with farmers to provide free maintenance services. Overall, there is a 5-year contract with the farmer to keep using the system.

Dr. Abdul Majeed (ICARDA)

In Potohar area there is 1000 mm rainfall and irrigation are ¼ as compared to Rawalpindi.

Faizan ul Hasan (PCRWR)

Pakistan Standards & Quality Control Authority (PSQCA) has a mandate to issue standards but on ground there are no standards / checks on SIP equipment.

OFWM has linked drip system with SIP to prevent excessive groundwater abstraction with SIPs. Studies needs to be done to determine if SIP is a determining factor in depleting groundwater resource, so we can have clarity how to move forward.

Dr. Muhammad Iqbal (OFWM)

Most important point is groundwater depletion and High Efficiency Irrigation System (HEIS) increases efficiency by 50%. This is the reason it is vital to couple SIP with HEIS.

Kashif Manzoor (PCRWR)

SIP with 10hp submersible pump and no HEIS gives discharge of 0.75 cusec, whereas diesel pump gives discharge rate of 10 cusec water.

Abdul Wajid Rana (IFPRI)

Without developing backend market for HEIS for operational management, sustainability of HEIS will remain a challenge for small/medium farmers. This was the reason HEIS failed in Baluchistan and Sindh.

Malik Muhammad Waris (OFWM)

Due to lack of indigenization of HEIS, cost did not go down.

Kashif Manzoor (PCRWR)

No zoning and failure of selecting appropriate crops has led to failure of adoption of HEIS at scale.

Dr. Abdul Majeed (ICARDA)

Usually there is dual method of irrigation happening in one field i.e., using flood and high efficiency irrigation in one field is not sustainable and recipe for failure.

Everything starts with suitable crop selection which in turn determines water requirements, discharge rate, specifications of head and piping of drip.

Dr. Azeem Shah (IWMI)

300 SIPs survey was conducted late last year. Except 3 farmers all the farmers installed SIP with self-finance. Among the surveyed SIP farmers no one was using HEIS. Farmer is not willing to change the cropping pattern as there is no difference in percentage of field crops grown by surveyed SIP and non-SIP farmers.

Malik Muhammad Waris (OFWM)

If not drip system, sprinkler coupled with SIP can be an option to grow field crops. At least SIP will get rid of diesel costs.

Dr. Mohsin Hafeez (IWMI)

Australian experience shows that zoning was done first before introducing SIPs. SIPs are used with water storage ponds and HEIS to grow high value crops.

2nd Topic: *What are the Market failures and what can be the mitigation steps?*

Muhammad Muzzamil (Buraq Integrated Solutions)

It will be very expensive for the government to install poles so that every farmer can install green meters to sell excess electricity. Alternatively, farmers should be allowed to use excess energy on site i.e., SIP farmer should be able to use excess electricity to operate flour mill on site.

Dr. Abdul Majeed (ICARDA)

SIP farmers who usually abandon drip system are the ones that have sufficient water i.e., canal and groundwater and they do not abandon conjunctive use of water. They do not have any need to use drip system.

Dr. Bashir Ahmad (PARC)

Mostly SIPs are away from grid, where grid is available it is of 1 phase. For grid connectivity 3 phases are recommended. To make grid 3 phase every where it is need there is a huge investment is required. To avoid these costs, site specific option can be opted. PARC in collaboration with Lahore University of Management Sciences (LUMS) is planning to conduct experiments on local grids.

Dr. Mohsin Hafeez (IWMI)

NEECA during discussion on electricity structures told us that there are 30%-line losses. There are differences of 1 phase and 3 phase. Is there any practice at community level to manage power produced by SIPs?

Dr. Abdul Majeed (ICARDA)

Model of cooperatives will be a challenge in Pakistan as people will fight with each other and running that model will not be practical.

Kashif Manzoor (PCRWR)

Standard of the equipment is an issue. While quoting own observation in Tandliwala (on sides of Ravi River) through subsidy farmers must pay 6 to 7 lacs whereas privately it costs 4-5 lacs.

Dr. Azeem Shah (IWMI)

He told about the experience of interaction with farmers in Rahim Yar Khan, where farmers told that for subsidy on drip system and SIP, they must pay 8 lacs and privately they could install the system at 5 lacs. Possible reasons of high cost of subsidy is tax of 30 – 35 %, service providers profit, and standard of equipment is better.

3rd Topic: *What are the options around Feed-in-tariff?*

Dr. Azeem Shah (IWMI)

Mostly SIPs are used during full duration of the sunlight. It was noted during a field visit, in wheat season, when water requirement is low farmers are still extracting groundwater even when water not required.

Net metering will be a challenge if farmer's home is away from pump location or electric poles are not present. For feed-in-tariff will it work at community or individual level.

Abdul Wajid Rana (IFPRI)

For net metering, at some point in long run government has to pay farmers, which will be a challenge for government.

Dr. Bashir Ahmad (PARC)

Surveying 300 farmers expert analysis show that 50% of the times excess capacity of pump is used.

Kashif Manzoor (PCRWR)

In my observation, farmer has no excess energy generated with SIP as water requirement of the farmer is never fulfilled in summers and they use other pumps with SIPs.

Malik Muhammad Waris (OFWM)

During designing phase of drip system with SIP, required discharge rate of SIP are calculated in view of water requirement of the crop. This ensures no over pumping with the SIP.

Abdul Wajid Rana (IFPRI)

No provincial government can sustain subsidy on its own except with Donor project finances. IMF will eliminate subsidy in energy sector. Moreover, agriculture secretary is doing standardization of everything under PEECA law. So financially and equipment wise no provincial government can sustain anything. In 5 – 6 years' time debt/equity model has to be adopted to keep promoting HEIS with SIPs sustainable.

Faizan ul Hasan (PCRWR)

Conservation is a complex issue. Baluchistan was a grazing land but there is an attempt to make it a fruit basket, while it has not resulted in any significant increase in exports. Result is subsidy bill on electricity is in billions, 30000 tubewell all serving large scale rich farmers and decline in groundwater level.

Giving an example of Murray Darling Basin in Australia, he said that farmers are given tax rebates on rainwater harvesting but pumps are installed with self-finance.

Dr. Bashir Ahmad (PARC)

If most of farmers are installing SIP with self-finance, then SIPs can be promoted through loans on easy conditions to the farmer.

Faizan ul Hasan (PCRWR)

At Basin scale in 4 Doabs, difference between extraction and recharge is not a lot. Problem of declining groundwater is arising in pockets away from canals and in urban areas. Canal system of Punjab is designed to support 70% cropping intensity, now cropping intensity is 200%. Increase in Population is one of the main problems.

Dr Mohsin Hafeez (IWMI)

Rainwater harvesting at local level can be one of the solutions. HEIS being a high-cost option is a hurdle, to increase its adoption it should be more affordable. Moreover, specific geographical locations need to be identified to promote HEIS successfully i.e., target Thal areas or Barani areas.

Muhammad Ismail (ICIMOD)

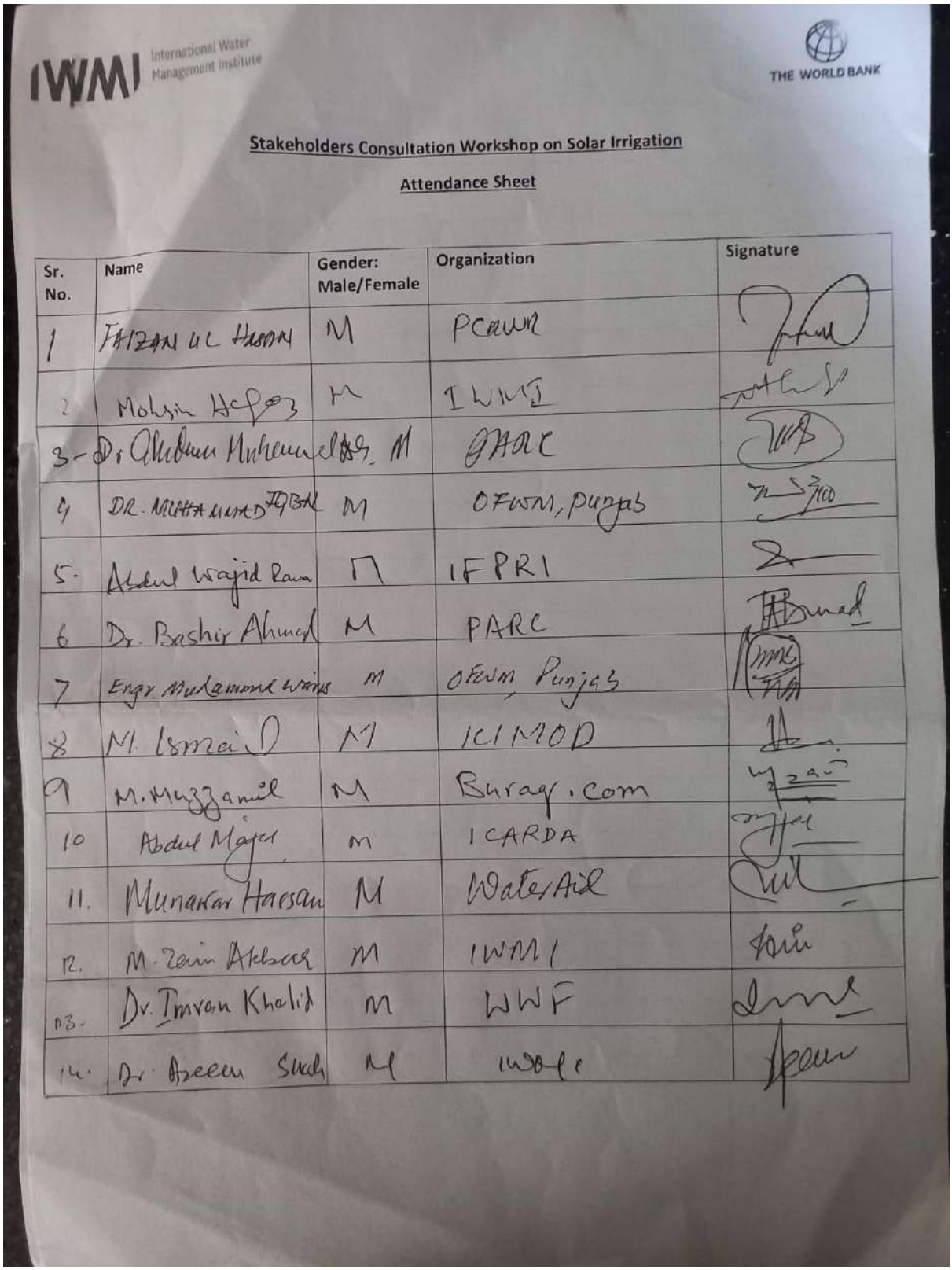
Social organization and gender aspect should be incorporated in the upcoming subsidy scheme.

At the end all participants gave their closing remarks.

Key Takeaways

- To promote drip system coupled with SIPs, zoning must be done based on climate and groundwater levels. Zoning based on climate would entail identifying rain fed, canal irrigated and sandy desert areas. Farmers in rain fed and sandy areas have higher chance of adopting and using drip system as compared to canal irrigated areas where there is shallow groundwater.
- Proper compliance is required to ensure long term uptake of HEIS.
- Standardization of the equipment in the private market is important.

Appendix A: List of Participants



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Stakeholders Consultation Workshop on Solar Irrigation

Attendance Sheet

Sr. No.	Name	Gender: Male/Female	Organization	Signature
1	FAIZAN UL HASSAN	M	PCRWR	
2	Mohsin Hafeez	M	IWMI	
3	Dr. Ghulam Muhammad Ali	M	PARC	
4	DR. MUHAMMAD IQBAL	M	OFWM, Punjab	
5.	Abdul Wajid Rana	M	IFPRI	
6	Dr. Bashir Ahmad	M	PARC	
7	Engr. Muhammad Waris	M	OFWM, Punjab	
8	M. Ismail	M	ICIMOD	
9	M. Muzzamil	M	Buraq.com	
10	Abdul Majeed	M	ICARDA	
11.	Munawar Hassan	M	WaterAid	
12.	M. Zain Akbar	M	IWMI	
13.	Dr. Imran Khalid	M	WWF	
14.	Dr. Azeem Sindh	M	IWMI	

Appendix B: Photo Gallery

Participants at the workshop

Credits: IWMI SoLAR-Pakistan