WELL LABS
WATER · ENVIRONMENT · LAND · LIVELIHOODS

POLICY BRIEF

Can Solar Irrigation Help Farmers Earn More & Use Less Water?

Understanding Sustainable Agricultural Transitions

Photo credit: Metro Media (IWMI)

KEY INSIGHTS

- Both ***biophysical and socio-economic factors*** influence the impact of solar irrigation on agriculture.
- Different regions face different types of constraints in terms of ***access to land, energy and water***. It determines what farmers are likely to do when provided with solar irrigation.
- Solar irrigation provides the opportunity to introduce a pricing regime because there is an opportunity cost for water with the ***introduction of Feed-in-Tariffs***.
- However, this regime transition alone will not be sufficient to encourage the transition to less water-consuming crops.
- A range of ***systemic changes*** are needed to help farmers break lock-ins and transition out of their current production practices.
- ***Simulation tools*** can help anticipate system responses before large-scale programme implementation

The Water, Environment, Land and Livelihoods (WELL) Labs developed a simple Excel-based tool using an energy-water-land framework that can help anticipate how farmers may respond to solar irrigation in different contexts. The tool can forecast the impact of solar irrigation where you work and inform decision-making on factors such as feed-in-tariff rates and subsidies.

This would be particularly useful for state-level implementers of projects like the Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan (PM-KUSUM) launched by the Union Ministry of New and Renewable Energy to promote solar irrigation in India. This tool can clarify the impact of different policy options on farmers' incomes, and indicate whether they are likely to make different crop choices.

If you are interested in the tool, please write to us, so we can walk you through the tool and the framework.

Reach us at
well.comms@ifmr.ac.in

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BACKGROUND

A majority of farmers in India depend on rainfall for their livelihoods because they lack access to irrigation. They are vulnerable to erratic weather. Farmers who do have access to wells to irrigate their land are confronted with another problem. Groundwater is rapidly depleting forcing them to spend more to dig deeper.

Solar irrigation has the potential to address both problems.

It increases access to irrigation by providing energy to farmers who are not connected to the grid or use expensive diesel pump sets. It curbs groundwater abstraction through net metering, which allows farmers to sell excess electricity back to the grid.

We don't fully understand the impacts of introducing solar irrigation across regions.

How would farmers respond to solar-powered irrigation

Would farmers end up **pumping more water** for irrigation?

Would this added source of income allow farmers to **shift to less water-intensive crops**?

Would they **sell excess energy back to the grid** and earn an income from it?

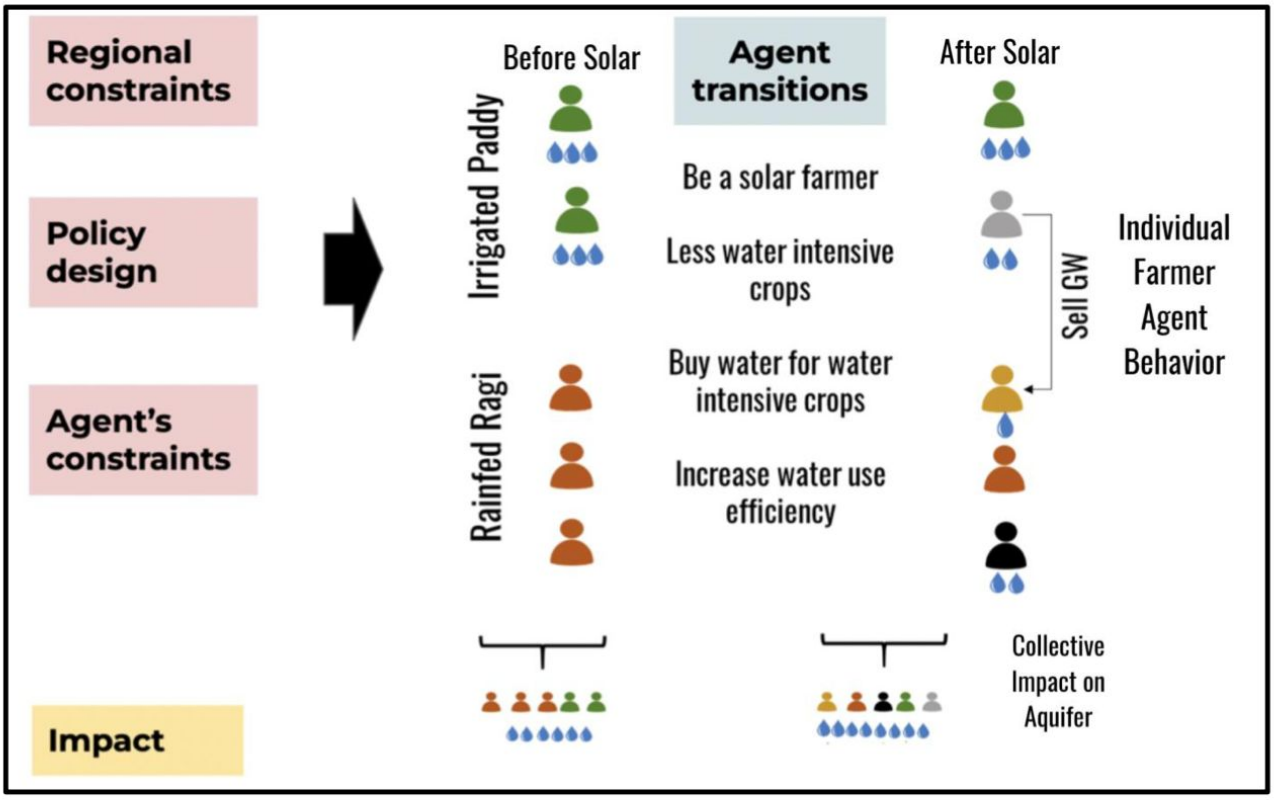
Existing studies are confined to specific pilots and we need 'what if' analyses to predict what might happen under different conditions.

- We need to be able to be able to anticipate responses ***under different policy scenarios***.
- We need a better grip on how farmers would behave ***under less favourable terms***. Most pilot schemes are 'gold plated', i.e. they offer high subsidies.
- We need to anticipate effects of solar irrigation on shifts in cropping patterns shifts ***in decadal time scales*** too.

We applied an agent-based modelling approach to understand farmer choices and transitions after the introduction of solar irrigation in six districts.

OUR METHOD

We estimated farmers' net present value, irrigation water requirements and economic and cultural risks to identify possible options that are available.



We interviewed experts to understand plausible transition pathways, and to validate the options that emerged from the modelling exercise. Finally, we plotted the most plausible outcome in the districts we chose for the study.

Farmers make choices based on the constraints they face

We identified 6 different case studies based on the classification below.

ENERGY LIMITED (Bihar)

- Access to grid
- Electricity hours

WATER LIMITED (Karnataka)

- Borewell yields
- Borewell depth

LAND LIMITED (Punjab)

- Fraction of cropland that is irrigated.

OUR OBJECTIVE

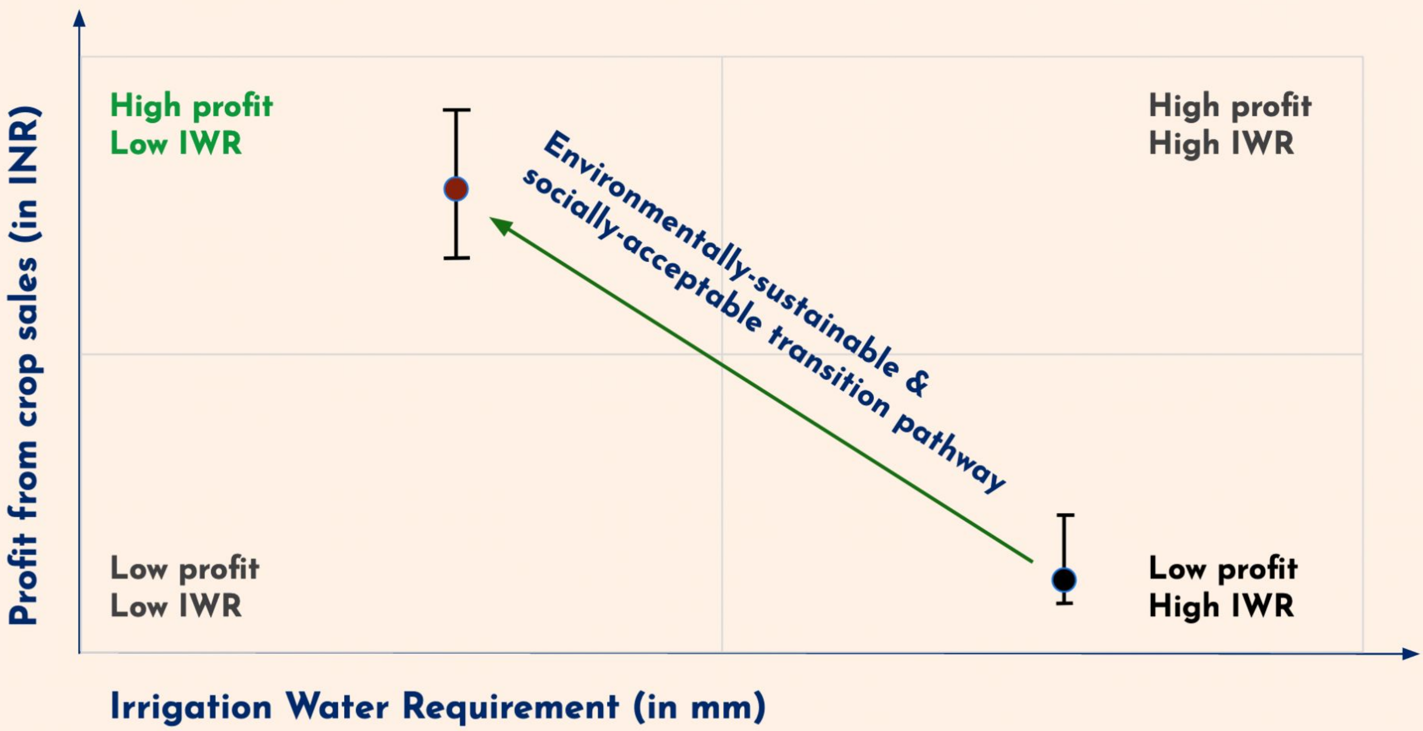
We wanted to understand the potential for sustainable transitions.

This means farmers are able to reduce water use while increasing income and reducing or maintaining the same level of risk.

In this context, a 'sustainable transition that is also socially acceptable' would be one in which the farmer transitions from a low profit-high water-low risk using crop to a high profit-low water using crop *(graph below)*.

The existence of sustainability transitions is promising, but they may not always work out because factors including risk appetite, technical know-how, social networks and culture influence farmers' choice of crops.

Photo credit: Metro Media (IWMI)



CASE STUDIES

ANAND, GUJARAT

Groundwater levels in most parts of the district have been rising; hence continuing to grow current crops is likely to be sustainable.

The dairy industry dictates the crops grown here. In addition to current crop choices, we are likely to see the inclusion of a third summer crop - fodder.

BATHINDA, PUNJAB

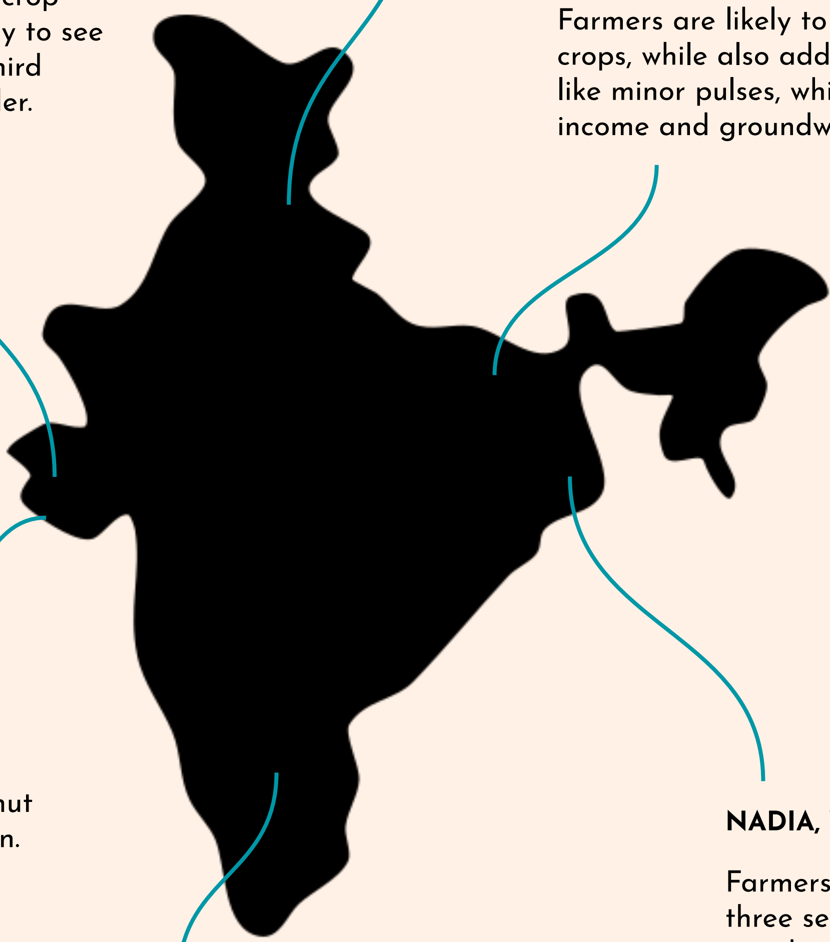
Farmers are likely to continue growing paddy-wheat and cotton-potato, given strong government procurement systems.

A sustainable transition to a less water-intensive crop will require the setting up of strong market linkages for alternatives like kinnow. Otherwise, the groundwater status in most parts of the district will continue to remain critical and overexploited.

WEST CHAMPARAN, BIHAR

Farmers are likely to continue with current crops, while also adding a third summer crop like minor pulses, which marginally increases income and groundwater use.

Aquifers in most parts of Bihar are not overexploited. Continuing current crops can still be viewed as a sustainable choice. Adoption of solar may not happen if it reduces income levels compared to current incomes, as is the case with sugarcane farmers.



BOTAD, GUJARAT

Farmers grow a combination of cotton and groundnut during kharif season.

Changing this combination, in addition to growing wheat or chickpea in the rabi season is likely to be more sustainable for the district's groundwater. Agrivoltaics are also a real possibility in this district.

BENGALURU RURAL, KARNATAKA

Finger millet (ragi) farmers are likely to switch over to agrivoltaics (sale of solar power with no associated irrigation), if subsidised, while arecanut farmers will continue growing it given its strong procurement system.

Most parts of this district have been categorised as critical and overexploited. Switching from water- intensive crops like arecanut, rice and sugarcane will be critical to ensure groundwater sustainability.

NADIA, WEST BENGAL

Farmers grow rice across all three seasons, and are likely to switch over to growing rice during kharif and lentils in the rabi seasons.

This is a far more sustainable option compared to the present cropping pattern as the water requirement reduces and farmers may be able to earn better by switching from rice to other crops like lentils.

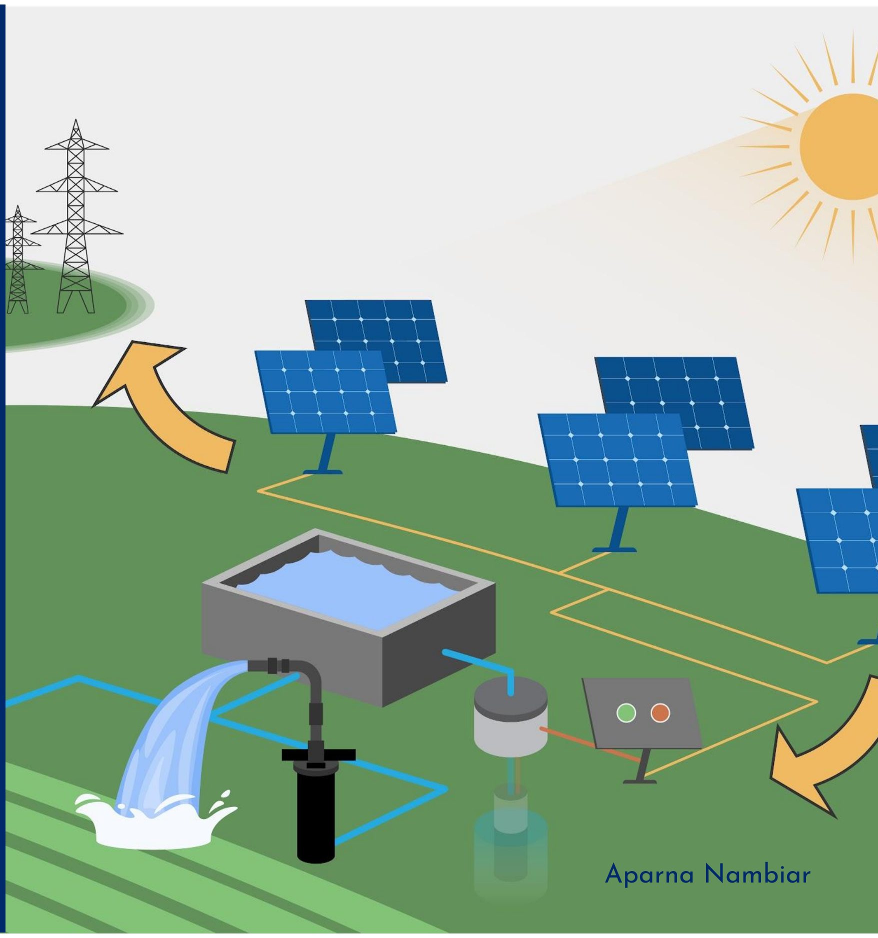
Our study shows that solar irrigation - on its own - is inadequate to change farmers' crop choices.

For solar irrigation to result in more sustainable transitions, such as the cultivation of crops that are less water intensive, sociotechnical evolutions also need to occur. This means that the entire system, ranging from pre-production to consumption, will have to evolve to reduce risk and incentivise farmers to change their practices.

Changes in agricultural policies, such as the introduction of Minimum Support Prices for less water-intensive crops, and energy policies, such as the removal of electricity subsidies that allows farmers in states like Punjab free or highly-subsidised access to the grid, can pave the way for long-lasting change stemming from the introduction of solar irrigation.

To our knowledge, this is the first research study that has attempted to apply ABM in the context of solar irrigation and its likely impact on farmers' incomes and groundwater sustainability in India.

There are opportunities and constraints that vary widely across states. It is critical to closely examine local contexts and apply the ABM approach to accurately gauge where solar irrigation can make a significant difference rather than force-fitting such schemes in regions where it could exacerbate current precarity.



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