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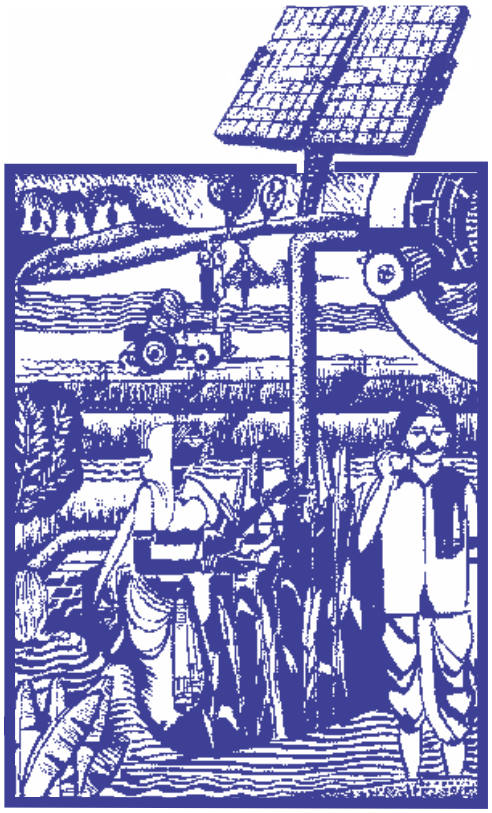

IWMI-TATA
Water Policy Program

Water Policy Research

HIGHLIGHT

Kick-starting KUSUM *(Kisan Urja Suraksha evam Utthaan Mahaabhiyan)*

Tushaar Shah

The Union Budget 2018 announced *Kisan Urja Suraksha evam Utthaan Mahaabhiyan* (KUSUM), a prodigious ₹140,000 crore scheme to replace diesel pumps and grid-connected electric tubewells for irrigation by solar irrigation pumps (SIPs) with a buy-back arrangement for farmers' surplus solar energy at a remunerative price. KUSUM can be a game changer. It can check groundwater over-exploitation, offer farmers day-time uninterrupted power supply, reduce carbon footprint of agriculture, curtail farm power subsidy burden and, most of all, provide a new source of risk-free income for farmers. However, for kick-starting KUSUM, Government of India needs to propose a well-articulated implementation strategy. We explore what this might be.

KICK-STARTING KUSUM
(*KISAN URJA SURAKSHA EVAM UTTHAAN MAHAABHIYAN*)*†

Research highlight based on a paper with the same title

1. INTRODUCTION

In his 2018 budget speech, Finance Minister Arun Jaitley outlined the contours of KUSUM (*Kisan Urja Suraksha evam Utthaan Mahaabhiyan*), a new scheme to subsidize solar irrigation pumps (SIPs) for farmers with the option to sell surplus power to distribution companies (DISCOMs) (ET 2018*a*). Mr Jaitley said the Government of India will take "necessary measures and encourage State Governments to put in place a mechanism that their surplus solar power is purchased by the distribution companies or licensees at reasonably remunerative rates."[1] KUSUM would entail a total outlay of ₹1,40,000 crore over 10 years, of which the central government is to contribute ₹48,000 crore (ET 2018*b*). Farmers are to contribute 10 per cent of the capital cost upfront, cover 30 per cent by bank loan while the remaining 60 per cent is to be borne equally by subsidy provided by Government of India and respective state governments.

2. ECONOMICS AND ECOLOGY OF SOLAR IRRIGATION PUMPS

KUSUM can be a game-changer for India's irrigation and energy economies. Studies show that farmers' experience with SIPs is highly satisfactory (Gupta 2017; Kishore *et al*. 2014). For farmers in western India, hassled by unreliable and night power supply, SIPs offer welcome relief by providing uninterrupted day-time power. For some 5.3 million diesel pump irrigators in eastern India irrigating with energy costing ₹18-22/kWh, SIPs drastically reduce irrigation cost and permit irrigation expansion. Up to 6 per cent of India's total GHG emissions emanate from groundwater irrigation (Shah 2009). Replacing diesel and electric pumps by SIPs will significantly reduce the carbon footprint of Indian agriculture. The biggest gainers are DISCOMs. Depending on location and pumping depth, every grid- connected pump replaced by a SIP can save the country farm power subsidy ranging from ₹35,000 to ₹90,000/year.

Finance Minister's speech 2018
Photo Credit: PTI https://akm-img-a-in.tosshub.com/indiatoday/ images/story/201702/jaitleyspeechstory_647_020117124006.jpg

"Many farmers are installing solar water pumps to irrigate their field. Generation of solar electricity is harvesting of Sun by the farmers using their lands. Governments to put in place a mechanism that their surplus solar power is purchased by the distribution companies or licencees at reasonably remunerative rates."

* This Highlight is based on research carried out under the IWMI-Tata Program (ITP) with additional support from Indian Council of Agricultural Research (ICAR), Swiss Agency for Development and Cooperation (SDC) and the CGIAR Research Program on Water, Land and Ecosystems (WLE). It is not externally peer-reviewed and the views expressed are of the author/s alone and not of ITP or its funding partners.

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[1] https://www.pradhanmantriyojana.in/kusum-yojana/

However, SIPs have two downsides, economic and ecological. A SIP costs next to nothing to operate but entails 10-15 times larger capital investment compared to diesel or electric pumps. Without 70-95 per cent capital subsidy currently on offer, solar pumps would have few takers in India. Such capital-intensive technology becomes viable only with a high utilization rate. India's diesel pumps operate only for an average of 460 hours/year (ITP 2017) but are viable because of low capital investment. Not so with SIPs. A 5 kWp SIP costing ₹5 lakh and operated for 500 hours/year in irrigation—against its potential of 2500 hours—is a poor investment for the farmer and for the society. An SIP owner will always be tempted to 'encash' free solar energy by irrigating water intensive crops, increasing cropping intensity and selling more water to neighbours at a low price—all of which will increase groundwater draft, deepening the crisis in western India's parched aquifers. Free electricity is blamed for groundwater over-exploitation from Punjab down to Tamilnadu, but its destructive impact is limited by restricted hours and unreliable supply. With reliable day-time free solar power, SIPs can be way more lethal for our aquifers.

3. Promoting Solar Power as Remunerative Crop (SPaRC)

The need is to promote SIPs as an integrated energy-water-livelihoods solution rather than merely a 'green' energy solution. With its energy buy-back option, KUSUM will promote solar energy as a remunerative cash crop that farmers can 'grow' for their irrigation needs and additional income from energy sales. This idea was piloted by the Madhya Gujarat Vij Company Ltd (MGVCL) and International Water Management Institute (IWMI) in Dhundi village in Gujarat. Here, 9 SIP irrigators, formed into a cooperative, were given an attractive power buy-back guarantee at ₹7.13—a feed in tariff (FiT) of ₹4.63/kWh by MGVCL topped up by IWMI with ₹1.25/kWh as Green Energy Bonus and ₹1.25/kWh as Groundwater Conservation Bonus. In return, farmers forfeited the right to apply for a grid power connection for 25 years. The pilot was discussed in EPW (Shah *et al.* 2017). Solar farmers earned an average ₹6,000/month from the SIP-from irrigation, water sales and energy sales.

Figure 1 shows monthly solar generation by Dhundi cooperative (in kWh per kWp of installed pumping capacity) and the proportion used for irrigation. During December 2015 to April 2016, farmers had no buy-back option and all energy produced was used in irrigation. Things changed once MGVCL began buying surplus power in late May 2016. Farmers began to sell much of their solar energy to MGVCL except during April and May when profitable summer irrigation peaked. Arguably, without the buy-back option, over 60 per cent of Dhundi's solar energy would have been used for pumping more groundwater. After June 2018, when the IWMI top-up of ₹2.50/kWh ends, we expect SIP irrigators to expand irrigation significantly and reduce energy sales[2].

The MNRE Minister recognized that KUSUM will lead to: “promotion of decentralised solar power production,

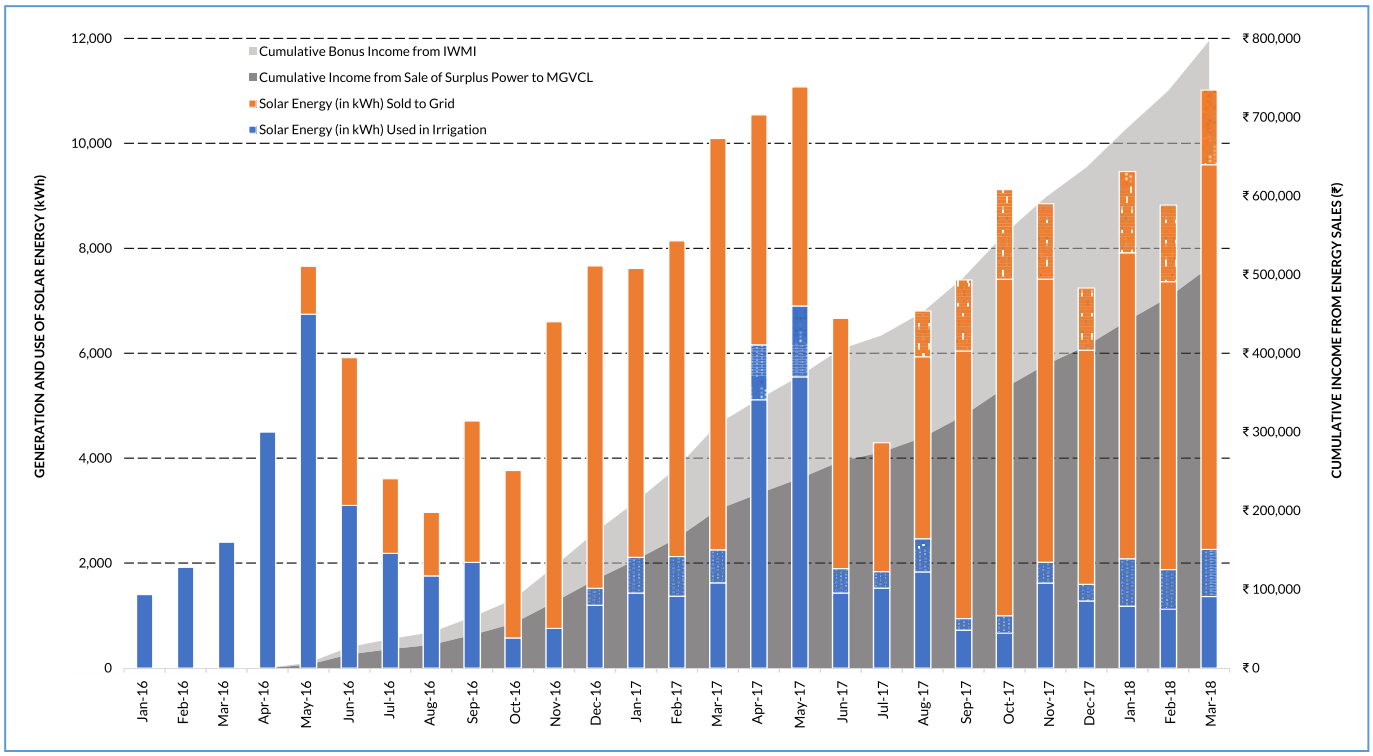

Figure 1: Solar energy generation and its use in irrigation: Monthly data from Dhundi Solar Cooperative

[2] See Gupta (2017) for similar results in Rajasthan.

reduction of transmission losses as well as providing support to the financial health of DISCOMs by reducing the subsidy burden to the agriculture sector. The scheme would also promote energy efficiency and water conservation and provide security to farmers" (The Hindu 2018). All these benefits will accrue only if farmers substitute solar for grid power, and not use solar pump as a stand-by, which is mostly the case so far (Kishore *et al.* 2014; Gupta 2017; Durga *et al.* 2016).

4. Making KUSUM attractive to farmers

Will farmers buy into KUSUM as designed now? A farmer prospecting a 5 kWp SIP under KUSUM will invest up front ₹30,000 and take a loan of ₹90,000 at 12 per cent/year repayable over 6 years[3]. Over an economic life of 20 years and at a discount rate of 10 per cent/year, this investment will turn in positive NPV only if the annual net financial benefit exceeds ₹15,000/year[4]. KUSUM will be an attractive deal for a diesel irrigator, buying 500 litres of diesel/year at ₹65/liter. The SIP will save her ₹32,500/year which she can top up by selling irrigation with free solar power.

But why will an electric tubwell owner in Punjab, Tamilnadu or Telangana invest in SIP and relinquish his free grid power connection, a hard-earned entitlement? They will, only if their electricity use is metered and charged at ₹6/kWh, the actual cost to serve them grid power. The only other way to get them to willingly give up grid power for solar energy is to offer them a deal better than free grid power: free, day-time reliable solar power plus a remunerative FiT for their metered surplus solar power.

But DISCOMs' are loathe to offer farmers higher FiT than the lowest bid in solar auctions, which is around ₹2.25/kWh. As of now, KUSUM offers to top this up by a meagre ₹0.5/kWh, which will take the FiT to ₹2.75/kWh. Assuming a 5 kWp solar array generates 7500 kWh/year and half of it is injected to the grid, the net revenue flow for the farmer will be ₹10,312/year which is a poor return on farmer's investment. A remunerative FiT for solar irrigators would be around ₹5/kWh which will offer annual revenue flow from the sale of surplus energy of ₹18,750. With buy-back option offered only in lieu of grid connection surrender or net metering, the DISCOM will be better off even with a remunerative FiT since solar power purchase will be a fraction of current grid power use provided at near-zero rate. For every MW of solarized tubewells, the saving in grid power subsidy will be ₹60 lakh/year[5] and pay out for solar power purchase will be ₹37.5 lakh[6] assuming half the solar power generated is evacuated.

Many other benefits follow a remunerative FiT. It will impart strong impetus to groundwater conservation[7]. It will make it easier to get all tubewell owners on a feeder to solarize, which DISCOMs increasingly insist. Buying farmers' solar power needs no new investment in transmission network. DISCOMs keep all the Renewable Energy Credits (RECs) for solar power generated by farmers. Farmers injecting power at the tail-end makes the grid more stable. Internationally, there is growing concern about expanding 'energy sprawls' from solar parks, and the need to promote distributed solar (Bronin 2010). Grid connected SIPs do just this.

Had Renewable Purchase Obligations (RPOs) been vigorously enforced, which is not the case now (Nayar 2016), DISCOMs would find SIPs very cheap source of RECs since they would pay only for power evacuated but claim REC for all power generated[8]. In such a scenario, DISCOMs would agree to offer a high FiT to attract more tubewell owners to solarise. However, since farmer-produced REC has no economic value as yet, there is a strong case for KUSUM to offer DISCOMs ₹2/kWh, instead of ₹0.5/kWh, as evacuation-based incentive (EBI) for every unit they buy from SIP irrigators at a FiT of ₹3/kWh, so that farmers get ₹5/kWh of evacuation. KUSUM should also offer to subsidize panels to the tune of 1.25 times the pump capacity so that farmers can increase tubewell operation by an hour or two on peak irrigation days and sell more energy on other days. Even with this, the farmer's investment will just pass the viability threshold for shifting from free grid power to SIP. But farmers may still buy in because of reliable power supply, steady and risk-free income from solar energy sales right at the farm-gate. This is the only way to reward SIPs' multiple collateral socio-ecological benefits and to make KUSUM attractive enough for tubewell owners to give up free or nearly-free grid power.

5. Getting DISCOMs on board

KUSUM can help DISCOMs by: [a] reducing subsidy burden; [b] make possible real-time metering of energy and water use; and [c] reduce anarchy and restore order on rural network (Srivastava 2018). Yet, DISCOMs are likely to be lukewarm to KUSUM for four reasons which need to be satisfactorily addressed:

1. *Organization culture:* DISCOMs have always been retail sellers of energy; buying power from tiny distributed generators is a culture shock and would need a vigorous campaign to change attitudes and skill-sets of staff.
2. *Operational Economics:* Many states are saddled with surplus power they find hard to dispose-off, making

[3] Assuming ₹60,000/kWp as the capital cost of solar irrigation pump assembly (including panels, efficient pump, inverter, meters and all.

[4] The annual instalment of the loan of ₹90,000 at 12 per cent will be ₹21,890, and the PV of the total payments @ 10 per cent discount rate will be ₹1,25,380. Over a 20 year period, only an annuity of ₹14, 700 will accumulate to a PV of this amount at 10 per cent discount rate.

[5] For average grid power consumption of 1000 kWh/kW valued at cost-to-serve of ₹6/kWh

[6] Assuming 1500 kWh of solar generation/year/kWp and solar power FiT of ₹5/kWh.

[7] Franklin (2015) and Amjath-Babu *et al.* (2018) carried out simulation studies for Punjab, which showed that the shift in cropping pattern and reduction in water use accelerates as the water tables decline and electricity price increases.

[8] Assuming that DISCOMs will claim all RECs for solar power generated, and not just evacuated, by SIPs as is the case with power purchase contract given to Dhundi cooperative.

them lukewarm to farmers as new power sellers. Since subsidies are absorbed by government and industrial consumers, saving subsidies is not an urgent priority. Pushing off-peak night power to agriculture helps DISCOMs flatten their load curves.

3. *Technical Issues:* To buy farmers' solar power, DISCOMs have to keep agricultural feeders permanently running during the day. If only a few tubewells on a feeder are solarized, the remaining tubewells enjoy permanent day-time grid power, which will raise the ire from other feeders and undermine power rostering. In Gujarat, DISCOMs are enthusiastic about SPaRC but only after solarising all tubewells on an agricultural feeder.
4. *Vigilence and transaction costs:* Finally, DISCOMs apprehend high vigilance load and this significantly raises DISCOMs' transaction costs. To prevent a farmer from exploiting the arbitrage between subsidized grid power and remunerative FiT for solar power, DISCOMs want surrender of grid connection before solar power purchase starts. But not many farmers are willing to permanently surrender their hard-won tubewell connection. Gujarat is now considering net-metering SIPs so that farmers can also draw grid power to be charged at the same rate as is paid for solar power sales. Net-metering will make it easier to solarize feeders but not reduce vigilance and transaction costs for DISCOMs.

6. Feeder-level Solar Irrigators' Cooperative Enterprises (FL-SPICE)

Dealing with Feeder-level Solar Irrigators' Cooperatives (FL-SPICE)—be they registered cooperatives, FPOs, or Limited Liability Partnerships-instead of individual solar irrigators can relieve DISCOMs from the burden of high vigilance and transaction costs.

FL-SPICE can provide such intermediation by playing six distinct roles to ensure stability, integrity and equity in the transactions between DISCOMs and solar farmers:

1. *Aggregator:* With SPICE pooling members' surplus solar power, the DISCOM only needs to meter net energy export of the feeder at a single point and pay the cooperative on a monthly cycle.
2. *Guarantor*: FL-SPICE will vouchsafe the integrity of transactions between its members and DISCOM; and timely repayment of loans by its members since it will control the cash-flow between DISCOM and members.
3. *Smart-metering:* The FL-SPICE can ring-fence the DISCOM from farmer malfeasance by ensuring with smart meters on a real-time basis that solar generation (G) is always equal to solar energy evacuation (E) plus energy use in irrigation (I) less import of grid power (M). It will also smart-meter G, E, M and I of each member and allocate the total pay-out amongst members based on net export of solar power by each member. Smart-metering can be jigged to shut off the feeder outside daylight hours and with every violation of the G=E+I-M identity at the feeder level;
4. *Economic mechanisms:* The SPICE can design internal FiT to minimize the arbitrage between remunerative FiT for solar and subsidized rate of grid power. For example, paying low or zero FiT for first half (or 2/3rd) of daily solar generation and loading the daily FiT pay-out to the

Shri Saurabhbhai Patel, Energy Minister, Government of Gujarat visited Dhundi on May 2, 2018

second half (or 1/3rd) of generation can reduce the incentive for malpractice.

5. *Joint Liability Group:* With deterrent and graduated penalty the DISCOM can impose on the SPICE for each instance of deviation in the G= I+E-M identity at the feeder-level, the SPICE will need to operate as a joint-liability group in which the consequences of individual malfeasance fall on the collective, making mutual monitoring essential and gainful.
6. *Operation and Maintenance (O&M) support:* As the manager of the solar feeder, the FL-SPICE will provide the whole range of techno-economic support to members such as maintenance and repair of SIPs, extension support to help members improve energy and water efficiency and maximize income from crop and energy production, and so on.

Organising and capacitating FL-SPICEs will not happen on its own; it requires special skills, and it augurs well for KUSUM that organisations like National Dairy Development Board (NDDB)—which has organised thousands of successful dairy farmers cooperatives—have come forward to help organise FL-SPICEs on a large scale provided conditions are propitious.

7. Way Forward

For best socio-ecological outcomes, KUSUM's top priority should be to ensure that SIPs substitute existing diesel and electric pumps rather than complement them, as is currently happening. For our 5.3 million diesel irrigation pump irrigators in eastern India, 60 per cent capital cost subsidy under KUSUM will be strong incentive to solarize especially with a streamlined subsidy-loan delivery eco-system.

However, its beneficial impact on pro-poor irrigation can be multiplied by an accompanying subsidy on buried PVC piped distribution system. Pilot projects in Bihar show that replacing diesel pumps by SIPs supported by buried pipe distribution system transforms a monopolistic and exploitive groundwater market into a competitive and pro-poor one (ITP 2018).

Getting electric tubewell owners in western India to switch from free or subsidized grid power to solar power should be the key objective of KUSUM. Achieving this will be a challenge that can only be met by making it attractive for farmers to economise energy (and water) use in irrigation and sell more solar power to the DISCOMs. The optimal arrangement will be one in which: [a] besides 30 per cent capital cost subsidy, GoI offers Evacuation Based Incentive (EBI) of ₹2/kWh of solar power purchased at a FiT of ₹3/kWh by DISCOMs from farmers taking the total to ₹5/kWh; [b] all tubewell owners on an entire feeder are persuaded to get solarized, net-metered and formed into a FL-SPICE with the help of organizations like NDDB and NGOs experienced in organizing and capacitating farmer cooperatives; [c] DISCOMs offer them a buy-back contract for net energy export (charging import of grid power at the same rate as FiT) and make monthly evacuation based payments which FL-SPICE in turn distributes among members according to net evacuation by each; and [d] the FL-SPICE operate like joint liability groups guaranteeing fair-play and timely loan repayment by members, besides offering members technical support and extension to maximize their income.

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Members of Dhundi Solar Cooperative

About the IWMI-Tata Program and Water Policy Highlights

The IWMI-Tata Water Policy Program (ITP) was launched in 2000 as a co-equal partnership between the International Water Management Institute (IWMI), Colombo and Sir Ratan Tata Trust (SRTT), Mumbai. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resource management. Its objective is to help policy makers at the central, state and local levels address their water challenges – in areas such as sustainable groundwater management, water scarcity, and rural poverty – by translating research findings into practical policy recommendations. Through this program, IWMI collaborates with a range of partners across India to identify, analyze and document relevant water management approaches and current practices. These practices are assessed and synthesized for maximum policy impact in the series on Water Policy Highlights and IWMI-Tata Comments.

Water Policy Highlights are pre-publication discussion papers developed primarily as the basis for discussion during ITP's Annual Partners' Meet. The research underlying these Highlights was funded with support from International Water Management Institute (IWMI), Tata Trusts, Indian Council of Agricultural Research (ICAR), Swiss Agency for Development and Cooperation (SDC), CGIAR Research Program on Water, Land and Ecosystems (WLE) and CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). However, the Highlights are not externally peer-reviewed and the views expressed are of the author/s alone and not of ITP or any of its funding partners.

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