From Rooftops to Farmtops

Augmenting India's Distributed Solar Goals through net-metered solar pumps

IWMI-TATA Water Policy Program

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Introduction

The Government of India has recently announced a scheme for solar water pumps known as Kisan Urja Suraksha Utthaan Maha Abhiyan (KUSUM). One of the key features of this scheme is that it provides for grid-connected solar pumps. For a long time, solar pumps were considered to be standalone systems, that is to be deployed in those places where the grid had not reached. Solar pumps were seen as the second best solution to grid connected pumps. They were deployed by those farmers who were dependent on very expensive diesel based pumpsets, to offset fuel costs. However, with improvements in technology and reduction in the price of solar equipment, solar pumps are now a good replacement for most, even all, grid connected electric pumps.

Almost all states in India do not offer 24x7 power for farmers. Power on farmer feeders are regulated in shifts of 8 hours and tends to be erratic. Farmers therefore have no control on their energy supply. This results in the practice of leaving the pump switched on throughout the day, so that when power is supplied, the field is irrigated. This is a wasteful method of irrigation, particularly in India, which faces acute water scarcity as it often results in flooding fields.

The KUSUM scheme has the potential to revolutionise agriculture as well as the way in which India moves towards the solar goal of 100 GW by 2022. Grid connected and net metered solar pumps can now irrigate fields when required and evacuate power to the grid when the pumps aren't being used. This is a revolutionary idea since it will convert farmers, who were traditionally consumers of subsidized power from the grid, to net exporters of 'green' solar power to the grid. Farmers can now potentially benefit from India's distributed solar goal of 40 GW by 2022. The 40 GW solar goal is often thought to be a rooftop solar goal. However, the definition of distributed energy can extend to distributed 'Farm-Top' installations - "*From Rooftops to Farmtops*".

If the KUSUM scheme is successful, it will also solve two problems. One of the Indian power sector's fundamental problems - subsidised and often unmetered electricity for the farm sector and second the need of high-quality day-time power to farmers. In the case of Gujarat, nearly 27% of Gujarat's electricity goes towards the farm sector, while recovery

from this sector is a meager 3% of overall revenues. In many states the agricultural connections are also unmetered, resulting in systemic inefficiencies such as theft and T&D losses getting bundled as agricultural loss. Raising power prices for agricultural consumers is challenging given the overall stress being faced in the farm sector. What the KUSUM scheme, if successful, would do, is to reduce agricultural consumption from the grid and therefore reduce on-going subsidies to this sector and improve energy access to farmers. It also fundamentally empowers farmers by providing them an extra 'climate proof' income, particularly at a time when low farmer incomes are a serious problem. This could be one way to meet the Central Government's goal of doubling farm income by 2022. Incidentally the timeline for this is aligned to the timeline of India's National Solar Mission (NSM).

Potential Benefits of Net Metered Solar Pumps

1. **Provide high-quality day time power**
   One of the banes of a farmer's existence is the lack of reliable day-time electricity. This can easily be addressed through high quality solar pumps that provide farmers with power during the day. Since the pumps are net-metered, the farmers always have an option of drawing power from the grid in case of an excessively cloudy day or when the pumps are down due to any technical issue. This will insulate the farmer from any risks associated with down-times.Similarly, in case the fields do not need irrigation, the solar array can feed power into the grid.

2. **Additional Income for Farmers**
   Net metered pumps not only cater to the farmers own consumption, but if sized adequately, can result in excess power that can be fed into the grid. Farmers can earn money for the power injected into the grid, quite similar to the rooftop net-metering scheme. The size of the solar system in relation to the pump capacity can be decided by State Governments based on their policies.

3. **Reduction of Subsidy Burden on State Government and Cross Subsidy on DisComs**
   Power for the agricultural sector is either free or priced nominally. While the price of power procurement has gone up over time, agricultural power prices have not reflected this trend. This has resulted in two things: 1) increase in the extent of State Government Subsidy often disbursed to the DisComs via the annual tariff petition process and 2) increase in the cross subsidy from the industrial and commercial segments. Solar pumps can provide energy independence to farmers and sever the dependence on subsidies. The lack of running fuel costs, as in the case of diesel pumps, is another economic benefit. Net-metered solar pumps have the potential to turn around the power sector in India.

4. **Reduction in exploitation of underground water**
   One of the concerns of providing high-quality, round-the-clock grid power to farmers is the over-exploitation of groundwater. There is ample evidence to suggest a strong correlation between subsidized

energy access and groundwater exploitation. While solar pumps do provide high quality power for irrigation purposes during the day time and plug in an incentive for farmers to use water efficiently and divert power into the grid in order to earn additional revenue. This choice will certainly depend on several factors such as the quantum of incentive, the season and market price for crops being grown. However for the first time, farmers could have the ability to make a choice.

Potential Risks

1. **Quality of Solar Pumps and Maintenance**
   One of the biggest concerns is the quality of solar equipment (modules, inverters, structures and other components) deployed in the field. India's experience with distributed highly subsidized rooftop solar systems shows that some if not all installers of solar systems compromise on quality. There are concerns in that lower quality systems will not last for ten years when the stated lifetime of a solar system is usually 20 plus years. Given the fact that the Farm-Top scheme in located in what could be considered harsher environments, these concerns are valid and must be addressed through stringent quality control.

   All schemes and policies must ensure real-time monitoring of farm-top systems. Secondly, installers must ensure support through a maintenance contract. Payments to the suppliers should be time-based and linked to the generation of the solar systems.

2. **Getting farmers on board**
   If farmers should have the option of exporting energy onto the grid during the day, the grid must be kept on in order to facilitate this flow of energy. Even if one farmer, among a group of farmers connected to a single feeder, opts for the farm-top scheme, then the distribution company would be obliged to leave the grid ON during the day. This would fundamentally change the manner in which power is managed at the moment. It might also reverse any incentive for the remaining farmers to co-opt for the scheme, since they would now be receiving uninterrupted day time power via the grid.

   One way, to solve this is to adopt a cooperative model, where farmers would be required to come together as a group. Gujarat for instance is experimenting with the idea of having a minimum number of farmers accepting the scheme before which the feeder could be turned on. However, this approach is fraught with complications and access issues for individual farmers.

The Potential

The table below estimates the ceiling potential for farmtop installations in India. The energy consumption data has been sourced from respective state electricity regulatory commissions (SERC). The megawatt capacity assumes that the entire energy consumption is supplied through solar energy pumps.

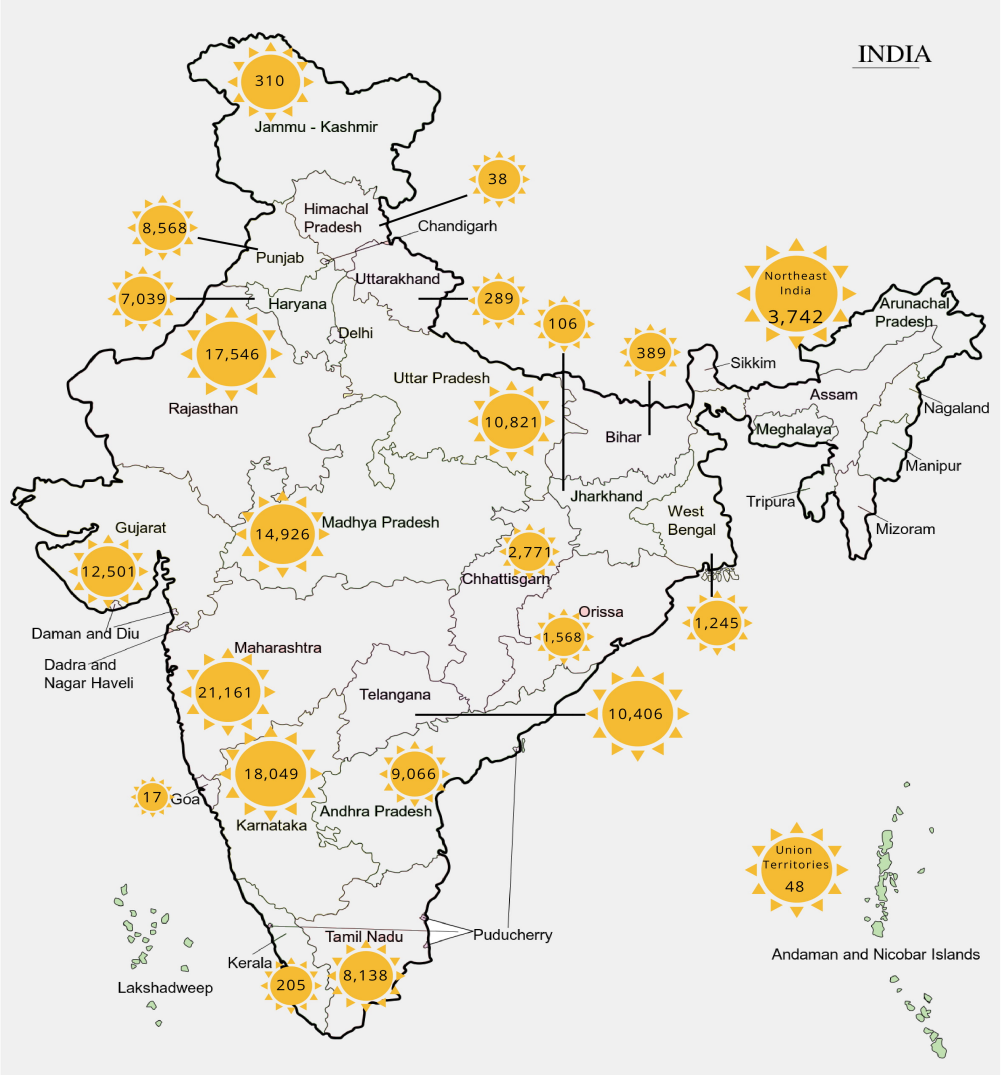
Table: Sate-wise Overview of Agricultural Energy Consumption in India and corresponding solar PV capacity required to supply the energy

State Name	Agricultural Consumption (Million Units)	Solar Capacity Required to Replace Consumption (MegaWatt)
Andaman and Nicobar Island	1	1
Andhra Pradesh	12,707	9,066
Arunachal Pradesh	0	0
Assam	36	26
Bihar	545	389
Chandigarh	1	1
Chhattisgarh	3,884	2,771
Dadra & Nagar Haveli	6	4
Daman & Diu	3	2
Delhi	0	0
Goa	24	17
Gujarat	17,521	12,501
Haryana	9,866	7,039
Himachal Pradesh	53	38
Jammu Kashmir	434	310
Jharkhand	148	106
Karnataka	25,297	18,049
Kerala	287	205
Lakshadweep	0	0
Madhya Pradesh	20,920	14,926
Maharashtra	29,659	21,161
Manipur	2	1

Meghalaya	0	0
Mizoram	0	0
Nagaland	0	0
Orissa	2,198	1,568
Puducherry	57	41
Punjab	12,009	8,568
Rajasthan	24,593	17,546
Sikkim	1	1
Tamil Nadu	11,406	8,138
Telangana	14,586	10,406
Tripura	5,206	3,714
Uttar Pradesh	15,167	10,821
Uttarakhand	406	289
West Bengal	1,745	1,245
TOTAL	**208,770**	**148,951**

As indicated by the table above, if the complete agricultural consumption across all states in India were to be replaced with net-metered solar pumps, then India would surpass its distributed solar goal of 40 GW by a wide margin, but also achieve the overall solar target of 100 GW by 2022. It must be noted that this represents a top-line maximum potential. Taking into account on ground realities, policy support, implementation and adoption rates, the actual capacity would be far less. However, this number is a useful guide from a planning perspective. Even if a modest 10% is achieved in the next five years, that would translate to a very significant commissioned capacity of 14.8 GW.

In a snapshot



All numbers in MegaWatt