



Farmers preferences for incentives on solar pumps: Evidence from a choice experiment in Punjab

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Solar power offers the potential to meet a substantial share of the requirement of electricity in agriculture, but the current level of adoption by farmers is low in India. Despite the potential of solar energy generation in one of the major agricultural states of India, only a small proportion of the farmers use solar agriculture pumps in Punjab. This paper applies choice modeling to understand the acceptance of grid-connected solar pumps and farmers' willingness to pay for solar energy. Choice data was collected from 859 farmers in Punjab in 2021-22 and mixed logit and conditional logit models were used to estimate farmers' preferences for financial incentives covering capital subsidy and buyback options on solar pumps.

The results show that a capital subsidy on the solar pump is positively associated with intention of farmers' to substitute electric pumps powered by free electricity by solar pumps. The willingness to pay for solar pumps increases with higher capital subsidies. A seventy-five percent capital subsidy on solar pump is associated with 93 percent uptake, while sixty percent subsidy has a 35 percent uptake. There are heterogeneous preferences for different types of financial incentives. The study establishes that the absolute subsidy is not the only factor but a lot depends on the how the financial incentive schemes are designed. The findings in this paper confirm that solar pumps need subsidies and preferably easy access to credit, particularly credit-linked capital subsidy as most farmers lack financial resources.

We suggest that solar subsidies combined with grid purchases of surplus solar electricity can both reduce emissions and reduce the over-use of ground water, by indirectly introducing a price of electricity for water pumping. We use cost benefit analysis to quantify the likely positive social benefits of solar subsidies.



Further, the results demonstrate that the socioeconomic characteristics of the farmers play significant role in influencing uptake. More educated, medium, and large farmers and multiple tube well owners are more likely to accept grid-connected solar pumps. Inadequate information about schemes and lack of institutional support are observed as reasons for the stated unwillingness to accept solar pump. Therefore, providing awareness about installing and using solar pumps is likely to enhance farmer acceptance of solar PV technology in agriculture.

The high preference for the buyback of surplus solar energy among various socioeconomic groups and sub-regional divisions has strategic implications. First farmers do express, on average a preference for solar buyback, thus indirectly putting a price on their own electricity consumption. Secondly, the combination of subsidy and buyback drives farmers to choose individual pumps more often over solar feeders. Feeder-level solarization is considered the second-best option. From the users' perspective, individual pumps are more convenient. Thirdly, the energy buyback option can incentivize judicious water use because using electricity for water pumping reduces export to the grid.

These findings can help to strategize balanced mix of individual solar pumps and solar feeders for incentivizing prosumers in selling solar energy and consumers in managing their demand. An increase in demand and technological advancements in solar energy will present opportunities for individual and community solar penetration. Future work could determine different incentives to be offered and buyback prices differentiated by geographic, seasonal, farm, and household characteristics.

The results of this study provide essential information for developing effective solar energy promotion policies. Given the extent of network externalities in the electricity sector, it is crucial that the adoption process of solar pumps accelerates, and that the government subsidizes solar technology. Promoting solar pumps will make them cost competitive with traditional sources of power generation and foster technology improvements, thereby making them economically self-sustainable in the long run. These findings are not only relevant for facilitating the adoption of solar pumps but can also effectively encourage the adoption of other renewable energies.

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