

EFFECTS OF ELECTRIC PUMPS ON FARM-LEVEL AGRICULTURAL PRODUCTION AND GROUNDWATER USE IN WEST BENGAL

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Overview

How does access to less expensive and greener energy for water lifting affect agricultural and environmental outcomes? In particular, we ask if owners of lower-variable-cost electric pumps in West Bengal cultivate their land more intensely, have higher staple-crop yields and value-added, and irrigate their land more frequently and for longer durations than owners of higher-variable-cost diesel pumps and water buyers? Electric pumps have also less impacts on the environment than diesel pumps with potentially reduced emissions. We examine this question in a context where (a) there are no major surface-water irrigation schemes, (b) all farmers historically needed a permit for an electric pump connection and had to pay the full fixed cost of installing the electric pump and connecting it to the grid, and (c) recent policy changes have made it easier for farmers in some areas to acquire electric connections. In 2011, the West Bengal government reduced the transaction costs of acquiring electricity connections by relaxing the permit system in administrative blocks that were considered ‘safe’ in terms of groundwater recharge, and by introducing a one-time subsidy of on the fixed installation cost. The policies introduced by the West Bengal government in 2011 provide us a natural-experiment type of opportunity to estimate the effects of access to electricity – a less expensive energy for water lifting – on agricultural and environmental outcomes.

Most of the research on the effects of energy prices on agriculture have focused on variable-cost-reducing subsidies on electricity tariffs. Less has been done on understanding the agricultural-production and groundwater-use effects of the transaction costs associated with accessing water with unsubsidized energy. The effect of the 2011 and 2012 policy changes in West Bengal has been to lower the transaction costs of applying for and installing electricity connections, thus reducing the fixed-costs of installing electric pumps and easing access to a cheaper energy source for water lifting. This article examines the effect of that cheaper and greener energy source on farm-level outcomes and water use.

Methods

Estimating the effect of electric-pump ownership on agricultural outcomes is likely to be confounded by two factors. The first is the non-random relaxation of the permit system, where the permit was relaxed in blocks where groundwater was not very ‘developed’ and where water levels easily recharged after the monsoons (i.e. ‘safe’ blocks), while the permit system continued in blocks where groundwater was already developed or where water levels did not recharge well (‘semi-critical’ blocks). To address this bias, we use a regression discontinuity design to select blocks that are just above and just below the threshold that separates ‘safe’ from ‘semi-critical’ blocks. This design controls for block-level features that may drive differences in agricultural outcomes. The second is selection into pump ownership, where farmers who historically have had better outcomes may also be more likely to have electric pumps. To address this bias, we use propensity score matching methods to build a counterfactual group of water buyers and diesel pump owners with observable characteristics that are similar to those of electric pump owners.

Using primary data collected through a survey of 1,396 farming households, the results indicate that for the monsoon season (*khari*), electric-pump owners allocate more of their cultivated land to rice (*aman*), and have higher rice yields and value-added than diesel-pump owners. They also irrigate their rice plots more times in the season and for longer durations than both diesel-pump owners and water buyers. For the winter season, electric-pump owners allocate more of their cultivated land to rice (*boro*) than both diesel-pump owners and water buyers, and they irrigate their rice plots more times in the season and for more hours than water buyers. Finally, electric-pump owners have higher cropping intensities on their most irrigated plots than both diesel-pump owners and water buyers. In short, electric pump ownership affects agricultural outcomes and water use at the extensive and intensive margins in both seasons.

Results

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Conclusions

A quick back-of-the-envelope calculation gives a sense of the additional value-added that electric pump owners benefit from. With an average farm size of about 2 acres, the additional value-added in 2013 for electric pump owners was INR 7970. The subsidy of INR 8000 per farm that the government of West Bengal has provided to reduce the fixed cost of electric pump connections would be transferred to the farmer through additional benefit from agriculture production within one year. This back-of-the-envelope calculation does not take into consideration the additional income electric pump owners receive from water selling; electric pump owners received INR 12,000 more as compared to diesel pump owners from selling water to neighboring farmers in 2013. These results provide an economic rationale for subsidizing fixed costs of electric connections, as a pro-smallholder strategy.