

# Pricing Farm Electricity, Water Use and Efficiency: The Case of Paddy Cultivation in Punjab

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## Abstract

There has been a declining trend in groundwater depths in India and subsidies on farm electricity is seen as one of a key factors contributing to over-extraction of groundwater resources in the country raising concerns about its sustainability for irrigation. In this paper, we estimate the reduction in groundwater pumping under volumetric pricing of farm electricity for the state of Punjab where farm electricity is free. Further, we quantify gains in efficiency in terms of reduction of the deadweight loss under this pricing regime. We use parcel-level cost of cultivation data from the Ministry of Agriculture for the block period of 2011-12 to 2013-14 combined with data on groundwater depth and rainfall to estimate the production function for paddy using instrumental variable approach. This is used to get the estimates of the marginal product of water to compute the optimal level of water use at different levels of electricity price. We also quantify change in other inputs and paddy yields due to unit-price induced reduction in groundwater pumping. We find that the estimated marginal product of water at the irrigation volumes chosen by the farmers is very low. The average marginal product of water is estimated to be 34 kilograms for additional thousand cubic meters of water per hectare. Simulations show that increasing the price of electricity from current level of zero to the true cost of electricity supply leads to sharp cutbacks in water extraction using electric pumps. We show welfare gains in terms of reduction of the deadweight loss as a result of pricing agricultural electricity at the margin. We quantify average lump-sum subsidy that can be given to farmers as Direct Benefit Transfers into their bank accounts to keep their surplus unchanged.

**Keywords:** agricultural production function, deadweight loss, groundwater depletion, marginal product of water, volumetric pricing

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