



Output vs Input subsidies in agriculture: a discrete choice experiment to estimate farmers' preferences for rice and electricity subsidies in Punjab

EPRG Working Paper EPRG2406

Cambridge Working Paper in Economics CWPE2433

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One of the most serious and insidious effects of the enormous changes in Punjab agriculture over the past 60 years has been the rapid depletion and contamination of groundwater. These problems are considered critical for the State which has been historically considered the breadbasket of India. At the heart of this problem has been the incentive to exploit ground water using tube wells powered by electricity that is provided free to farmers. This paper examines the willingness of farmers to switch to low-water variety rice and pay for electricity use, due to a combination of additional rice subsidies and electricity charges.

This study applies choice modeling to show that if compensation is guaranteed, farmers are more likely to opt for low-water crop which slows down water depletion, reduces electricity consumption, and brings down carbon dioxide emissions.

The demand analysis is based on two stated choice experiments conducted with 859 farmers in Punjab in 2021-22, shedding light on key attributes which drive rice variety substitution decisions. The econometric estimation analyzed farmers' valuations for compensatory payment to make variety shifts and acceptability of different levels of compensatory payment and electricity charge. Random effects probit and conditional logit model took account of the preference heterogeneity for area-based payment for substitution by short-duration rice and minimum assured price for basmati rice variety. It is found that there is a significant valuation for most of the compensatory payment attribute levels, suggesting that compensation at fairly moderate levels could be offered to induce substitution by low-water rice variety and encourage willingness to pay for electricity. The discrete choice methodology allowed the estimation of willingness to pay (WTP) and evaluation of possible pricing strategies that could incentivize the participation of a majority of farmers required to provide the optimal level of demand response. The results suggest that introducing relatively low monthly electricity and load-based electricity charge could encourage farmers' willingness to pay.

It is found that area-based compensation of Rs. 4200 per month for substitution by short-duration rice and minimum assured price of Rs. 3200/q for basmati variety would

be accepted by about 74 percent of the farmers. About 66 percent and 58 percent of the



farmers are willing to pay the fixed monthly electricity charge with an area-based payment of Rs. 4200 per acre for short-duration rice and minimum assured price of Rs. 3200 per quintal for basmati respectively. Acceptance of load-based electricity charge is 56 percent for incentive of Rs. 4500 per acre and 58 percent for Rs. 3500 per quintal for low-water rice variety. The cost-benefit analysis has revealed that the major portion of the cost of financing the compensation could be carved out of repurposing electricity subsidies.

One limitation of this research is that it is based on hypothetical and stated choices of compensation schemes. Some randomness of choice on the farmer's side is therefore likely. The randomness of choice is expected to be heterogeneous across respondents. Segmented estimation is applied to understand the heterogeneity of choice behaviour. Some farmers may have higher willingness to pay and identifying them provides scope for introducing reform. University educated farmers are more likely to pay electricity bills with the offer of area-based payment and minimum assured price for substitution by low-water rice variety. Marginal farmers, medium farmers, and multiple tube well-owning farmers are likely to prefer load-based electricity charge with area-based payment. Farmers in the Malwa region of Punjab are more likely to accept area-based payment for substitution by short-duration rice, while farmers in the Majha region of Punjab are more favorably inclined towards substituting basmati rice with the offer of minimum assured price. Farmers in the Majha region show lower negative preferences for willingness to pay for electricity. The variation in valuation across different socio-economic-demographic characteristics and spatial spread proves that 'one size fits' all may not necessarily fit all.

This paper is the first step towards a full cost-benefit analysis of a more complex policy design and highlights the strategic opportunities for applying the toolbox of choice modeling to address the invidious energy-water-food nexus in India. Future work could explore heterogeneity in farmers' preferences for different crop varieties and willingness to pay for electricity. The direct impact of socio-economic and demographic characteristics on preferences can be examined as another extension of the baseline model. Consideration of attribute interactions could be an interesting extension of this work.

The findings of this paper establish that identifying factors that influence farmers' preferences can be used to prepare potentially more cost-efficient and more widely acceptable diversification and energy pricing strategies. We provide evidence that a new and more intelligent combination of agricultural output subsidies and electricity input use charges which produce higher aggregate social welfare could be acceptable to farmers. It is hoped that the selection and targeting of policy measures to tap the water and energy-saving potential of the farmers would be better informed by this line of research on behaviour, policy, and preferences in the future.

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Publication June 2024
Financial Support EPRG