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Estimation of Irrigation Water Demand and Economic Values of Water in Northern China

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Irrigation plays a vital role in the agricultural sector of many countries. Water pricing policy is one of most important policy instruments of demand management. Implementing an effective water price policy requires an in-depth understanding of agricultural water demand and the economic value of irrigation water. Despite many researches indicate water price is an effective measure to reduce irrigation application, the results of research about both price elasticity of irrigation water demand and economic value of irrigation water are far from being consistent. Worse more, many studies have focused on the developed countries while less literature is about China. There is also little related research has studied surface water and groundwater, respectively. In addition, there is less quantitative analysis based on a set of large-scale field survey panel data.

The overall goal of this paper is to assess the price elasticities of irrigation water demands and their economic values. This study first estimates price elasticities of irrigation water demands and crop production functions. The values of marginal product (VMPs) of water are then imputed by multiplying the estimated output elasticities with respect to water with crop prices, crop yields and irrigation application rates. The VMPs measure how much water is valued by rural households, which provide policy makers with some guideline on the minimum increments in water prices needed to achieve water savings. A set of four-round of survey data enable the use of plot fixed effects in the estimation of functions. The supporting data is on the levels of village, household and plots and was conducted in 2001, 2004, 2007 and 2011, respectively. The coverage of data includes Ningxia and Henan province in the upstream and downstream of the Yellow River Basin respectively, and Hebei province in the Haihe River Basin. The data is a set of panel dataset, concluding a total of 88 villages, 518 households, 1036 plots.

Both price elasticities and VMPs vary by types of crops and sources of irrigation water. For instance, maize's price elasticity s more sensitive than wheat, and the price elasticities surface water demand for two crops are greater than that of groundwater (the absolute value of price elasticity of surface water for wheat and maize are 0.3 and 0.5; under groundwater irrigation, the results became 0.09 and 0.18, respectively). Moreover, the VMPs of irrigation water for wheat and maize on the plots of surface water irrigation are similar, which is about 0.15 yuan/m3; while in plots of underground water, the VMP of maize is obviously higher (wheat and maize are 0.17 and 0.37 yuan/m3, respectively). In addition, the VMPs of both crops under groundwater irrigation are greater than that of surface water. Moreover, for a large share of the sample, households gain higher VMPs of water than how much they are currently paying for water (about 67% for wheat and 71% for maize). Thus, a one-size-fits-all water pricing policy may not be the most effective approach.