*Understanding the consequences of increased irrigation efficiency for consumptive water use*

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**Introduction**

Sustainable and efficient use of water resources for agriculture is an increasingly important goal as global food demand increases, aquifer stores decline, and droughts become more frequent. Increasing the efficiency of irrigation water use – the ratio of consumptive use to water extracted – is therefore seen as an appealing option for reducing water use. However, limited case studies have shown that as irrigation efficiency increases, producer decision-making and cropland expansion has the potential to increase consumptive water use, undermining the original goal of the efficiency increase. Here, we identify the conditions under which irrigation efficiency leads to a decrease in water use, a “rebound effect” where water use is decreased but not as much as expected, and where Jevon’s paradox leads to an increase in water use. These insights are gained from an economic model that accounts for the spatial heterogeneity in key drivers of these impacts across the U.S.

**Methods**

We employ the SIMPLE-G-US model here, and will focus on understanding which conditions (represented as parameters in the model) are key to accurately predicting the direction of change in water use that results from a change in irrigation efficiency. Within this economic model, we will simulate both a technological advancement (e.g., cost reductions for improving irrigation efficiency) and a policy scenario (mandated increases in irrigation efficiency). First, historical model simulations will be validated using data on irrigation technology, water consumption, and crop yields across the U.S. available from the USGS. Then we will perform parameter sensitivity analysis to elucidate which conditions, changes, and uncertainties are most important drivers of the model outcomes.

**Expected results**

Results from the model validation and sensitivity analysis will show:

* How well we are currently able to predict water use changes resulting from irrigation efficiency changes
* Which conditions (e.g., cropland area, water supply, initial irrigation efficiency, prices, productivity) are most important in driving changes in consumptive water use in the face of irrigation efficiency improvements
* Identifying areas of the US where irrigation efficiency policy will likely result in reductions in consumptive water use