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Jordan Suter
jordan.suter@colostate.edu

Chris Goemans

Ryan Bailey

Isaya Kisekka

Mani Rouhi Rad

See next page for additional authors

Presenter/Author Information

Jordan Suter, Chris Goemans, Ryan Bailey, Isaya Kisekka, Mani Rouhi Rad, and Dale Manning

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Integrating Hydrologic, Agronomic, and Economic Modelling to Evaluate the Impacts of Groundwater Conservation Policies in the Ogallala Aquifer Region

Dale Manning (dale.manning@colostate.edu)[1]
Jordan Suter (Jordan.suter@colostate.edu)[1]
Chris Goemans (chris.goemans@colostate.edu[1]
Mani Rouhi Rad (mani.rouhirad@yale.edu)[1]
Ryan Bailey (ryan.bailey@colostate.edu)[1]
Isaya Kisekka (ikisekka@ucdavis.edu)[2]

1 Colorado State University
2 UC-Davis Affiliations

Abstract: The Ogallala Aquifer provides irrigation water for agricultural producers across eight Midwestern US states. Declining groundwater levels across the region have catalysed interest in managing groundwater extraction. The common pool nature of the aquifer means that gains to limiting groundwater extraction should exist, though the costs and benefits likely differ substantially across space. Characterizing this heterogeneity can aid policymakers and managers in identifying areas where management efforts have the potential to yield the most gain. Despite this, relatively little research has examined heterogeneity in groundwater management policy impacts. We develop a hydro-agro-economic modelling framework to estimate the short- and medium-run impacts of groundwater conservation policies. The model links profit-maximizing producer planting and irrigation decisions to crop growth and aquifer drawdown across each well in the study area. A crop model (DSSAT) provides estimates of the relationship between crop growth and water use, conditional on crop choice, well yield, soil type, total acres planted, and weather over a growing season. At the time of planting, the producer does not know the weather with certainty and is assumed to choose crop management practices and soil moisture targets to maximize expected profit. Optimal irrigation quantities resulting from daily weather realizations provide pumping volumes to a linked regional SWAT-MODFLOW model. The model is applied to Finney County, KS where initial findings illustrate considerable heterogeneity in the impacts of groundwater conservation policies.

***Keywords**:* hydro-economic modelling; policy evaluation; crop modelling; irrigation model;