

Economic Opportunities for Producing Bioenergy Feedstocks and Optimizing Aquifer Life in the US High Plains

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Introduction & Objectives

We evaluate economic opportunities for producing alternative bioenergy feedstocks in agricultural lands overlying the Ogallala aquifer and estimate maximum long-term benefits under land use management and groundwater limitations.

Significance of the U.S. High Plains region:

- Freshwater:** Ogallala is the largest freshwater aquifer in the U.S. linked to the High Plains system.
- Grain Production:** The region is dominated by 41% agriculture (~14% are irrigated for grain production) and 56% rangeland with high productive soils.
- Agricultural Industry:** \$35 billion in crop sales each year (Basso et al., 2013).

Drought tolerant bioenergy crops offer a solution to the region's interconnected challenges of dwindling groundwater supplies and a changing climate.

- Producers face decreased well capacities, falling crop yields, and higher extraction costs.
- Adaptation to these challenges involve switching to alternative irrigated crops that have higher returns on water, transitioning to dryland production, or cease farming and enroll in CRP or rent land for pasture.

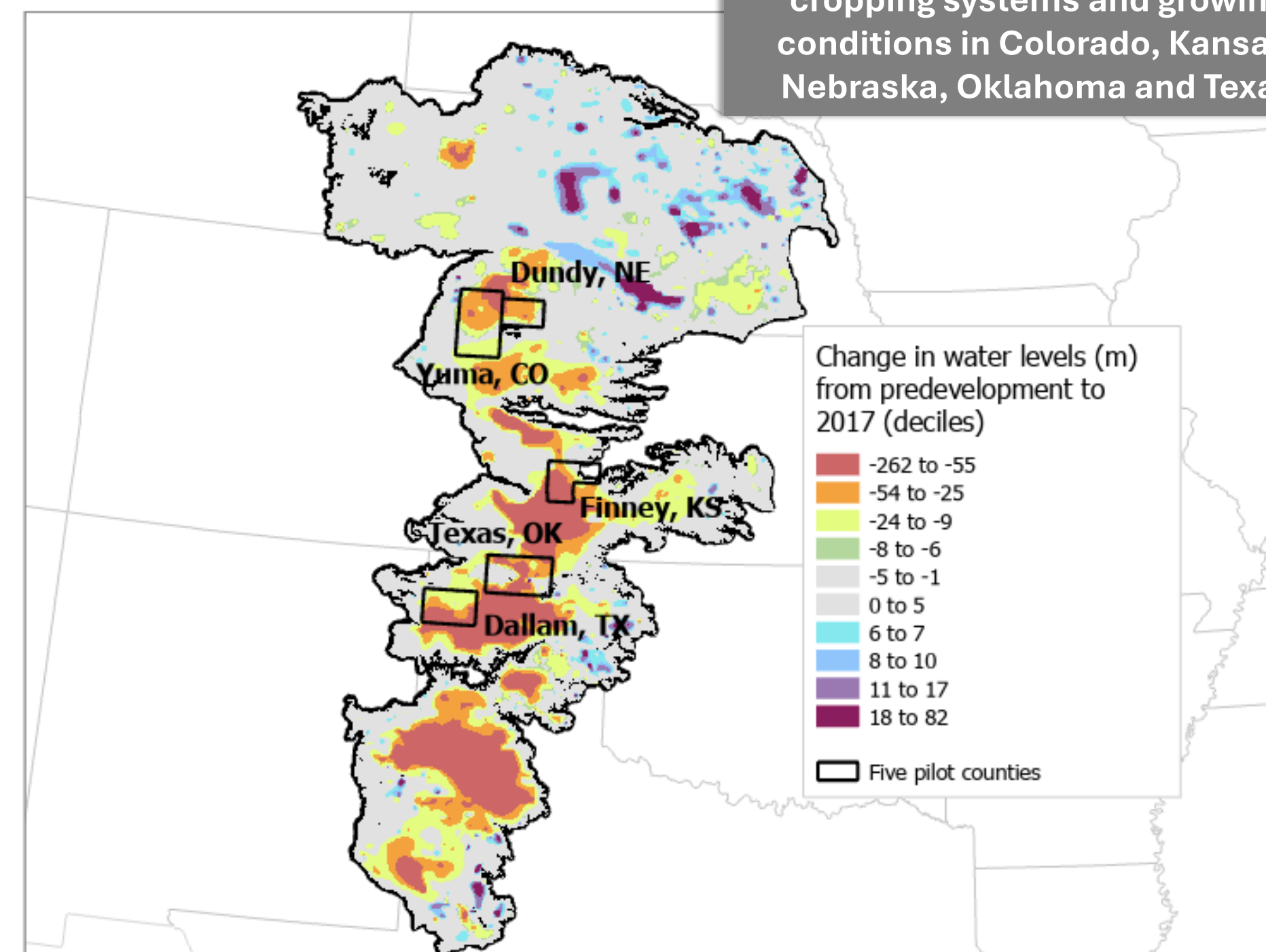


Figure 1. Change in water levels from predevelopment to 2017 and location of five pilot counties overlying the U.S. High Plains aquifer

Source for map: McGuire, V.L., Strauch, K.R., et al. (2022).

<https://doi.org/10.3133/sir20225080>

Five pilot counties follow Deines et al. (2020).

Approach & Methods

Step 1: Economic analyses to construct county-level net returns under existing agricultural systems in study area (NASS, 2022 & U.S. DOE, 2016).

Step 2: Utilize existing remotely sensed data on aquifer and well characteristics in study area (Gleeson et al., 2014).

Step 3: Intersect the groundwater permeability and porosity to estimate the minimum saturated thickness to sustain 90-days pumping (Ramaswamy et al., 2017).

Step 4: Calculate net returns under alternative irrigated (corn and sorghum) and non-irrigated (corn, sorghum and switchgrass) agricultural systems using an enterprise budgets approach.

Step 5: Determine the optimal irrigated and non-irrigated crop choices for five major irrigated locations across the US High Plains, subject to groundwater constraint, using a 30-year multiperiod model.

Our approach is illustrated below in Figure 2.

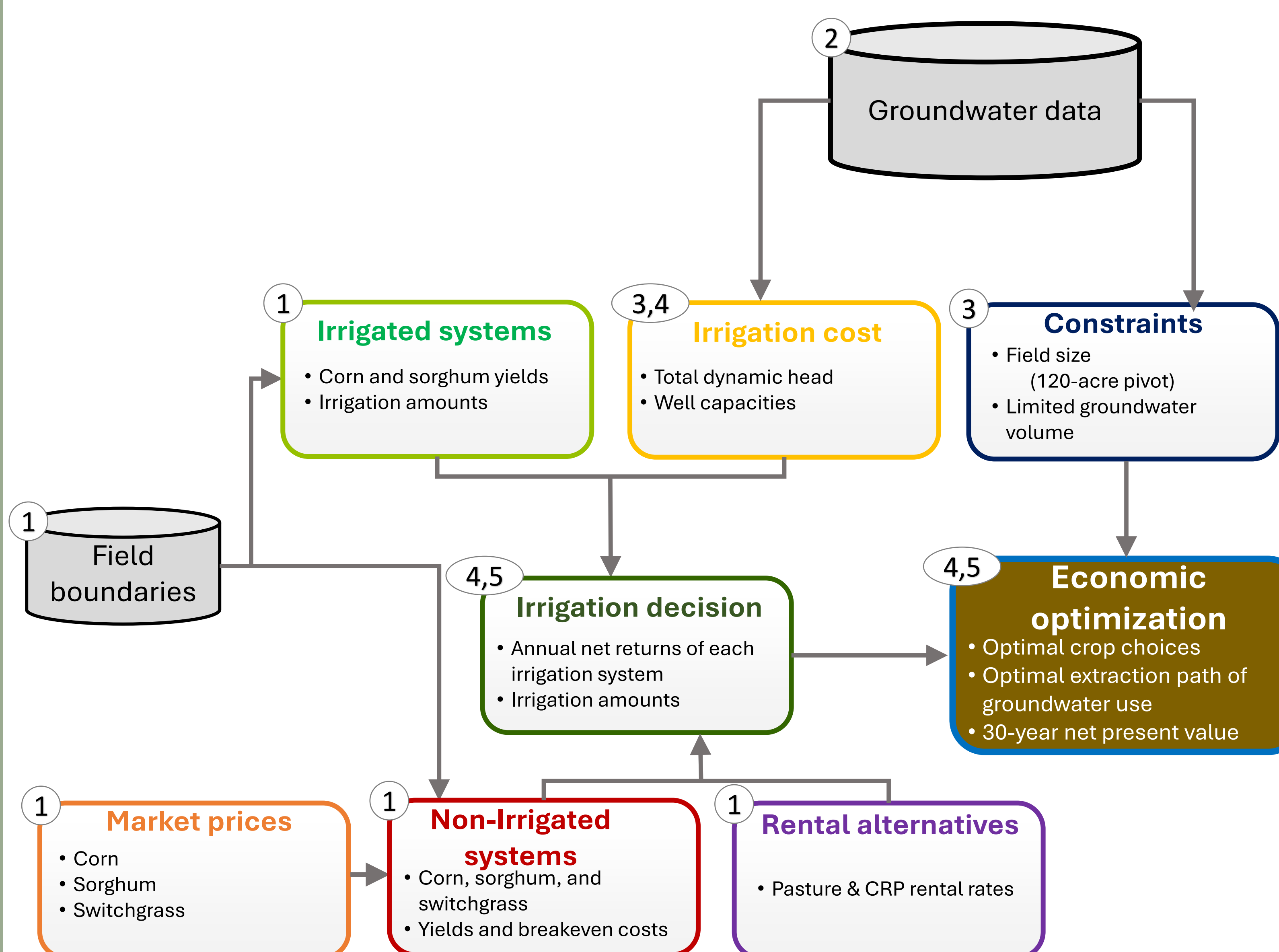


Figure 2. Flowchart of our approach

References: Basso, B., A.D. Kendall, D.W. Hyndman. 2013. The future of agriculture over the Ogallala Aquifer: Solutions to grow crops more efficiently with limited water. *Earth's Future*, 1: 39-41.

Deines, J.M., M.E. Schipanski, B. Golden, S.C. Zipper, S. Nozari, C. Rottler, B. Guerrero, V. Sharda. 2020. Transitions from irrigated to dryland agriculture in the Ogallala Aquifer: land use suitability and regional economic impacts *Agric. Water Manag.*, 233 (2020), Article 106061

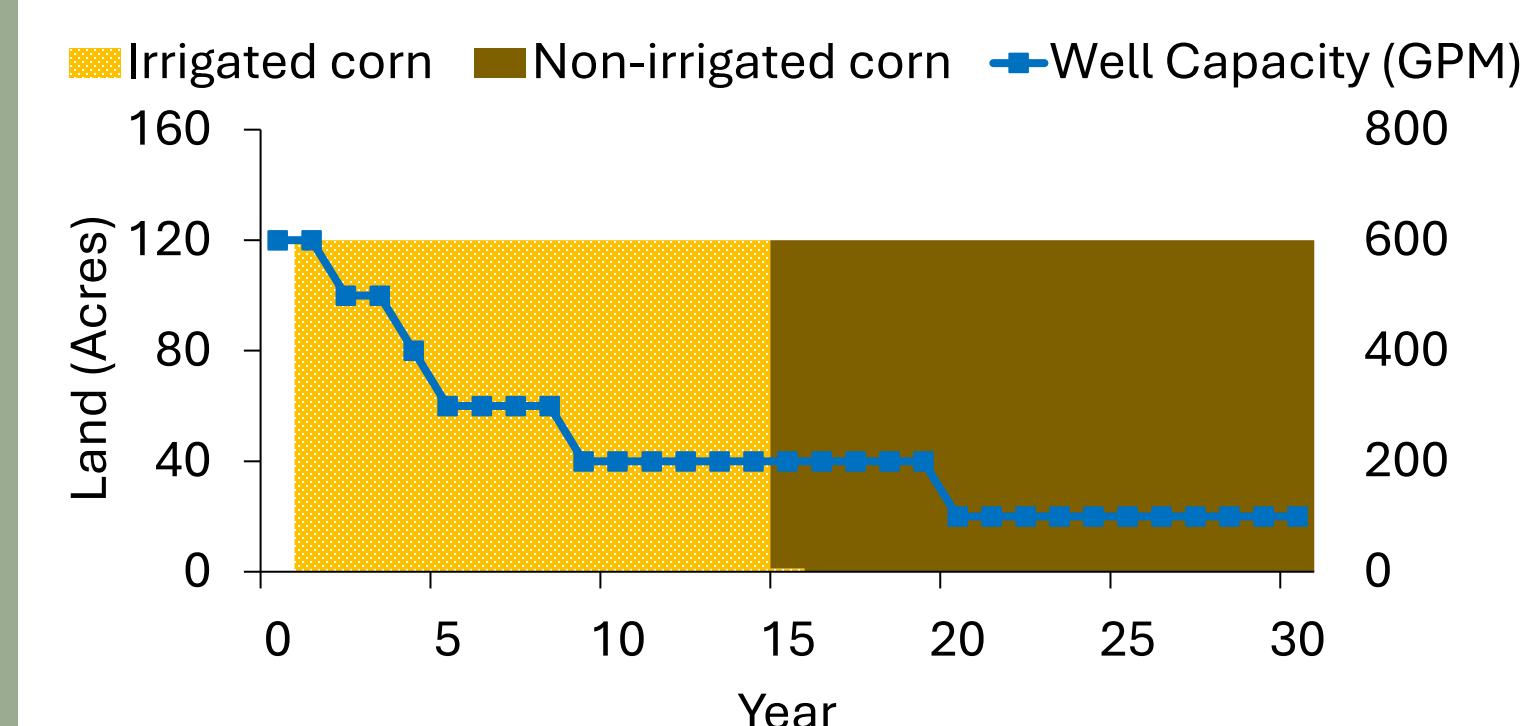
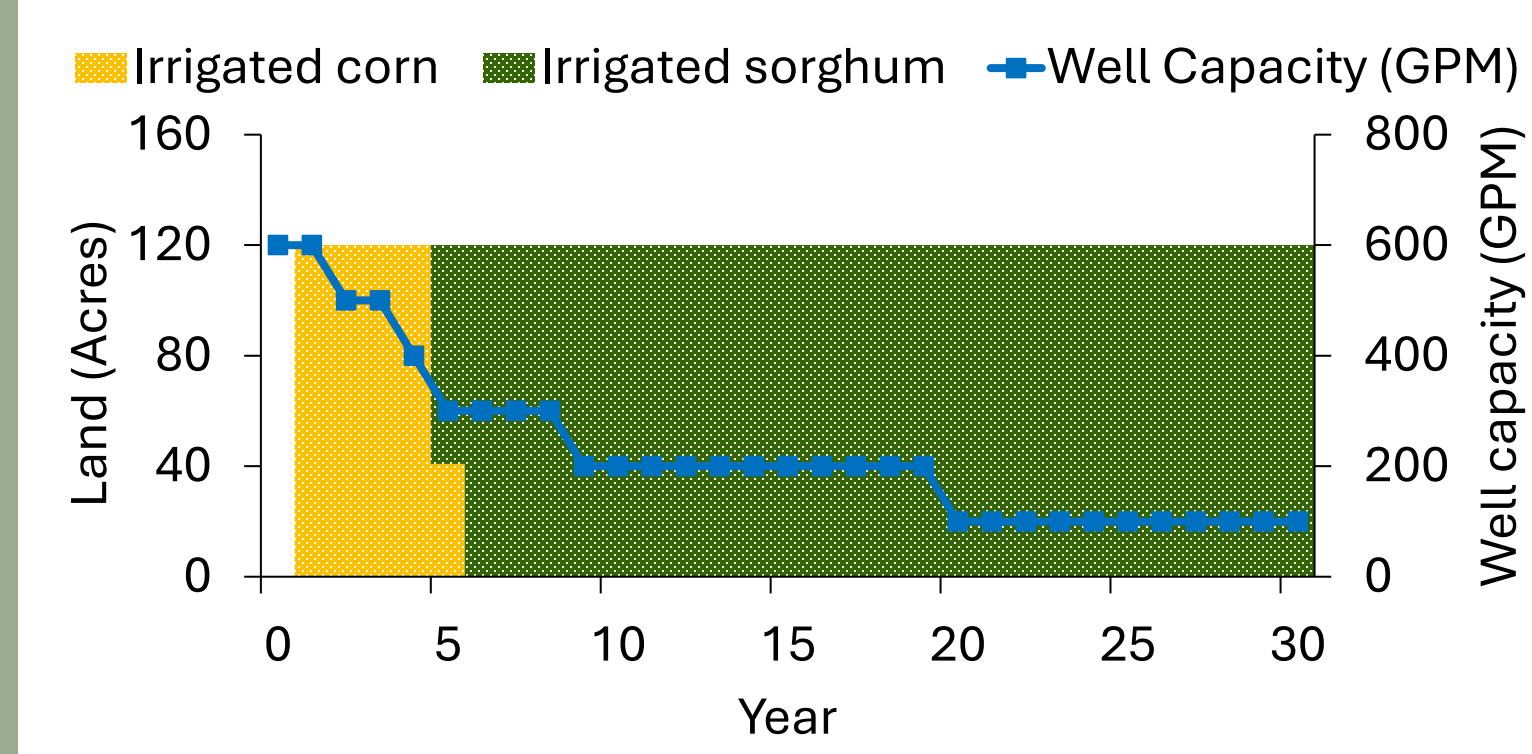
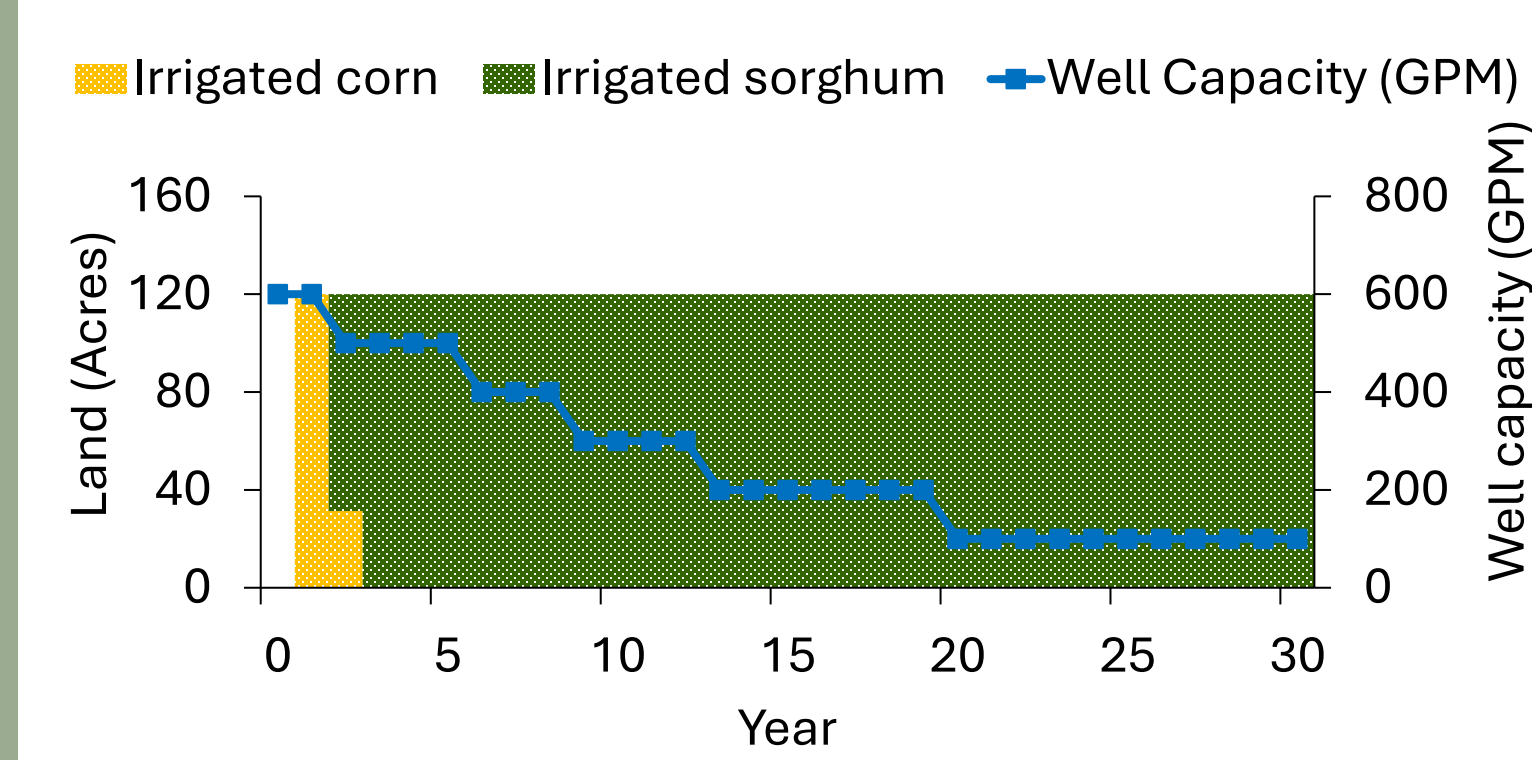
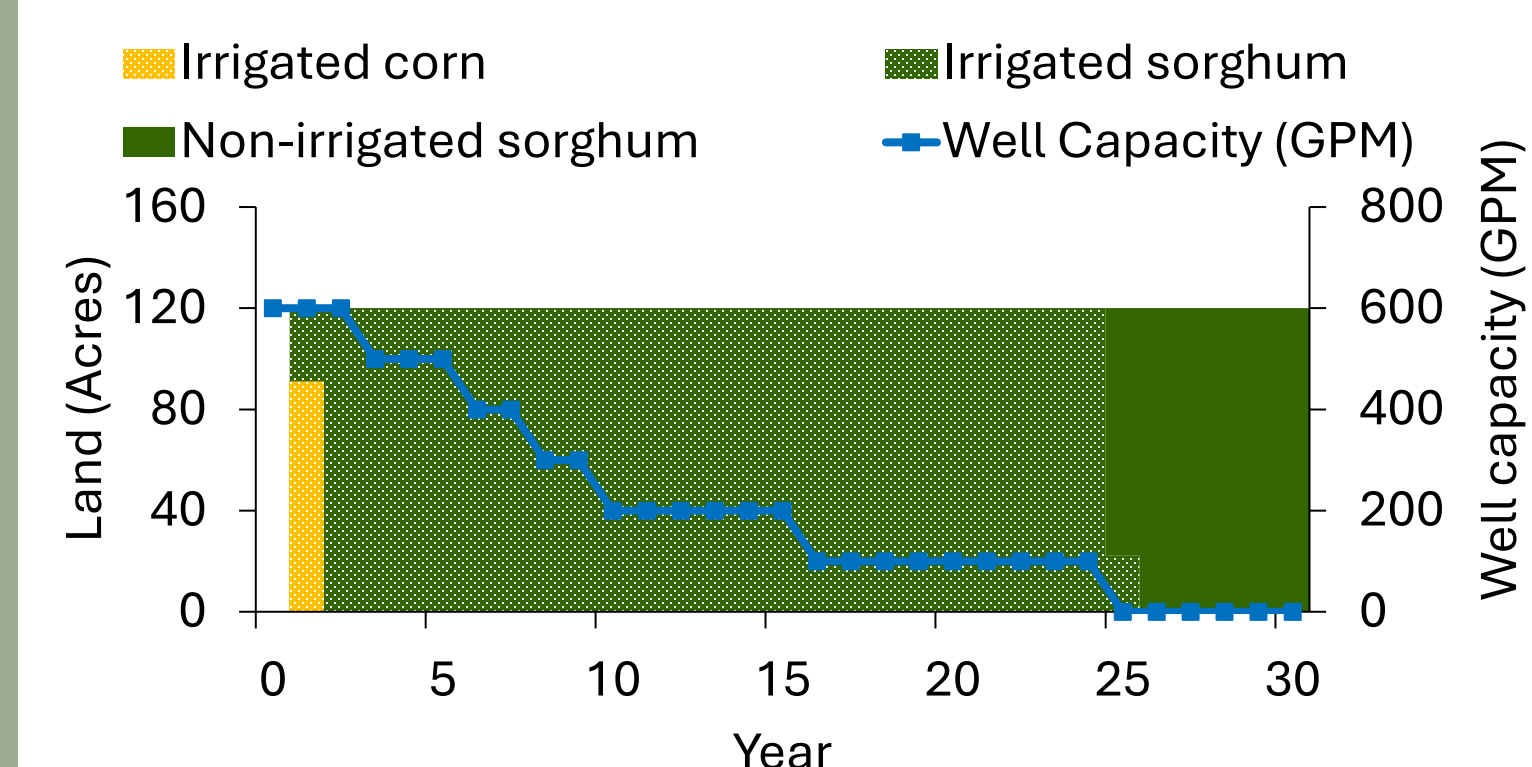
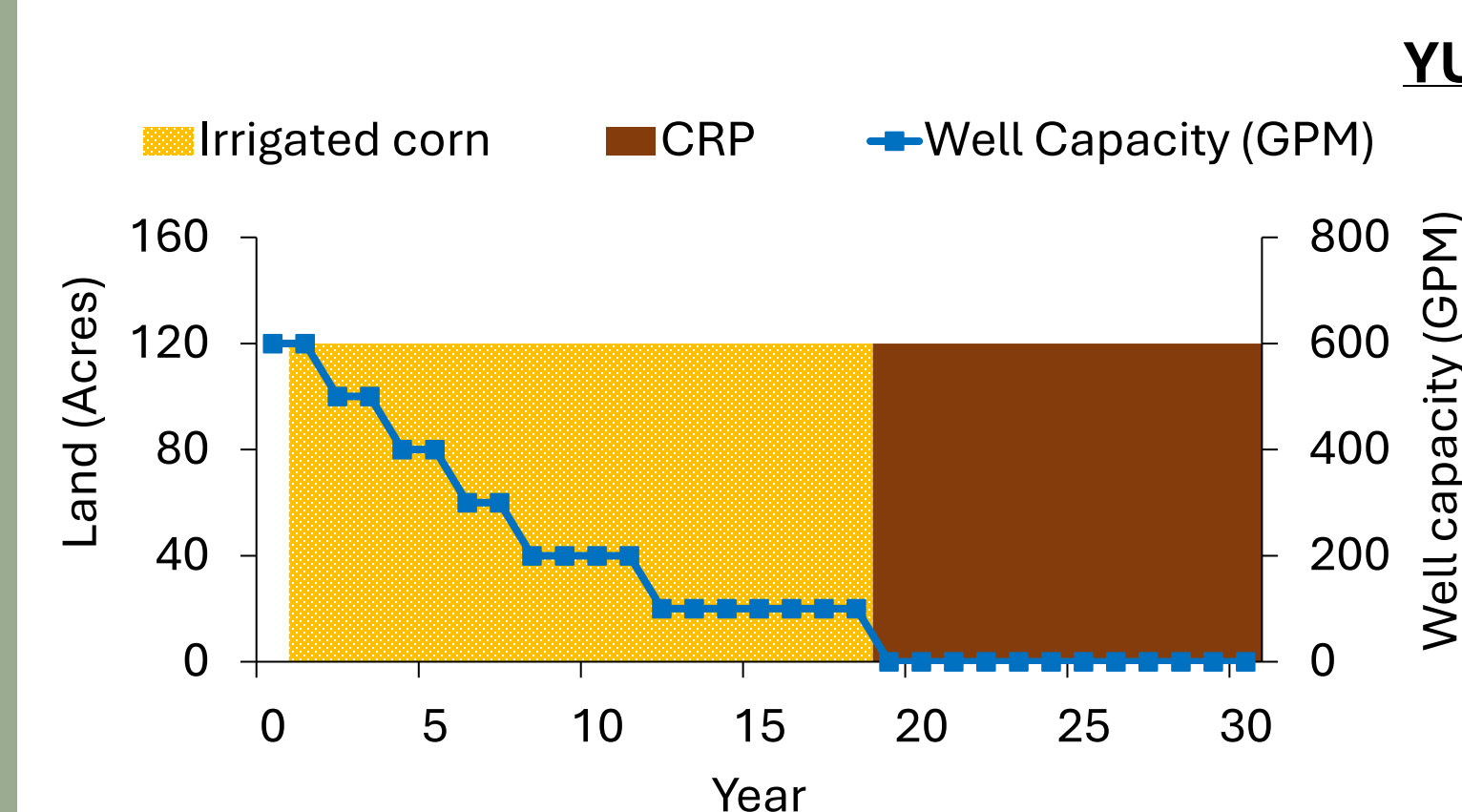
Gleeson, T., N. Moosdorf, J. Hartmann, and L.P.H. van Beek. 2014. A glimpse beneath earth's surface: GLobal HYdrogeology MaPS (GLHYMPS) of permeability and porosity. *Geophysical Research Letters*, 41: 2014GL059856

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Acknowledgment: This work was supported by the Great Lakes Bioenergy Research Center, US Department of Energy, Office of Science, Office of Biological and Environmental Research (award DE-SC0018409)

Results for Five Pilot Counties

Irrigated system followed by dryland transition choices for 120-acre pivot with well capacity of 600 GPM



Static crop budgets showing the most profitable dryland system choices for non-irrigated lands

