

Brief #1: Measuring Conservation

Estimating the Water Conservation Potential of Voluntary Irrigation Withdrawals on Working Livestock Pastures

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Overview

- Irrigated pasture-livestock systems dominate agriculture in Western Colorado, yet data on their water use and water conservation potential under voluntary irrigation withdrawals remains limited.
- We partnered with Western States Ranches to test eight irrigation scenarios on two working pastures, Orchard Ranch near Eckert and Banner Ranch near Delta, on Colorado's Western Slope.
- Results showed strong potential for voluntary withdrawal practices to reduce water use while maintaining some forage production. The greatest reductions came from early- and shoulder-season cutbacks—up to 47% when compared to fully irrigated reference fields.

Purpose

We evaluated the potential of voluntary irrigation withdrawal strategies, to help inform the design of practical, incentive-based water conservation programs for grazed pastures.

The findings will help stakeholders and policymakers:

- Assess the potential of voluntary irrigation withdrawals on working pastures to meaningfully contribute to regional water conservation efforts.
- Recommend measurement methods and program design features that align water savings goals with operational realities of livestock producers.

Approach

We tested 8 irrigation withdrawal strategies across ranches, using remote-sensing models to estimate actual evapotranspiration (ETa) and conserved consumptive use (CCU).

- Treatments included full-withdrawal, spring only, fall only, shoulder month, split season (June 1, July 1, and Aug 1 shutoffs), and no-withdrawal strategies.
- Integrated livestock grazing into the study ensured that estimates reflect real-world grazing conditions.

We used NDVI remote sensing to measure ETa, CCU, and spatial variability compared to fully-irrigated reference fields.

Findings

The results provide field-based evidence that voluntary irrigation withdrawals can reduce ETa in grazed pastures.

- Seasonal ET on the fully irrigated reference fields was 33.7 and 35.3 inches at Banner and Harts Basin ranches, respectively.
- Field-scale ETa estimates, derived from NDVI, were correlated with irrigation timing.

Irrigation withdrawal implemented early in the season had the largest CCU benefit, confirming the expected outcomes.

- Full-season withdrawal and late-season only irrigation had highest CCU compared to the fully irrigated reference fields, 40-47% at Banner and 27-30% at Harts Basin.
- Standard irrigation early in growing season with mid- or late-season withdrawal (July 1 or August 1 shutoff) resulted in less CCU, 6-10% at Banner and 15-17% at Harts Basin, indicating diminished returns with delayed withdrawal.
- Irrigation only in May and September (shoulder months) showed moderate CCU, offering a balanced approach between conservation and forage growth.

Strategically implementing reductions can conserve water without fully compromising forage availability.

Insights

The findings are relevant for voluntary water-sharing programs that may compensate producers for water conservation:

- Results help fill key data gaps on ETa and CCU under irrigation curtailment in Western Colorado.
- Accurate estimation of CCU requires careful selection of reference fields, suggesting a potential benefit to using multiple reference zones.

Significant within-field variability, particularly at Orchard Ranch, influenced CCU outcomes.

- This is particularly true for heterogeneous pastures, like Orchard Ranch, where variability is more pronounced.

Combining remote sensing (SIMS and NDVI-based methods) with field data improves accuracy of water use measurements.

- Local field conditions play significant role in conservation outcomes, emphasizing the need for site-specific strategies and flexible program designs.
- ETa estimates can support the scalability and transparency of voluntary, incentive-based water-sharing programs, increasing producers view of the programs.

