COLORADO
Colorado Water Conservation Board
Department of Natural Resources

## Colorado Water Conservation Board

# Water Plan

## Water Project Summary

| | |
|---|---|
| Name of Applicant | Colorado State University |
| Name of Water Project | Opportunities for enhancing the water productivity of alfalfa based production systems in Western Colorado |
| Grant Request Amount | **$190,278.30** |
| Primary Category | $190,278.30 |
| *Agricultural Projects* | |
| Total Applicant Match | **$63,432.62** |
| *Applicant Cash Match* | $31,717.79 |
| *Applicant In-Kind Match* | $31,714.83 |
| Total Other Sources of Funding | **$0.00** |
| Total Project Cost | **$253,710.92** |

## Applicant & Grantee Information

Name of Grantee: Colorado State University
Mailing Address: 2002 Campus Delivery Fort Collins CO 80523

Organization Contact: Srinivasa rao Pinnamaneni
Position/Title: Research Scientist
Email: sriniv@colostate.edu
Phone: (352) 328-7047

Organization Contact - Alternate: Sponsored Programs
Position/Title:
Email:
Phone: 9702428686

Grant Management Contact: Srinivasa rao Pinnamaneni
Position/Title: Research Scientist
Email: sriniv@colostate.edu
Phone: (352) 328-7047

## Description of Grantee/Applicant

No description provided

## Type of Eligible Entity

- [x] Public (Government)
- [ ] Public (District)
- [ ] Public (Municipality)
- [ ] Ditch Company
- [ ] Private Incorporated
- [ ] Private Individual, Partnership, or Sole Proprietor
- [ ] Non-governmental Organization
- [ ]

- [ ] Covered Entity
- [ ] Other

## Category of Water Project

- [x] Agricultural Projects
  *Developing communications materials that specifically work with and educate the agricultural community on headwater restoration, identifying the state of the science of this type of work to assist agricultural users among others.*
- [ ] Conservation & Land Use Planning
  *Activities and projects that implement long-term strategies for conservation, land use, and drought planning.*
- [ ] Engagement & Innovation Activities
  *Activities and projects that support water education, outreach, and innovation efforts. Please fill out the Supplemental Application on the website.*
- [ ] Watershed Restoration & Recreation
  *Projects that promote watershed health, environmental health, and recreation.*
- [ ] Water Storage & Supply
  *Projects that facilitate the development of additional storage, artificial aquifer recharge, and dredging existing reservoirs to restore the reservoirs' full decreed capacity and Multi-beneficial projects and those projects identified in basin implementation plans to address the water supply and demand gap.*

## Location of Water Project

| | |
|---|---|
| Latitude | 38.717027 |
| Longitude | -107.661751 |
| Lat Long Flag | |
| Water Source | Lower Gunnison River Basin-<br>Crawford Water Conservancy District (CWCD) |
| Basins | Gunnison |
| Counties | Delta |
| Districts | 40-North Fork/Tribs. |

## Water Project Overview

| | |
|---|---|
| Major Water Use Type | Agricultural |
| Type of Water Project | Study |
| Scheduled Start Date - Design | 4/1/2025 |
| Scheduled Start Date - Construction | |

Description

About 650,000 acres of alfalfa (Medicago sativa L.) were harvested in the state of Colorado in 2023 (NASS, 2023). Alfalfa crop constitutes a large fraction of the agricultural water use on the Upper Colorado River Basin and can withstand occasional limited irrigation in some areas without significant yield losses by altering some management practices. One among them is instead of monoculture of alfalfa, a mixture of alfalfa, falcata along with either grass (meadow brome, orchard grass) or other legumes (Sainfoin, Cicer milk vetch, CMV) have been reported to sustain the productivity and hay quality to a greater extent (Cox et al 2017; Sanderson et al 2016). We are trying to find answers through research and on-farm trials to a question asked by an alfalfa grower in Western Colorado- What are the best drought tolerant alfalfa lines or alfalfa + grass/legume species combination options available to growers - under restricted water availability? Both CMV and Sainfoin are chosen as they are non-bloating legumes having higher persistence than alfalfa and are readily preferred by livestock growers. This proposal aims to quantify evapotranspiration (ET) of alfalfa+grass/legume mixtures (improved practice) vis a vis

monoculture of alfalfa (conventional practice) in the hay growers fields. This research not only helps in optimizing water use but also supports the economic stability of alfalfa growers in Western Colorado.

## Measurable Results

New Storage Created (acre-feet)
New Annual Water Supplies Developed or Conserved (acre-feet), Consumptive or Nonconsumptive
Existing Storage Preserved or Enhanced (acre-feet)
New Storage Created (acre-feet)
Length of Stream Restored or Protected (linear feet)
Length of Pipe, Canal Built or Improved (linear feet)
Efficiency Savings (dollars/year)
Efficiency Savings (acre-feet/year)
Area of Restored or Preserved Habitat (acres)
Quantity of Water Shared through Alternative Transfer Mechanisms or water sharing agreement (acre-feet)
Number of Coloradans Impacted by Incorporating Water-Saving Actions into Land Use Planning
Number of Coloradans Impacted by Engagement Activity

Other

Water Use Efficiency: Determine which alfalfa mixtures maximize production per unit of water used, contributing to sustainable water management practices in the region using eddy covariance and remote sensing approaches.

Economic Viability: Assess cost-benefit scenarios for growers adopting new practices, including reduced input costs associated with lower irrigation needs.

Recommendations for Growers: Create a guideline for the selection of suitable alfalfa+grass or alfalfa+legume combinations tailored to specific local conditions (dryland, sprinkler systems)

## Water Project Justification

Irrigated agriculture is responsible for 52% of overall water consumption in Colorado River Basin (CRB) and crops such as alfalfa and other grass hays account for 46% of all direct water consumption. About 650,000 acres of alfalfa (Medicago sativa L.) were harvested in the state of Colorado in 2023 (NASS, 2023). Alfalfa crop constitutes a large fraction of the agricultural water use on the Upper Colorado River Basin, and can withstand occasional limited irrigation in some areas without significant yield losses by altering some management practices. One among them is instead of monoculture of alfalfa, a mixture of alfalfa, falcata along with either grass (meadow brome, orchard grass) or other legumes (Sainfoin, Cicer milk vetch, CMV) have been reported to sustain the productivity and hay quality to a greater extent (Cox et al 2017; Sanderson et al 2016). We are trying to find answers through research and on-farm trials to a question asked by an alfalfa grower in Western Colorado- What are the best drought tolerant alfalfa lines or alfalfa + grass/legume species combination options available to growers - under restricted water availability? Both CMV and Sainfoin are chosen as they are non-bloating legumes having higher persistence than alfalfa and are readily preferred by livestock growers. This proposal aims to quantify evapotranspiration (ET) of alfalfa+grass/legume mixtures (improved practice) vis a vis monoculture of alfalfa (conventional practice) in the hay growers fields through large scale on-farm trials in Western Colorado.

## Related Studies

Montazar, A., & Putnam, D. (2023). Evapotranspiration and Yield Impact Tools for More Water-Use Efficient Alfalfa Production in Desert Environments. Agriculture, 13(11), 2098.
Cox, S., Peel, M. D., Creech, J. E., Waldron, B. L., Eun, J. S., Zobell, D. R., ... & Snyder, D. L. (2017). Forage production of grass–legume binary mixtures on intermountain western USA irrigated pastures. Crop Science, 57(3), 1742-1753. https://doi.org/10.2135/cropsci2016.04.0235
Richter, B. D., G. Lamsal, L. Marston, S. Dhakal, L. S. Sangha, R. R. Rushforth, D. Wei, B. L. Ruddell, K. F. Davis, A. Hernandez-Cruz, S. Sandoval-Solis, and J. C. Schmidt. "New Water Accounting Reveals Why the Colorado River No Longer Reaches the Sea." Communications Earth & Environment 5, no. 1 (2024): 1–12. https://doi.org/10.1038/s43247-024-01291-0

Singh, R., G. Senay, N. Velpuri, S. Bohms, R. Scott, and J. Verdin. "Actual Evapotranspiration (Water Use) Assessment of the Colorado River Basin at the Landsat Resolution Using the Operational Simplified Surface Energy Balance Model." Remote Sensing 6, no. 1 (2013): 233–256. https://doi.org/10.3390/rs6010233.

Ottman, M. J., Tickes, B. R., & Roth, R. L. (1996). Alfalfa yield and stand response to irrigation termination in an arid environment. Agronomy journal, 88(1), 44-48.

Putnam, D., Takele, E., Kallenback, R., & Graves, W. (2000). Irrigating alfalfa in the Low Desert: Can summer dry-down be effective for saving water in alfalfa. Report submitted to the Bureau of Reclamation (USDI), Yuma, Arizona.

Lindenmayer, R. B., Hansen, N. C., Brummer, J., & Pritchett, J. G. (2011). Deficit irrigation of alfalfa for watersavings in the Great Plains and Intermountain West: A review and analysis of the literature. Agronomy Journal, 103(1), 45-50.

Retta, A., & Hanks, R. J. (1980). Corn and alfalfa production as influenced by limited irrigation. Irrigation science, 1, 135-147.

Costa-Filho, E., J. L. Chávez, H. Zhang. (2023). A multi-sensor analysis of selected reflectance-based crop coefficient models for daily maize evapotranspiration estimation. Journal of Agricultural Science, 15 (12). DOI:10.5539/jas.v15n12p1.

Costa-Filho, E., Chávez, J. L., Zhang, H. (2024). Mapping maize evapotranspiration with two-source land surface energy balance approaches and multiscale remote sensing imagery pixel sizes: accuracy determination toward a sustainable irrigated agriculture. Sustainability, 16(11), 4850.

Pôças, I., Calera, A., Campos, I., Cunha, M. (2020). Remote sensing for estimating and mapping single and basal crop coefficients: A review on spectral vegetation indices approaches. Agricultural Water Management, 233, 106081. doi:https://doi.org/10.1016/j.agwat.2020.106081

Trout, T. J., DeJonge, K. C. (2018). Crop water use and crop coefficients of maize in the Great Plains. Journal of Irrigation and Drainage Engineering, 144(6), 04018009. https://doi.org/10.1061/(ASCE) IR.1943-4774.0001309

## Taxpayer Bill of Rights

No Tax Bill of Rights provided