Memorandum

To: Greg Peterson
From: Brenna Mefford and Erin Wilson
Date: 1/10/2024
Re: 2023 Ag Drought Resilience Project Results

Over the past ten years, drought and limited water supplies have impacted agricultural operations throughout Colorado more frequently than seen historically. In response to increased drought conditions, in 2023 the Colorado Ag Water Alliance (CAWA) and project partners launched the Ag Drought Resiliency Program to provide funding to support the design and implementation of drought resilience and innovative water conservation projects with agricultural water users and water managers. The program serves to address several gaps in funding and support for incubator projects on farms and ranches that can improve agriculture's drought resiliency. In 2023 the program funded 31 projects that included the following project types:

- Alternative Cropping
- Irrigation Efficiency Improvements
- Hay and Forage Management
- Livestock Management
- Soil Health Improvements

This memo provides a summary of the projects, general lessons learned, and includes a one-page summary of every project completed in 2023 in Appendix A.

Projects Selected and Project Status

Two projects of the 31 funded were not implemented. Most of the implemented projects were completed in 2023, but some did not begin until the fall of 2023 and will be completed in 2024. Below is a summary of the projects funded and the status of each project. Note that the Alternative Forages Project summary is based on three applicants combined into one project.

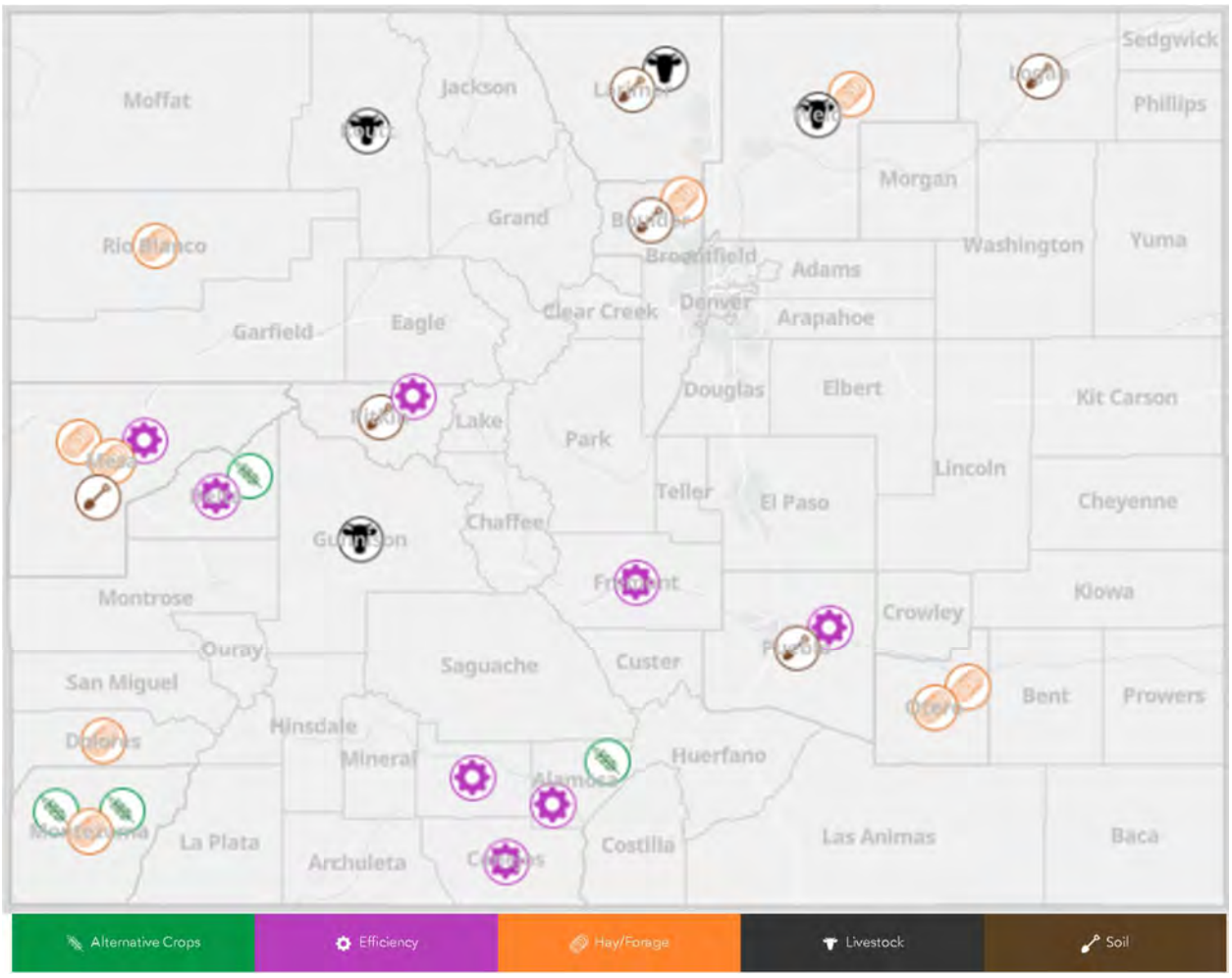
Project Name	Project Organization	Grant Amount	Project Type	Status
Drip Tape – Gated Pipe Connector Project	Delta Conservation District	$ 19,450	Irrigation Efficiency	Completed in 2023
Forage Conversion	2C Ranch	$5,610	Hay and Forage Project	Completed in 2023

Project Name	Project Organization	Grant Amount	Project Type	Status
Perennial Forages – Mesa Project	Mountain Island Ranch	$11,830	Hay and Forage Project	Planted in Fall of 2023, Will be Completed in 2024
Stubble Height and Soil Health	Reker Farms	$4,110	Soil Health Project	Part of the project completed in 2023, will be finished in 2024
Virtual Fencing Project	Routt County Conservation District	$17,500	Livestock Project	Completed in 2023
Precision Irrigation Project	Rio Grande Conservation District	$21,820.00	Irrigation Efficiency Project	Part of the project completed in 2023, will be finished in 2024
Drought Hardy Seeds and Legumes Project	Pueblo Seed & Feed Co.	$32,500	Alternative Crops Project	Completed in 2023
Compost and Biochar Project	GBT Farms	$7,480	Soil Health Project	Completed in 2023
Cowpeas for Animal Feed Project	Ark Valley Research Center	$2,800	Hay and Forage Project	Completed in 2023
Alternative Forages Project	Three Applicants combined into one Project	$28,240	Hay and Forage Project	Completed in 2023
Soil Moisture Monitoring Project	LoPresti Farms	$3,170	Irrigation Efficiency Project	Completed in 2023
Colbran Forage Trials	Project not implemented; no funding was used			
Wet Meadow Restoration Project	Upper Gunnison	$25,770	Livestock Project	Completed in 2023

Project Name	Project Organization	Grant Amount	Project Type	Status
Kernza and Sainfoin Trails Project	Ute Farm & Ranch	$20,460	Alternative Crops Project	Completed in 2023
Legume Trials Project	Quiet Farm	$1,370	Alternative Crops Project	Completed in 2023
Grazing Cover Crops Verus Selling Field Corn	TLC Farms	$6,300	Split Field Livestock and Corn Project	Completed in 2023
Corn Residue and Soil Moisture Project	Boulder Valley Conservation District	$13,080	Soil Health Project	Due to unprecedented weather and inoperable sensors project was not completed
Ground Cover on Transplants	Pueblo Tomatoes	$5,600	Soil Health Project	Completed in 2023, but limited results due to severe weather
Soil Treatments	Roaring Fork Conservancy	$18,860	Soil Health Project	Project began in Fall of 2023, will be completed in 2024
Corn Intercrop Grazing	Corn Intercrop Grazing	$8,700	Livestock Project	Completed in 2023
Mapping Ditch Assets	Mapping Ditch Assets	$26,780	Irrigation Efficiency	Completed in 2023
Perennial Forages – Otero Project	KX Ranch	$16,930	Hay and Forage Project	Project began in Fall of 2023, will be completed in 2024
Attaching Lay-Flat Pipe to Gated Pipe	Conejos Farm	$4,000	Irrigation Efficiency	Completed in 2023
Surfactant Treatment Project	Lazy S Ranch	$3,480	Hay and Forage Project	Completed in 2023

Project Name	Project Organization	Grant Amount	Project Type	Status
Biochar Injection Project	Biochar Injection Project	$10,930	Soil Health Project	Completed in 2023
Contours and Ditches Project	Two Roots Farm	$18,730	Irrigation Efficiency	Project began in Fall of 2023, will be completed in 2024
Bale Grazing Project	Grama Grass & Livestock	$21,230	Hay and Forage Project	Completed in 2023
Lentils – Cash Crop & Forage	Project not implemented; no funding was used			
Autonomous Pivot & Radar	Mitchelle	$6,500	Irrigation Efficiency Project	Completed in 2023

The spatial distribution of the funded projects is shown in the below map.



General Lessons Learned

Projects had specific lessons learned that are documented in each one-page summary included in Appendix A. The following are general lessons learned across all the projects:

- **Weather**: 2023 was hydrologically an average to wet year for most of Colorado. While this was a blessing after parts of the state experienced severe back-to-back drought years, it also meant that some of the moisture came as severe weather in parts of the state. Across the state, crops experienced unusually high amounts of spring precipitation and hail. Both the severe weather and spring moisture resulted in challenges for some of the projects that were out of the producer's control, including delays in planting dates and/or start of project implementation.
- **Sensors**: Many of the projects included the producer experimenting with new technologies to either help irrigate more efficiently or better monitor their crops. The producers often had trouble getting the sensors to perform as they were supposed to or found that the software that accompanied the sensors was difficult to use. The largest issues seemed to be with soil moisture sensors. Sensors often did not communicate as promised by the company or the software was not user friendly and required more time than producers expected to understand how to use the data to make decisions.
- **First Time User Error**: The Ag Drought Resilience Projects were funded to allow these producers to try out a new method or new technology. The producers often had to learn on the go as they implemented their ideas. This often resulted in some type of first-time user error, as is to be expected. The projects with the least amount of user error often had an outside consultant (agronomist, etc.) that was more experienced helping with the project.

Potential for Scalability

In general, most of the projects could be easily scaled and the methods could be used elsewhere in the state. For alternative crop projects, the producers should determine if the new crop has been tested in their specific area before trying out a crop based on results from new crop types grown in different climates. A few of the projects noted that while the results could be scaled up, many of the neighbors or other producers in their area would not be interested as the practice was outside of the norm for the area. For most projects, the hardest part would be the initial cost to scale up, either the producer needs a new type of equipment or needs new and/or improved infrastructure to implement one of these projects.

Summary

2023 was a hydrologically challenging year to implement many of the projects around the state. Between a cold and wet spring and severe weather (hail), many of the project operations were behind schedule and a few ended up with limited results. Even with the unexpected spring/early summer weather, most projects were still able to be implemented and results were obtained and provided to CAWA. The projects that had clear results generally had well defined goals and had both trial and control areas for comparison. These projects also were identified as the easiest to replicate.

Appendix A

One Page Project Summaries for Projects Completed in 2023 or Projects with Initial Results in 2023

DROUGHT RESILIENCY PROJECTS

Drip Tape – Gated Pipe Connector Project

Project Type: Irrigation Efficiency Project
Project Location: Delta and Mesa Counties
Grant Amount: $19,450
Producer Type: Commodity, Grass and Alfalfa Hay
Irrigation Method: Gated Pipe with Drip Tape
Identified Water-related Challenge:
Drip irrigation is among the most efficient methods of irrigation. However, drip irrigation typically requires clean water that is delivered under pressure. This often translates, into expensive filters and pumps and can include a bill for electricity. Along with the cost of buying and installing drip tape, the result is that drip irrigation is used on a very limited number of acres in Colorado.

Solution: The project attempted to make a drip irrigation connector that could be used to connect drip tape to gated pipe. The connector would fit a normal gate pipe allowing drip irrigation to be used on fields with gated pipe infrastructure already installed.

Results: The team successfully developed and tested a drip adapter that can be used with gated pipe. The adapter was created with the following criteria: the adapter needed to fit into an existing gated pipe without altering the pipe, it must be possible to easily switch back and forth between drip irrigation and flood irrigation, and each adapter should cost a maximum of $4.00.

In preliminary field trials, water was applied at an acceptable rate along a 900-foot drip tape. Water pressure in the gated pipe was approximately 2 psi.

Additionally, the team preliminarily tested the ability to filter water with very fine mesh screens before it entered the drip tape. These tests showed positive signs of implementation with the product.

Scalability: Highly scalable but the design will need further refinement to meet the specified criteria and be able to reliably be used by irrigators.

Lessons Learned: The team will focus their future efforts for the product in the following ways:

- Improve the design to better achieve the design specifications. Currently the team is on version 3 of the design.
- Test various methods of filtering water for drip tape that are practical for gated pipe irrigators.
- Explore varieties of drip tape that are practical for easy conversion of gated pipe flood irrigation to gated pipe drip irrigation.
- Conduct additional field trials.

DROUGHT RESILIENCY PROJECTS

Forage Conversion

Project Type: Hay and Forage Project
Project Location: Rio Blanco County
Grant Amount: $5,610
Producer Type: Rancher
Irrigation Method: Center Pivot
Identified Water-related Challenge:
Due to sod binding in Smooth Brome-dominated meadow, forage yields have declined despite ample irrigation water and fertilizer application.

Solution: The producer will establish and measure the characteristics of establishing more drought tolerant, non- sod binding forage within an irrigated meadow. The meadow will be ripped, tilled and planted with an interim crop(s), then a final mixture of meadow grasses and legumes to understand the drought tolerance and yield differences between the new mix and Smooth Brome.

Results: A 15 acre portion of a pivot irrigated field was disked, chiseled, ripped and power harrowed, and planted to an 80/20 barley and pea mix in early June. Despite rough field conditions, the barley established well and had 100% soil coverage where planted. Mininal peas were visible in the stand. The barley was harvested and baled in late September and yielded 1.48 T/acre. The control field beside it produced 1.8 T/ac of mostly smooth brome hay. No herbicides were used on either field. Both fields received 3.5 inches of rain and 11" of irrigation water pre-harvest and 0.6 inches of rain and 3 inches of irrigation water post-harvest. Both fields were grazed together after harvest. An estimated 0.47 T/ac was removed via grazing. Higher stubble height was left (4"-6") on the control field this year. Wildlife, geese and the cows gravitated toward the barley, then the grass. The costs of tilling and planting were $4,558 tillage + $1,405 for the barley and pea seed mix. The barley hay had a Crude Protein content of 9 % versus 7.4% for the control forage. The barley hay had a Total Digestible Nutrients (TDN) value of 69.3% versus 63.1% for the brome hay. No soil fertility differences were discernable.

Scalability: Very scalable. It is a common problem throughout the mountain areas of the west slope. Refinement of the tillage and seedbed preparation process is needed.

Lessons Learned: Preparing the Smooth Brome sod-bound field for planting was more difficult than anticipated and required ripping and cross-ripping, chiseling, disking and finally using a power-harrow with a planter attached to plant the interim barley and pea mix. Ripping brought up rocks but was necessary to turn the sod. The seedbed was still rough to plant into but the barley did well. A rototiller may have been helpful for seedbed preparation but was not locally available. Smooth brome could still be observed growing after harvest. The producer estimated 75% of the smooth brome was eliminated. The producer had planned to disk, etc. in the Fall, 2023 to prepare a more uniform seedbed for planting in 2024, but was too busy. The producer will decide this winter whether to plant another interim crop next spring or plant the final forage mix.

DROUGHT RESILIENCY PROJECTS

Stubble Height and Soil Health Project

Project Type: Soil Health Project
Project Location: Logan County
Grant Amount: $4,110
Producer Type: Wheat, Millet, Sorghum, cattle
Irrigation Method: None (dryland)
Identified Water-related Challenge:
Intermittent droughts have reduced soil moisture levels in the producer's fields. The decline in soil moisture negatively impacts crop yields and soil health.

Solution: This study assesses the influence of stubble height on soil moisture levels, building on previous work that has found a positive correlation between increased stubble height and higher soil water content at spring planting.

Results:

- On 8/3/2023, half the 80 acre field was harvested with a conventional combine header and the other half was harvested with a stripper head, leaving about 9 to 10 inches more stubble height. Soil moisture probes were installed and are measuring soil moisture and temperature levels. Soil samples were also collected and tested.
- Soil samples will again be collected in the Spring, 2024 before planting, and compared with the 2023 test results from the two 40-acre plots.
- Soil moisture probe data will also be compared.

Scalability: This study is easily replicated and scaled since it only requires a stripper combine head and a conventional head, along with soil moisture probes. The stripper head left about 9 to 10 inches of additional stubble height compared to the conventional head. Higher stubble height holds more snow and shades the soil, reducing evaporative loss.

Lessons Learned: The cost of having the field harvested with a stripper head was $25 per acre, which is 10 to 20 percent higher than the typical cost for contract harvesting with a conventional combine head.

DROUGHT RESILIENCY PROJECTS

Virtual Fencing Project

Project Type: Livestock Project
Project Location: Routt County
Grant Amount: $17,500
Producer Type: Livestock Grazing
Irrigation Method: N/A
Identified Water-related Challenge:
Ranchers in Routt County have been impacted by a multi-year drought. This has led to the proliferation of invasive weeds, decreased productivity of rangelands, the culling of herds, a migration of essential rangeland plants to higher elevations, and low summer river flows among other things.

Home Ranch cows with virtual fence collars
Photo Credit – CSU Extension

Solution: The Routt County Conservation District (RCCD) seeks to accelerate the implementation of Grazing Management Plans and Climate Smart Solutions on working rangelands in Routt County with a Virtual Fence Demonstration Project. RCCD believes virtual fencing will prove to be an essential tool in a rancher's toolbox in adapting to and withstanding the impacts of drought on their land and livelihood while improving wildlife habitat and water quantity & quality.

Results: Two Ranches utilized virtual fencing in 2023, Home Ranch and Sheep Mountain Partnership. Home Ranch had previously utilized the technology, while Sheep Mountain Partnership had not. The producers found that they were able to keep cattle out of riparian areas that typically would get trampled, cause streambank stability issues, and reduce water quality. Using the GPS feature they could more easily rotate the cattle through grazing allotments and keep the cattle from overgrazing areas. Keeping cattle out of riparian areas helps with water quality, which is very important during drought years when water supplies are limited. The project utilized Functional At-Risk (FAR) Rating to identify concerns with riparian areas and determine if different grazing strategies using Virtual Fence Lines were needed to improve stream health.

Scalability: This project is easily scalable as more cattle producers choose to adopt virtual fencing. The current base stations are staged to cover over 100,000 acres and more may be added as additional coverage is needed. Any producer with the area may purchase collars and use the current coverage.

Lessons Learned: Virtual Fencing can be a useful tool for livestock producers but may not be feasible for every operation or location. When appropriate, it allows for better control of livestock. This can allow producers to work around sensitive areas such as riparian areas, burn scars, etc. During drought this tool can aid in changing grazing rotations to include or exclude certain watering areas.

DROUGHT RESILIENCY PROJECTS

Precision Irrigation Project

Project Type: Irrigation Efficiency Project
Project Location: Rio Grande County
Grant Amount: $21,820
Producer Type: Cover Crop, Barley and Potato
Irrigation Method: Center Pivot
Identified Water-related Challenge:
Due to the over pumping of an unconfined aquifer and drought, water availability to producers has been reduced. These producers need to find ways to continue economic viability for their farms while reducing water use as well as maintaining vegetative cover year-round to reduce soil erosion and noxious weed problems.

Solution: The Rio Grande Conservation District will install a Low Energy Precision Application (LEPA) irrigation system, Valley Irrigation Cameras, and Valley Insights on their sprinklers as a real-world field trial to help producers conserve water and protect topsoil. LEPA irrigation systems, installed 8-18" from the topsoil, decrease water loss to wind and evaporation, ensuring that 95-98% of pumped water is delivered to the root zone. The district will also use cameras and other equipment to monitor crop condition and make irrigation decisions.

Results: Due to supply chain issues the producer was not able to get the cameras on the pivot until the end of the growing season. More results will be available in 2024 for this project. The main components of the LEPA system were on the pivot for most of the growing season, which resulted in the alfalfa coming up earlier and thicker than what is expected with a traditional pivot system. The San Luis Valley did experience higher than normal early-season precipitation, which could have played a role in the alfalfa's growth, but the LEPA system did help ensure that water was being directed toward the base of the alfalfa rather than being cast into the wind. With the higher levels of precipitation, the producer did not have to pump as much, so it is currently unclear how much water savings occurred due to the LEPA system. The producer plans to do a trial of half potatoes and half grain in 2024, which will allow for more results from the LEPA system on different crop types.

Scalability: Many producers in the area are interested/considering installing LEPA systems on their pivots because of this project.

Lessons Learned: For 2023 the producer did not have any negative experiences with the LEPA system but has not tested out the camera portion of the system thoroughly yet due to receiving them so late in the growing system. More results are expected in 2024.

DROUGHT RESILIENCY PROJECTS

Drought Hardy Seeds and Legumes Project

Project Type: Alternative Crops Project
Project Location: Montezuma County
Grant Amount: $32,500
Producer Type: Commodity
Irrigation Method: Unknown
Identified Water-related Challenge:
Increased drought has resulted in reduced water availability and a shortened water supply season. This reduced water availability has affected the producer's ability to irrigate fall grains and has led to reduced yield of their crops.

Solution: During the 2023 farming Season Pueblo Seed & Food Company trialed sixteen species of grain and legume crops with the goals of identifying drought tolerant food crops that are suitable for regional food markets and to begin increasing seed supplies. The species that were the focus of this project were: red amaranth (Mayo Amaranth), culinary barley (Tibetan Purple Barley), grain sorghum (Korjaj), wheat (Pueblo White), durum wheat (Khorosan), culinary rye (Wallis Rye), flour corn (Eagle Corn), finger millet (Dragon Claw), pearl millet, foxtail millet, Japanese barnyard millet, teff, pidgeon peas, urad bean, cow peas (Whipporwill and Red Ripper), and tepary bean.

Results: The Dragon's Claw Millet stood out for several reasons: it thrived in a low-fertility, newly opened field; was quick to mature; was relatively short @ ~16", thus resisting lodging; did not shatter; was not vulnerable to bird pressure and was relatively easy to thresh. Finger Millet's are also widely regarded as the most nutritious of the many millet species. It has an outstanding nutrition profile, ~12% average protein, and good fiber content. It is also shorter than many heritage wheat varieties, which helps resist lodging. Khorosan produces a lot of food and great yields. It is very hard with 15-16% protein and high yielding making it ideal for pasta, but also good for grain bowls and bread. Also, extremely drought hardy, heat tolerant and nutritious. Tibetan purple barley is a free-threshing culinary barley with deep roots, making it an excellent candidate for culinary diversification of drought hardy grains and legumes. It has especially high levels of fiber and zinc. Eagle corn produces highly nutritious ears in 100 days. It is short and therefore resists lodging and has deep roots compared to other corns. Wallis rye is a heavy yielding culinary variety that can grow quite tall with ample water. To prevent lodging, limited irrigation is important (unless producing straw is also an objective!). Like most ryes, it is very cold tolerant and can be planted late. Mayo Amaranth produces large bright red seed heads on 4-5'stalks. The grain and the leaves are edible and the plant can also be used for dye. It has excellent protein and does well with limited water. The main drawback with amaranth is that it is small-seeded and susceptible to weed pressure at the time of establishment. The whippoorwill and red ripper cow peas are excellent multi-use crops. They produce a lot of biomass and are highly palatable for livestock, making them superb for cover crops and forage. For food purposes, the beans have great flavor and are very nutritious. Cow peas would be a good choice for lower elevation farms, in particular. The Korjaj sorghum has a large grain head and is shorter than many sorghums @ 5-6', making it a great candidate for producing a lot of food and resisting lodging. It is also good for forage. We did observe a certain amount of rust on this variety. The cow peas and sorghum both are not recommended for higher elevation farms @ 7000' and above. These are heat-loving, long-season plants, although they can be induced to make seed earlier by withholding irrigation water or growing on a dryland basis. Tepary beans also have distinct limitations as a good crop. While they are extremely drought hardy and nutritious, many varieties are prone to shattering. Furthermore, if they are over-irrigated or subject to lots of natural rainfall, they will produce lots of foliage, but few beans.

Scalability: The varietals noted in the lessons learned column all showed promising signs of being adopted by farmers in the area. These crops would be easily scaled and adopted into farming operations.

Lessons Learned: The following varietals were noted as worth pursuing for food production purposes based on the project: Dragon's Claw Millet, Pueblo White Winter Wheat, Khorosan, Tibetan Purple Barley, Eagle Corn, Wallis Rye, Tibetan Purple Barley, Whippoorwill and Red Ripper cow pea, Sorghum bicolor, Sonoran White Tepary Bean.

DROUGHT RESILIENCY PROJECTS

Compost and Biochar Project

Project Type: Soil Health Project
Project Location: Weld County
Grant Amount: $7,480
Producer Type: Wheat and Barley
Irrigation Method: Sprinkler and Dryland
Identified Water-related Challenge:
Increased drought and reduced precipitation have negatively impacted the producer's dryland farming operation by reducing soil moisture which has resulted in reduced yield of crop's. Additionally, drought has reduced the water available to the producer for their irrigated acreage, resulting in reduced yield of crops.

Solution: This project will implement a composting system that will improve soil moisture retention on both dryland fields and irrigated fields. The compost mix will be composed of manure, straw chaff, brewer's yeast salvage and biochar.

Results: The study compared the difference in water holding capacity of dry soil, between a field with a compost mixture applied and a field with a compost and-biochar mixture of 3% biochar by volume. Both fields received the same seeding rate of sorghum and irrigation input. Soil samples were taken from each field in late August to capture the water holding capacity during the potential peak drought stress of the system. The study found that in this year one analysis, biochar was not determined to have a positive impact on the water holding capacity of the field, and in fact may even result in a small negative effect. While the biochar did not have a positive impact on the water holding capacity, the part of the field treated with the biochar/compost mix saw a 15 to 18 percent increase in yield per acre. Dry matter produced 1.93 tons/ac compared to 2.23 tons treated with Biochar. The producer was also able to justify the higher cost of treating the soil with compost/biochar with the increase in yield and was able to keep costs reasonable.

Scalability: The producer plans to expand this project in the coming year and has already applied the biochar/compost mix to a winter wheat field that will have results from in Summer of 2024.

Lessons Learned: The low amount of biochar applied made the use of this mixture more economically feasible than other biochar studies. Further studies should be done to explore how biochar may influence soil properties after multiple years and how yield is affected in hydrologically drier years. Additionally, studies should be conducted to analyze the effect that biochar has on improving water quality for agricultural fields.

DROUGHT RESILIENCY PROJECTS

Cowpeas for Animal Feed Project

Project Type: Hay and Forage Project
Project Location: Otero County
Grant Amount: $2,800
Producer Type: Alfalfa
Irrigation Method: Unknown
Identified Water-related Challenge:
Due to dwindling irrigation water availability, the producer has not been able to fully irrigate their alfalfa fields. The resulting shortage has led to decreased alfalfa yield.

Solution: This project will use cowpea as an alternative drought resistant forage crop. The project will test the animal feed values and soil health benefits of three selected forage cowpea varieties. Cowpea (commonly known as black-eyed pea) can be used for human food, animal fodder, and cover cropping and is tolerant of drought, high temperatures, salinity, and infertile soil.

Results: Three different varieties of cowpeas were selected and planted for the 2023 growing season. For all three varieties, soil samples were taken before planting and after planting to help determine soil health. Plant samples were taken to look at biomass and animal feed value. The study showed that the cowpea varieties with more vining tended to mature slower and produce less seed pods, but there was no significant difference for total biomass among the three varieties at plant maturity. Two of the varieties presented better overall relative feed values at maturity than alfalfa. While it will take three to five years to see soil health improvement, cowpeas reduced nitrogen fertilization and were able to be tilled back into the soil as nitrogen and organic matter.

Scalability: The project manager plans to collaborate with two growers in Otero County to plant cowpeas in their commercial field as well plant a larger test plot at the Arkansas Research Station. The manager also plans to look at how different water management regimes affect the cowpeas.

Lessons Learned: The cowpea test plots were part of a large field , where the field management could not be separated with adjacent plots. This made it hard to control all aspects of the cowpea growth; therefore, dedicated trial location is needed. To better understand how cowpeas affect soil health, a long-term study is needed as results were not noticeable after one year.

DROUGHT RESILIENCY PROJECTS

Alternative Forages Project

Project Type: Hay and Forage Project
Project Location: Montezuma County
Grant Amount: $28,240
Producer Type: Alfalfa
Irrigation Method: Unknown
Identified Water-related Challenge:
Prolonged drought conditions have led to a decrease in irrigation water storage for the producer, which, combined with decreased seasonal precipitation has resulted in reduced alfalfa yield for growers.

Solution: This project will work with three commercial producers to help shift cropping systems from alfalfa to forage mixes that use less than half the seasonal irrigation water. The economic returns are almost equal to alfalfa, allowing growers to maintain economic sustainability in exceptional drought conditions.

Results: With planting new drought resilient crop, the producers also experimented with a new cropping technique that involved no-till seed drilling into the older less vigorous alfalfa crops. The older alfalfa crop and new forage crops were harvested together, which increased hay quality while requiring less water than a typical alfalfa crop. Using a no-till approach with lower water use crop helped minimize soil disturbance, maintain soil armor, and maintain and/or improve soil health. A historical annual crop consumptive use analysis was completed on the fields to understand the new crops water consumption, as shown in the graph below. Note that the graph only shows crops water consumption from irrigation. In 2021 and 2022, the producers had significant reductions in their water allocation, while in 2023 they got a full water allocation but were still able to use less water (like the amount used in the drought years) to grow and harvest the alternative crops.

Scalability: Producers are looking at increasing acreage planted of these new crop types in 2024.

Lessons Learned: These crop switches worked well because the crops grow well in arid southwestern Colorado and, as expected, were able to grown with less water than alfalfa, which is typically grown. While growing lower water use crops allows farmers the ability to adapt to drought conditions, there needs to be a market for producers to sell the crops. The producers have not yet sold the hay but will provide values when they do to understand if the crops are economically viable compared to growing/selling Alfalfa.

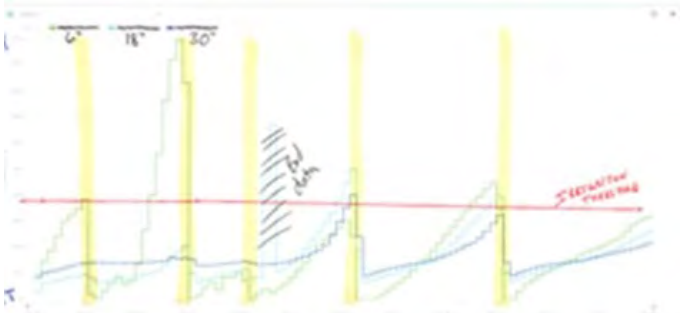
DROUGHT RESILIENCY PROJECTS

Soil Moisture Monitoring Project

Project Type: Irrigation Efficiency Project
Project Location: Pueblo County
Grant Amount: $3,170
Producer Type: Corn, Commodity
Irrigation Method: Flood
Identified Water-related Challenge:
Due to decreased water availability, crop yields have been decreasing. Additionally, the decrease of water supply is reducing the soil moisture on the producer's fields.

Solution: This project will use a weather station and soil moisture monitoring system to improve irrigation water management. The farm is almost entirely flood/furrow irrigated, with numerous hurdles to switching to more efficient irrigation methods. Soil moisture monitoring and irrigation scheduling based on evapotranspiration will help improve irrigation efficiency by irrigating to meet crop demands—compared with the standard practice of irrigating at regular intervals.

Results: The producer installed a weather station and soil moisture sensors at two different depths in one corn field. The soils sensor software was not user-friendly, initially making it difficult to determine when to irrigate using the soil moisture in conjunction with the weather data. The weather data was easier to interpret. Eventually, the producer was able to schedule irrigation based on soil moisture and weather data and developed the soil moisture graph shown below. The blue lines represent soil moisture, while the yellow lines represent irrigation events. The red line corresponds to the user defined irrigation threshold that would trigger an irrigation event if soil moisture declined to that level.



Scalability: The producer is considering using the sensors in other fields on the farm with different soil and crop types and potentially purchasing more soil sensors to use across the farm.

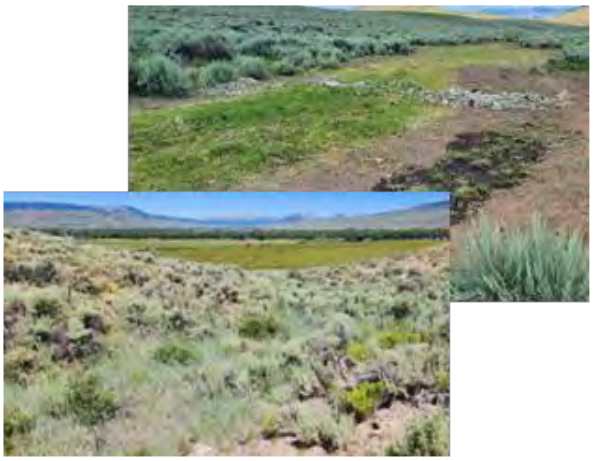
Lessons Learned:

- The producer realized that the crops did not require as much water in the early season because the root zone was not fully developed, compared to the end of the season when the roots were fully established.
- The soil moisture sensor interface did not provide a threshold for when the moisture was depleted enough that more water was required. The producer had to develop this on his own.

DROUGHT RESILIENCY PROJECTS

Wet Meadow Restoration Project

Project Type: Livestock Project
Project Location: Gunnison County
Grant Amount: $25,770
Producer Type: Grass Meadow
Irrigation Method: Not Applicable
Identified Water-related Challenge:
Due to previous land uses, water has been channelized across the producer's meadows which has led to increased erosion in the area. This erosion and loss of water percolation has exacerbated aridification of the surrounding landscape.



Solution: The Upper Gunnison Basin Wet Meadows Restoration Project has been using low-tech rock structures to arrest head cuts, protect stream beds and preserve upstream meadows from continued erosion on public lands for ten years. This project will work with three landowners to conduct this work on their private property and show how rock structures can help ranchers adapt and protect themselves against continued drought and aridification.

Results: Approximately 25 structures have been built on three different properties in the Upper Gunnison River Valley. The results have been positive so far with lessons learned that it is important to monitor and maintain the structures for them to positively impact the meadows. Several structures have worked to decrease erosion and have led to water being absorbed into the ground, helping keep these locations green allowing livestock forage. Some structures have yet to see the full positive impact anticipated. Observations have noted that these structures should be modified to better restore the meadows.

Scalability: This project could be enlarged to include more producers in the Upper Gunnison River Valley.

Lessons Learned:

- After structure installation, structures should be monitored and maintained to ensure they are correctly sized and constructed.
- More than just one year is needed to help restore the area and see results.

DROUGHT RESILIENCY PROJECTS

Kernza and Sainfoin Trials Project

Project Type: Alternative Crops Project
Project Location: Montezuma County
Grant Amount: $20,460
Producer Type: Forage Crops
Irrigation Method: Unknown
Identified Water-related Challenge:
Recent intense drought has led to a decrease in the producer's water availability. Even with investments in water efficient infrastructure, the producer has had less crop yield and had to fallow lands due reduced water supply.

Solution: This project will utilize drought tolerant and less water intensive crops to understand the potential to utilize these crops instead of alfalfa or timothy. The project will conduct field trials of Kernza varieties of intermediate wheatgrass and sainfoin, perennial grains that integrate food production and high-quality forage with soil and water conservation. They will evaluate the establishment, forage production and forage yield of the crops while determining whether there is a viable market for their grain in the future.

Results: Both Kernza and Sainfoin were planted in a field that had been fallowed since 2021 due to drought conditions. Irrigation system issues led to delayed emergence of both crop types, which allowed weeds to germinate and impact the newly seeded crops. The weeds formed a solid canopy that shaded out the emerging Sainfoin and Kernza. Even with the weed canopy, many Sainfoin and Kernza plants survived. In order to try and establish both crops, neither crops were harvested, nor were the fields grazed in the hopes to get these crops established in 2024. Currently the plan is to also apply chemicals and mow down the weeds to prevent the weeds from out-competing the two crops next years.

Scalability: If the project is successful at establishing both crops next year, this project could be potentially scaled up to other fields in the area.

Lessons Learned:

- Even with irrigation system issues, and competing weeds, both drought tolerant crops showed resilience.

DROUGHT RESILIENCY PROJECTS

Legume Trials Project

Project Type: Alternative Crops Project
Project Location: Delta County
Grant Amount: $1,370
Producer Type: Legumes and Grain
Irrigation Method: Drip Irrigation
Identified Water-related Challenge:
Due to past land management of the producers the field, the soils are heavily depleted and high in salts that are negatively impacting crop yield.

Solution: The project will plant drought tolerant crops that are ideal in poor soil conditions to positively impact the health of the field's soil. A test plot of nine 45-foot rows of eighteen different heirloom dry bean varieties was planted. An irrigation pump as well as a low-pressure irrigation kit were also purchased to irrigate the field. These crops all provide not only edible food sources for the producer and their livestock, but also offer the added benefit of nitrogen fixing and pollinator attraction.

Results: While growing beans to improve soil conditions, the producers also setup a new drip irrigation system for the field using a gravity-fed siphon system. The irrigation source is raw water and therefore, clogged up the drip emitter frequently and required significant effort to design a system to deliver raw water to the beans through the drip irrigation system without electricity. The producers are a closed-loop organic operation and found that the heirloom beans produced lower yields on average, but some varieties produced well even with no chemical treatments to prevent competition from weeds.

Scalability: Small western slope growers can successfully grow specialty heirloom varieties as there is customer demand, The crop can grow well in low-fertility soils and on-going drought conditions.

Lessons Learned:

- Plant varieties that look similar should not be planted as this made it difficult to sort the varieties during harvest.
- A simple trellis system would have helped to keep the plot easier to work and weed.
- After much work to improve the irrigation system, raw water could be used with the drip irrigation system to irrigate the crops.

DROUGHT RESILIENCY PROJECTS

Grazing Cover Crops Versus Selling Field Corn Project

Project Type: Split field Livestock and Corn Project
Project Location: Weld County
Grant Amount: $6,300
Producer Type: Wheat, Corn, Forage
Irrigation Method: Center Pivot
Identified Water-related Challenge:
Due to sub-optimal water availability and water quality, the producer is utilizing cover crops and cattle grazing to improve soil drought resilience and health.

Solution: The producer will analyze the impact of planting and grazing a mix of cover crops vs. the economics of planting field corn to be harvested as grain. Cover crop will be planted under part of a pivot irrigated field and grazed with cattle until fall. Corn will be planted beside the cover crop and will be harvested in the fall for grain. The resulting gain of the cattle will be compared against the yield and market value of the harvested grain to understand the economics of cover crop grazing versus growing corn for grain. Additionally, the impact of these two crops and land uses on soil moisture, compaction, soil biological activity and fertility will be compared.

Results: The cover crop was planted 6/12 and the corn was planted 6/14. Grazing produced a net loss of net loss of $40/ac versus a profit of $638/ac on the corn. However, purchasing cattle was a significant challenge due to high cattle prices. Part of the grazing herd was cows with young calves versus 400 to 600 lb steers and heifers which was originally planned. The total number of grazed cattle was 35 head (10 cows with calves, and 25 head of weaned calves weighing an average of 308 lbs). Death loss was 2 head (weaned calves). The cows gained an average of 88 lbs each. The average daily gain of the nursing calves was 2.3 lbs versus 2.2 lbs for the weaned dairy calves. The cover crop was irrigated less than the corn which saved $1,222 and the cover crop was not fertilized, which saved $6,052 versus the corn. No significant changes were seen in soil fertility. Due to the differing amounts of irrigation water applied each time (cover crop vs. corn), it was not possible to compare soil moisture differences between the two crops. Soil compaction was more variable in the cover cropped area than the corn. Lightly grazed areas showed less compaction whereas heavily grazed areas showed more.

Scalability: Scalable where labor is available. May be best suited for cows with calves at side or heavier weight grower calves. May be more comparable with corn in more water-limited years.

Lessons Learned: High cattle prices made buying target 450 – 600 lb. calves difficult and too expensive. Intensive rotational grazing was conducted at first using temporary fence, but as cover crop growth began to out pace cattle consumption, the cattle were released to graze the whole field. The cover crop improved the lactating cow condition scores. The outer edge of the field was planted to wheat. The portable water tank was typically placed in this area, which worked well.

DROUGHT RESILIENCY PROJECTS

Ground Cover on Transplants Project

Project Type: Soil Health Project
Project Location: Pueblo County
Grant Amount: $5,600
Producer Type: Produce
Irrigation Method: Furrow Irrigation
Identified Water-related Challenge:
Farmers are experiencing a reduced water supply and, as the trend of drought conditions persists, they are looking for ways to continue producing with less water availability.

Solution: This project will test the impact of mulch on water use efficiency while establishing transplants in the field. The project will use tomato transplants, as this is a commonly grown crop in the area.

Results: Two farms were selected to participate in this project. Both farms use furrow irrigation methods; however, one of the farms is a conventional operation and one farm utilizes regenerative methods. Both farms planted three sets of tomatoes to test varying conditions and different amounts of water use. The aged wood chips were used as mulch and layered around half the irrigated tomato transplants. Unfortunately, both farms were hit with severe weather events in June that limited relevant results gathered from the project:

- The more conventional farm saw high levels of precipitation which allowed all the tomato sets to become well established. The mulched tomatoes were the smallest, most likely due to the mulch utilizing the nitrogen in the fertilizer that the farm applied.
- The regenerative farm saw much less precipitation and was hit with hail that stripped the tomato plants. The mulched tomatoes performed the best on this farm as the mulch helped retain soil moisture and allowed the tomatoes to establish and recover.

Scalability: The project could be easily scaled up to larger sizes of test plots, however the amount of labor required to lay the mulch may limit large scale adoption.

Lessons Learned: Both participating farms learned how labor-intensive hand laying mulch is and that it would not be economical on a large scale unless it could be mechanized. The pilot project helped the farmers learn more about the benefits and issues of using mulch and how it could potentially help retain soil moisture.

DROUGHT RESILIENCY PROJECTS

Corn Intercrop Grazing Project

Project Type: Livestock Project
Project Location: Larimer County
Grant Amount: $8,700
Producer Type: Grass and Alfalfa Hay
Irrigation Method: Pivot Irrigation
Identified Water-related Challenge:
Due to severe drought the producer cannot reliably plan for irrigation water supplies to match crop water demands due to the uncertainty of water availability.

Solution: This project will evaluate how effectively skip row corn relayed with a multispecies cover crop can be grown with limited irrigation water and lower fertilizer rates to supply high energy winter feed that can be directly grazed by cows, sheep, and pigs. This is an effort to reduce input costs, transportation costs, feeding costs, crop water requirements, and harvesting costs, while at the same time utilizing intensive grazing practices to add carbon and organic matter to the soil for furthering regenerative farming practices.

Results: This project was not a full success as anticipated, because of 2 hail storms that stunted the corn growth. Here are some things that were learned:

1. This project would be more successful with more options for precision fertilizer placement for the corn to outcompete the other crop.
2. The hail stunted the corn enough for the other crop to outcompete the corn and limit its growth.
3. Due to rain in late May, our planting date was delayed by 10 days, this probably also limited the overall success of the project.

Scalability: This could be scaled to most acreages that are transitioning back to a perennial crop from an annual corn.

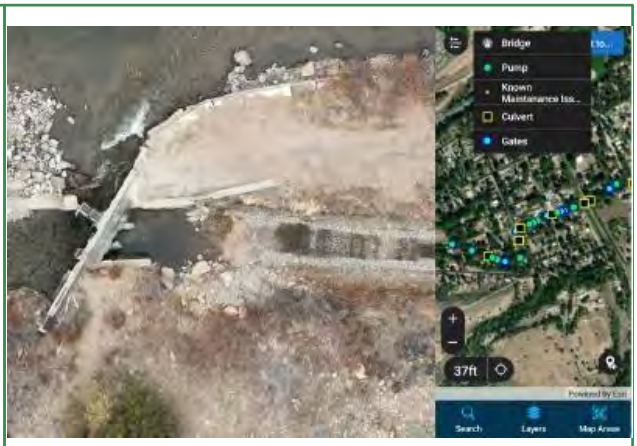
Lessons Learned: We learned a lot.

1. We were able to get the alfalfa cover crop grown and the corn grown to tassel before hail with only 4 inches applied and 4 inches of effective precipitation.
2. This could be a very effective way of maximizing water use efficiency as well as accelerating an alfalfa crop into the next year.

DROUGHT RESILIENCY PROJECTS

Mapping Ditch Assets Project

Project Type: Efficiency Project
Project Location: Fremont County
Grant Amount: $26,780
Producer Type: N/A
Irrigation Method: N/A
Identified Water-related Challenge:
Historic drought, shifts in snowmelt timing, increased water demands, and extended growing seasons have made it necessary to manage water resources more carefully and with increased accuracy.



Solution: The project will work with three ditch companies to modernize their water administration tools to help track ditch operations with the data. This will help water managers make more informed decisions to maximize the beneficial use of the available water.

Results: Aerial survey of three ditches that share a point of diversion off the Arkansas River were mapped using UAVs. The mapping included over five miles of ditches and hundreds of headgates. 3D reconstruction of the land surface was developed with ditch infrastructure identified. From this work geospatial maps and a geospatial database were developed, and ditch managers were trained on how to utilize these tools. Integrating the maps and records together helps keep the data organized and in a form that both simple and complex analyses can be performed. These three ditches have multiple water rights and are used by a variety of water users, with varying understanding of water rights. Further analyses still need to be completed to develop ditch scheduling, determine all maintenance need, and more efficiently operate the ditches.

Scalability: In the future, the three ditches could utilize an app that is specifically designed for them to help them easily locate infrastructure in the field, make administrative decisions, and note and track any issues.

Lessons Learned: Mapping large ditches that have lots of old infrastructure is important to help understand where improvements are needed to allow the ditches to operate more efficiently and, but more importantly, allow users to continue to use their full water rights. In complex systems, integrating maps and records can make it easier to make decisions quickly and respond swiftly to changes in hydrology.

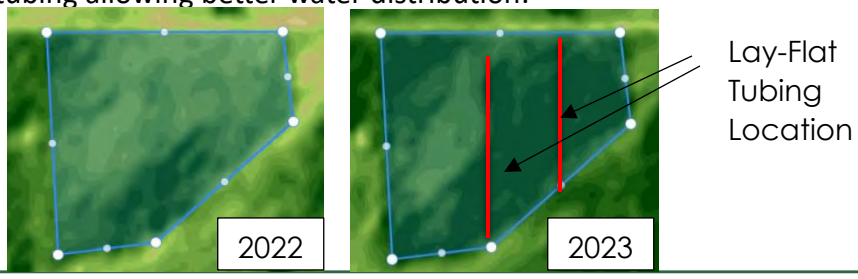
DROUGHT RESILIENCY PROJECTS

ATTACHING LAY-FLAT PIPE TO GATED PIPE

Project Type: Irrigation Efficiency
Project Location: Conejos County
Grant Amount: $4,000
Producer Type: Commodity, Grass and Alfalfa Hay
Irrigation Method: Gated Pipe with Surge Valve
Identified Water-related Challenge:
Fields soil type consists of gravely sandy loam, which requires over irrigation of the field to get water all the way down the furrows. In drought years, producer can run out of water in June before enough water has been applied to make it down the furrows. Gated Pipe has also increased soil erosion around the pipe.

Solution: The producer developed a system of flexible lay-flat pipe that could be easily installed using headers at any location on gated pipe. This allowed someone to easily move and better distribute water to locations that are hard to water to reach due to high water infiltration and/ or field surface topography.

Results: The producer installed lay-flat pipe rated for higher elevations (increased sun exposure) at two locations on the lower part of the field. The upper part of the field was irrigated as usual using gated pipe. Gates were installed on the lay-flat tubing to irrigate the field. In most years, the producer can get water across the whole field, but it often takes significant amount of time. The lay-flat tubing allowed the producer to irrigate the whole field quicker and more efficiently. While 2023 was hydrologically a decent year, being able to get water across the field faster and more efficiently will be even more crucial in drought years. Below is a picture of the NDVI in mid-June of 2022 and 2023. In 2023, the NDVI was much higher (darker green) on the northeast side of the field due to the lay-flat tubing allowing better water distribution.



Scalability: The producer plans to install more lay-flat tubing on the trial field as well as one other field in 2023.

Lessons Learned: In wind prone areas, the lay-flat pipe needs to have some water in it to prevent the pipe from blowing away. Unlike other pipe going through a field, the lay-flat pipe can be driven on and harvest can occur without having to pick it up.

DROUGHT RESILIENCY PROJECTS

Surfactant Treatment Project

Project Type: Hay and Forage Project
Project Location: Weld County
Grant Amount: $3,480
Producer Type: Grass Hay
Irrigation Method: Center Pivot
Identified Water-related Challenge:
A former CRP field that has been untouched for over 20 years and is experiencing decreased vegetation because of drought and lack of grazing.

Solution: The producer will use livestock (goats) on a portion of the property. Livestock will be moved frequently throughout the field using practices highlighted by a Holistic Management approach to improve soil health.

Results: The producer found a dramatic difference in soil exposure between grassland pasture that had been left fallow for decades without grazing and the same grassland pasture that had livestock on it. These findings show that fields that include livestock rotation and management had better soil quality and improved forage load. Additionally, the areas managed by livestock had less exposed soil than the areas not managed by livestock. The producer also found that areas not managed by livestock that were strip mowed had more exposed soil as the fine material left behind after mowing was blown away by winds. This led to less plant density compared to the areas managed by livestock.

Scalability: The producer wants to investigate how much the forage load and soil health can be improved in the future with more aggressive pasture management. Also, a future comparison of soil health between fields managed by horses and fields managed by goats will be conducted.

Lessons Learned: Grazing smaller areas and rotating livestock more frequently leads to better soil health but does require infrastructure (fencing and water) to be able to move the animals around quickly and keep them contained to small areas to aggressively graze. Its important to take into consideration what type of livestock will be grazing the pasture as different livestock prefer different plant types.

DROUGHT RESILIENCY PROJECTS

Biochar Injection Project

Project Type: Soil Health Project
Project Location: Mesa County
Grant Amount: $10,930
Producer Type: Small Produce Farm/Researcher
Irrigation Method: Furrow Flood
Identified Water-related Challenge:
Due to drought and increased temperatures the producer has had a decrease in the amount of water held by the soil of his fields.

Solution: This project will test a new method of applying biochar to improve the water holding capacity of soil. This technology, which is currently used in the sports turf industry, will inject liquid and dry biochar vertically down into the soil 6-10 inches deep in a grid pattern. They will inject biochar slurry into an existing irrigated hay crop and measure soil moisture and forage differences.

Results: Strips 1&3 (biochar), 2&4 (no amend.) Strips 1&2 watered once/mo., 3&4 twice/mo.

HAY BIOMASS (g) & YIELD (t/a)	STRIP 1				STRIP 2				STRIP 3				STRIP 4			
	STA.	JUN 12	JUL 25	OCT 5	STA.	JUN 12	JUL 25	OCT 5	STA.	JUN 12	JUL 25	OCT 5	STA.	JUN 12	JUL 25	OCT 5
	S1T	59.0	24.8	10.9	S2T	42.6	0.6	5.7	S3T	9.5	0.0	19.4	S4T	32.5	15.9	30.7
	S1M	39.8	52.0	43.5	S2M	73.5	69.9	18.2	S3M	54.2	59.7	60.8	S4M	85.4	41.2	33.9
	S1B	18.1	55.1	40.7	S2B	44.4	17.3	23.0	S3B	14.6	16.2	60.9	S4B	41.9	1.4	11.3
Avg. (g)		39.0	40.6	31.7		53.5	29.3	15.6		26.1	25.3	47.0		53.3	19.5	25.3
Yield (t/a)		0.31	0.33	0.25		0.43	0.23	0.13		0.21	0.20	0.38		0.43	0.16	0.20
Yield Avg. (t/a)		0.30				0.26				0.26				0.26		
% Yield Change		-19%				-71%				80%				-53%		

	S1HAY - BIOCHAR					S2HAY - NO AMEND.					S3HAY - BIOCHAR					S4HAY - NO AMEND.				
DATE	JUN 16	AUG 3	OCT 11	AVG.	% CHANGE	JUN 16	AUG 3	OCT 11	AVG.	% CHANGE	JUN 16	AUG 3	OCT 11	AVG.	% CHANGE	JUN 16	AUG 3	OCT 11	AVG.	% CHANGE
PROTEIN % DRY	11.3	16.5	14.7	14.2	30.1%	12.1	15.5	13.2	13.6	9.1%	9.9	14.4	12.2	12.2	23.2%	10.9	12	13.5	12.1	23.9%
RFQ	110	122	149	127.0	35.5%	130	115	146	130.3	12.3%	105	112	134	117.0	27.6%	112	107	138	119.0	23.2%
PROTEIN CAT.	PREMIUM					PREMIUM					GOOD					GOOD				

SEASON AVG. DATA		50% WATER					100% WATER				
DEPTH	PARAM.	STRIP 1	STRIP 2	% DIFF.	STRIP 1 VS. 2 OVERALL BIOCHAR		STRIP 3	STRIP 4	% DIFF.	STRIP 3 VS. 4 OVERALL BIOCHAR	
6"	VWC	24.3%	19.7%	21.1%	23.4%	MORE WATER IN SOIL PROFILE	23.9%	16.2%	38.4%	21.9%	MORE WATER IN SOIL PROFILE
12"		26.8%	21.2%	23.5%			25.0%	22.2%	11.9%		
18"		31.8%	24.6%	25.3%			26.2%	21.9%	18.0%		
6"	EC	0.51	0.28	59.3%	76.4%	HIGHER EC	0.34	0.25	31.5%	17.6%	LOWER EC
12"		0.74	0.40	59.7%			0.56	0.70	-23.7%		
18"		1.06	0.36	99.2%			0.42	0.62	-37.9%		
6"	TEMP	23.04	22.95	0.4%	0.5%	COOLER SOIL TEMPERATURE	22.52	23.62	-4.7%	3.3%	COOLER SOIL TEMPERATURE
12"		22.43	22.49	-0.2%			21.87	22.64	-3.5%		
18"		21.84	22.20	-1.6%			21.69	22.07	-1.7%		

Scalability: One can use other cheaper biochar methods and likely see benefits; but we believe this (and backed by research) to be the optimal way to install biochar in ag. This is why we are pursing the R&D new tech. suited for ag industry. Wit every be cheap? Probably not. Likely best viewed as long-term investment using cost-benefit analysis.

Lessons Learned: Silver bullets don't exist; but, we learned that this has a lot of potential and excitement around it. We are eager to further test and develop the technology if it keeps proving valuable. We believe we are just scratching the surface and opening new possibilities in resource conservation.

DROUGHT RESILIENCY PROJECTS

Bale Grazing Project

Project Type: Hay and Forage Project
Project Location: Boulder County
Grant Amount: $21,230
Producer Type: Livestock
Irrigation Method: Flood Irrigation
Identified Water-related Challenge:
Due to poor soil health, low water infiltration rates, increased prairie dog occupancy, and an abundance of weeds/non-native cool season grasses, the field in question needs an exaggerated amount of flood irrigation water. This makes it so that a smaller portion of the field gets irrigated well. This becomes more of a challenge in low water years.

Solution: For this project, the landowner will use ruminant animals to impact land that is populated by prairie dogs, invasive weeds, and brome grass. They will bale graze the animals on sections of land to disturb the heavy thatch created by brome grass, add a large amount of nutrients to the soil through manure and urine, and prepare the land for native grass planting.

Results: Over the course of fourteen days, we had 52 cows in 5 acres consuming 62,111 pounds of hay. During those 14 days, we moved the herd every day to 1/3-acre paddocks. Each day the cattle were fed 4,436.5 pounds of feed. About 15% of this feed was trampled into the ground. They were allowed to walk back through old paddocks to water. The overall herd weight was 67,600 pounds. This computes to a stock density of 225,000 pound to the acre. Prior to the bale graze, Grama Grass monitored the site. We took photo points consisting of qualitative data and photos, soil samples, forage samples, a brix reading, and more. A detailed report was submitted to CAWA.

Scalability: In 2023 we planted 5 acres, in 2024 we will plant 22 acres. As we continue to learn best practices, this practice can scale to as much as needed. The limiting factor is cost of hay.

Lessons Learned: We learned that the more impact from the cows the better and we could've used even more impact than we had. This impact is necessary to seed into a brome grass stand. In the cattle impacted area we had decent seeding success, in a control area without cattle impact we had little to no seeding success. Next year we will be able to see if two years of impact can improve seeding success. We learned that in one years time, with good timing, and high stock density the cows can get rid of a dense stand of thistle. We learned that planting into thistle after bale grazing can be highly successful. Continued soil analysis will provide mor information about our fertilization strategy. With our increased scale in 2023, we will see if we will be able to get water to more acres than we did in 2023.

DROUGHT RESILIENCY PROJECTS

Autonomous Pivot and Radar Project

Project Type: Efficiency Project
Project Location: Alamosa County
Grant Amount: $6,500
Producer Type: Potatoes
Irrigation Method: Center Pivot Irrigation
Identified Water-related Challenge:
Due to poor soil health and variable water availability, the producer has had impacts to their field's productivity and crop yield.

Solution: This project utilized two different water sensor technologies: (1) an autonomous pivot with ground penetrating radar to detect soil moisture throughout the field and (2) soil moisture sensors buried in the field .

Results:

Soil Moisture Sensors: Eight soil moisture sensors were ordered, only seven were used as part of the study because one of the sensors was unable to communicate with the sensor app. After planting, the seven sensors were buried in three separate locations at varying depths. The app provided a moisture safe zone, but the sensors generally did not read in that range even following an irrigation event. The sensors also were supposed to work without antennas, but would not properly transmit data without them, which required the antennas to be removed every time equipment was brought into the field.

Autonomous Pivot: This sensor attaches to the center pivot and uses ground penetrating radar to determine the soil moisture content. It can be set to varying depths, but 18" was selected as that is the rooting depth of potatoes at maturity. Potatoes were planted in a 34" row spacing and do not have a large enough root system to pick up water between rows for much of the growing system. This could have caused issues with the radar system showing more water available than actual, as the potatoes could not access the water measured. Even so, the autonomous pivot was much more user friendly and gave more accurate results than the soil moisture sensors.

Scalability: The producer would like to try out the autonomous pivot on other fields with different crop types and believes it could have real water savings potential.

Lessons Learned: The soil sensors required much more time and effort to get installed and still did not provide data that could be used to help determine when irrigation is necessary. The concept was promising, but the technology was not ready for commercial success. The autonomous pivot showed promise, and with more experience, the right crop types, and correct senor reading depth, could result in real water savings potential.