Ag Water Demonstration, Research, and Implementation Program (Ag-DRIP) 2023 Report

Farmer Participants

The AG-DRIP program started in Mid-2023. The goal was to enroll around 25 farmers in the first year. Finalizing contracts and hiring coordinators took longer than expected. However, we were able to enroll a total of 21 farms to participate in the first year of the program. For each farm that enrolled, we asked that they select a representative field to use for irrigation management and measurement. On some farms, this was a field with average conditions and for others it was one of their most problematic fields – having soil or irrigation issues. Beginning stages of the program were implemented in 2023. This included collecting irrigation and soil samples and installing soil moisture sensing stations (METER Group TEROS 10 and TEROS 21 soil moisture and water potential sensors) on the representative field at each farm. At farms, where there was not a nearby weather station, we installed an automated weather station (METER Group ATMOS 41W sensor) near the representative field.

We worked with farmers to develop their irrigation management plans and prepared for incentive payments for alternative crop use and for reporting their progress on their irrigation management plan. We also initiated monthly Zoom meetings with the participants to discuss soil sensors and irrigation management plans. Two additional farmers agreed to participate in the program at the end of the 2023 growing season and will be onboarded with the next group of participants in the 2024 growing season. The participants in 2023 covered a large variety of farm sizes, crops, soil types, irrigation systems, and climates throughout the program area (Figure 1). Many of the representative fields were alfalfa and grass hay, but there were also a few fruit and vegetable fields.

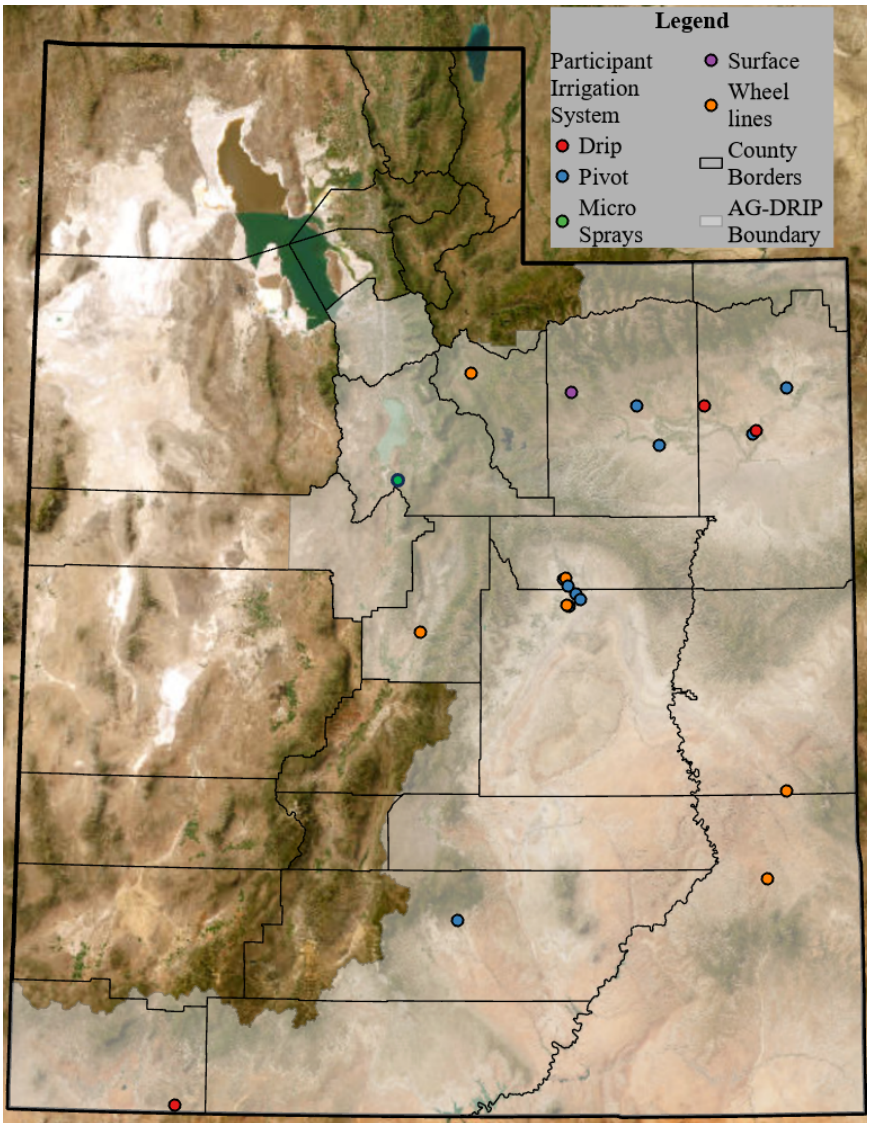

Figure 1. 2023 farmer participant locations.

Farm Background Analysis

Soil and irrigation samples were collected at each participant's farm in their representative field to determine whether irrigation management may be impacted by specific characteristics within the soil or irrigation water. Variables that could impact irrigation management and crop production are displayed below in Table 1. Other nutrient reports were collected and can be shared upon request. These reports were shared with participating farmers. If concerns were

noticed in nutrient or infiltration aspects of the reports, these were discussed with participants as potential items to address in their irrigation management plans. Examples of installed soil moisture sensor stations and weather stations are shown below in Figures 2 and 3.

Table 1. Background soil sample and irrigation properties to 12 in depth for AG-DRIP participants in 2023 at time of soil sensor installation.

Farmer	County	2023 Crop	Soil Analysis Results					Irrigation Analysis Results		
			Texture	pH	Salinity dS/m	OM %	SAR	EC umhos cm^{-1}	SAR	SAR Adjusted
A.	Carbon	Alfalfa	Silty Clay	7.8	1.2	2.8		793	0.97	2.27
B.	Duchesne	Pasture	Clay Loam	7.7	0.5	3.7		485	0.12	0.2
C.	Duchesne	Pasture	Sandy Loam	8.2	0.9	3.4		205	0.06	0.04
D.	Uintah	Peaches/apples	Sandy Clay Loam	7.6	5.1	1.7		455	0.08	0.17
E.	Uintah	Field Corn	Sandy Loam	7.9	0.6	1.2		302	0.77	1.17
F.	Uintah	Apple Trees	Sandy Clay Loam	7.9	0.7	2.7		189	0.21	0.26
G.	Washington	Vegetables	Sandy Loam	7.8	1.0	1.1		957	0.61	1.47
H.	Duchesne	Alfalfa	Silty Clay Loam	7.8	0.9	4.1		681	1.37	3.03
I.	Sanpete	Pasture	Clay Loam	7.6	0.8	4.7		522	0.23	0.51
J.	Utah	Tart Cherries	Loam	7.8	0.6	2.2		302	0.77	1.17
K.	Grand	Alfalfa	Loamy Sand	7.7	0.5	1.2		220	0.14	0.22
L.	Uintah	Pasture	Sandy Loam Clay Loam	7.7 8.0	4.3 8.6	2.1 2.8	1.4 4.4	1310	0.84	1.99
M.	Emery	Sorghum	Clay Loam	7.9	2.2	3.2		485	0.26	0.54
N.	Carbon	Alfalfa	Silty Clay Loam	7.6	3.6	2.5		547	0.7	1.43
O.	Wasatch	Alfalfa	Clay Loam	7.0	1.2	4.8		409	0.32	0.39
P.	Emery	Alfalfa	Silty Clay Loam	7.5	3.4	3.4		492	0.69	0.53
Q.	Carbon	Unplanted	n/a	n/a	n/a	n/a		523	0.76	1.64
R.	Carbon	Alfalfa	Silty Clay Loam	7.6	3.6	2.2		520	0.77	1.59
S.	Carbon	Sorghum	Silty Clay Loam	7.9	5.9	2.7	7.8	520	0.77	1.59
T.	Boulder	Pasture	Loamy Sand	7.8	0.4	1.0		165	0.46	0.54
U.	San Juan	Alfalfa	Sandy Loam	8.1	0.7	1.4		417	0.44	0.85

OM - organic matter
SAR - sodium adsorption ratio
EC - electrical conductivity
dS/m - decisiemens per metre
umhos cm^{-1} - micromhos per centimeter

Figure 2. Soil sensors installed and soil data loggers in fields during the 2023 growing season.

Figure 3. Atmos 41W weather station installed with subscription details.

Soil Moisture Sensor Data and Implementation

The installation of soil moisture sensors has a few purposes. First and foremost, it is to help participants make data-informed decisions about irrigation scheduling (when and how much water to apply). This was the primary focus in 2023. Soil moisture sensors can also be used to estimate soil water balances that can be used to estimate evapotranspiration (ET). Thus, soil moisture data will later be used to compare other ET estimation approaches using the weather stations and OpenET.

Graphs of soil moisture sensor readings for 19 of the 21 farms are displayed in Figure 4. Two of the farms were unable to connect to telemetry. However, one participant will connect the soil sensor data to an existing weather station at the farm to gain access to telemetry in the coming months and the other farm will have telemetry once the participant switches the SIM card in the data logger to a different carrier. Despite the lack of telemetry, soil data were still collected and stored in the data loggers and will be retrieved when the sensors are online. While some participants have shown genuine interest in utilizing the sensor data for irrigation management, others have not investigated it. This is because of the timing of introduction during the irrigation season, or their sensors were installed towards the end of the irrigation season for their area, or possible disinterest. At the end of 2023 growing season, we asked participants to indicate in their annual report how frequently they checked their soil moisture sensors. The mixed response from the participants is shown in Figure 5. About half of the participants had checked their soil moisture data daily, weekly, or monthly. We anticipate that use and utility will increase in 2024 when we can assist growers for an entire irrigation season.

We have dedicated some of our monthly AG-DRIP meetings with the participants to instruct them on how to navigate the sensor data and give direction on how to manage irrigation events with the sensors. Phone calls and in-person consultations for those who have not been able to attend the meeting have also taken place to instruct participants on navigating the online software program where soil moisture data are available (METER Group's ZENTRA Cloud). As seen in Figure 6 below, most of our participants have not utilized the sensor data to adjust their irrigation rates yet. Again, we anticipate that this will increase as we continue to train and assist participants with their irrigation management.

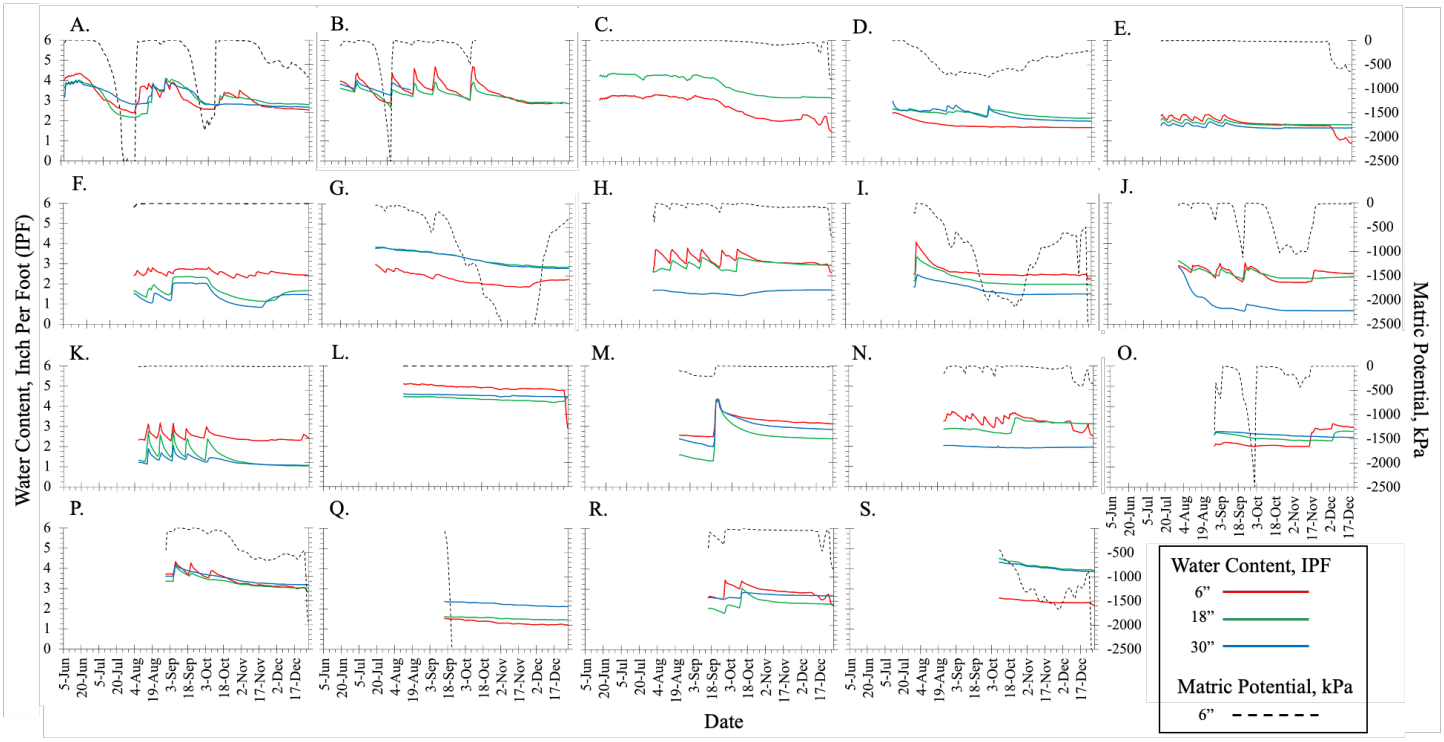

Figure 4. Soil moisture sensor data from 19 farms starting in 2023.

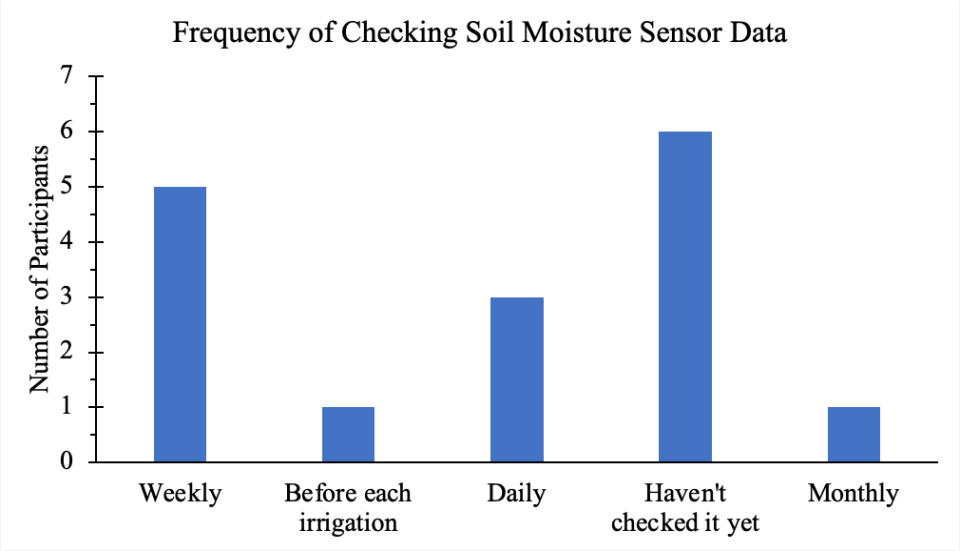

Figure 5. Report from participants on frequency of checking the soil moisture sensor data online.

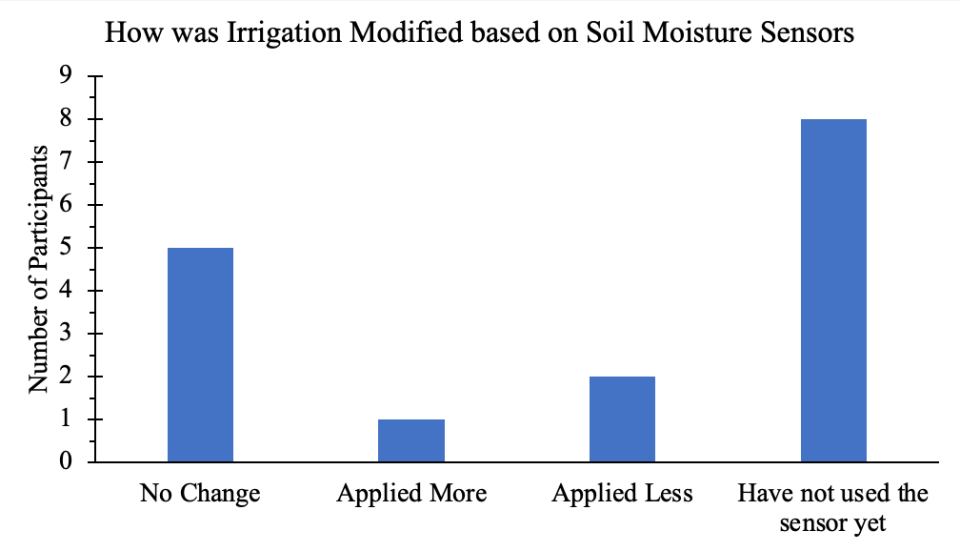

Figure 6. Report from participants on how their irrigation was adjusted based on the soil moisture sensor data.

Alternative Crops

We will provide up to $2,000 for each of the participating farmers at a rate of $200/acre for up to 10 acres for them to trial alternative crops with lower water requirements. This will allow farmers an opportunity to trial crops before investing in large areas of alternative crops. We asked participants in their annual report to indicate what crops they may be interested in implementing with their alternative crop credit. The mixture of crop types that are of interest to participants to incorporate on their farms is presented in Figure 7. We are in the process of making arrangement for the credits at local seed dealerships preferred by participants. We are currently setting up accounts to hold their credit, which credit will be available to them when they pick up their seed.

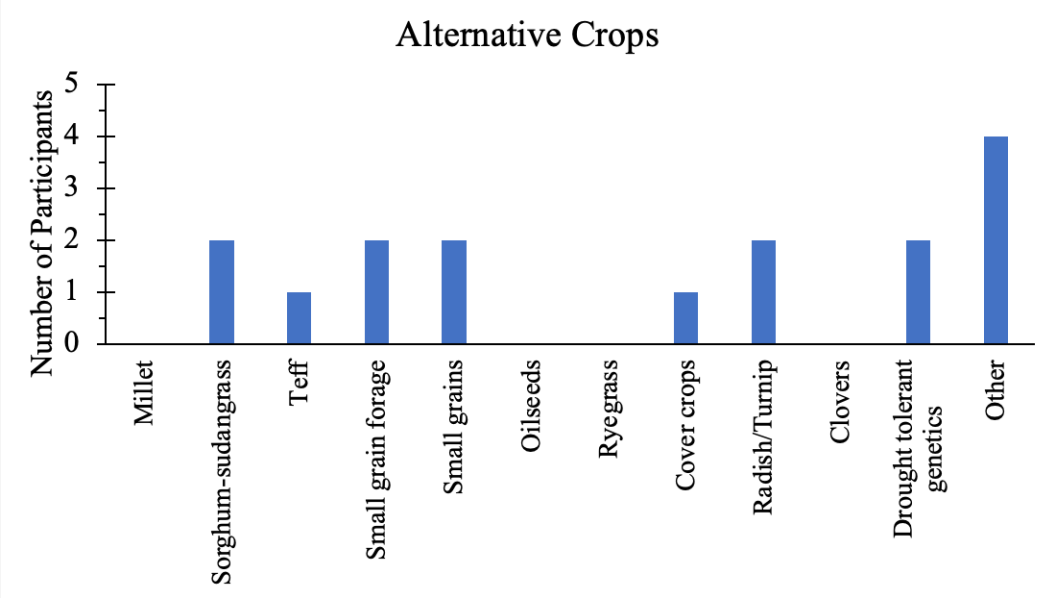

Figure 7. Report from participants on the types of crops they are interested in using for their alternative crop.

Irrigation Evaluations

As part of the program, we will conduct on-site irrigation evaluations by taking measurements in the fields under the conditions and practices normally by the growers. The evaluations will include on-site investigations for possible modifications such as change of sprinkler pressures, changing duration of application, etc. The measurements for the analysis will include, rate of inflow, uniformity of application, duration of application, rate of advance (surface irrigation), and rate of infiltration (surface irrigation). The analysis will help to inform the participants of the actual performance of their systems and help them to make decisions for improvement where desired. It took longer than expected to hire our second AG-DRIP coordinator. This led to a delay in irrigation evaluations in 2023. We were able to conduct one farm irrigation evaluation to train coordinators at the end of the 2023 irrigation season. We plan to complete the remaining evaluations from the 2023 farms and all 2024 farms in 2024.

Flow Meters

We plan to install flow measurement devices to accurately track irrigation water flow in pipes and open ditches on all participating farms. Accurate flow measurement is an important aspect of irrigation management and water accounting. The installation of flow meters will adhere to standard flow measurement principles including ensuring that proper flow conditions exist at the measurement locations.

Most sites have sprinkler irrigation and will have flow meters. Only flow meters in closed conduit measurement applications that have been tested by Utah Water Research Laboratory at USU using National Institute of Standards and Technology -NIST traceable instrumentation will be used. These meters have been approved by the Idaho Department of Water Resources (IDWR) as having accuracies of +/-2%.

In many cases, we will use electromagnetic flow meters. To ensure accuracy of the measurement, the magnetic meters and spooled ultrasonic meters will be installed with a minimum straight pipe length equivalent of three (3) pipe diameters upstream and two (2) pipe diameters downstream from the center of the meter. A telemetry system will be established to enable the farmers to access real-time field conditions to enable them to better plan their irrigation schedules to minimize over/under watering; thereby reducing water stress conditions on plants and improve yields.

We worked with all farms in 2023 to start the design process for installing flow monitoring devices. We asked each farm to indicate their preferred irrigation dealer. This resulted in mainly three irrigation dealers in the region (Mountainland Supply, Moyle Irrigation, and Basin Irrigation). We have been coordinating with these dealers who are currently designing flow devices for participating farms. In 2024, we will install monitoring devices on all 2023 and 2024 farms.

In addition to farms, we will assist irrigation companies with either installing or maintaining flow monitoring devices. Some companies already have monitoring systems in place so the incentive from AG-DRIP may be used to improve their telemetry, upgrade meters, and help maintain meters. We will be actively working with new irrigation company participants from 2023-2024 on improving water measurement.

Workshops/Field Days

Water Managers - As AG-DRIP was being established, we held a workshop for water managers at the Utah Water Users Association in March of 2023. There were about 40 managers at the meeting who participated in roundtable discussions about the needs of water managers. One idea that came from this roundtable was the need for more educational and networking opportunities for managers throughout the state. To help meet this need we planned two water manager field days in 2023. The Ferron Irrigation Company and Bear River Canal Company each volunteered to host a field day. We were planning to hold a training in Ferron sponsored by AG-DRIP but last-minute changes in the company caused a delay. We plan to hold a water manager field day/training in Ferron in the summer of 2024. We were able to hold the Bear River Canal Company field day/training. It was an exceptional event with nearly 90 participants – including water managers from several companies that lie within AG-DRIP boundaries. Feedback from participants was extremely positive, and many are anxious to have additional trainings. In addition to a training in Ferron in 2024, we will also identify another participating company to host a training near Price or Roosevelt/Vernal. We will also hold conduct the water manager workshop again at the 2024 Water Users Workshop. This will mainly include water managers, but many of them are also farmers.

Farmers - Based on feedback from participants and the project team, we plan to hold 2-3 field days on participants' farms during the 2024 growing season. These field days will include demonstrations of soil sensor maintenance, troubleshooting, managing irrigation with sensor data, managing flow meters, and irrigation evaluations. An additional annual event that will take place with the farm participants during either the fall or winter months is a workshop. These workshops will be coupled with the workshops for water managers and will provide training on enhancing water resiliency within agriculture, and give opportunities for participants to network, share experiences, and plan additional investments and adoption in water optimization. We will aim to hold our first AG-DRIP workshop in the late fall of 2024 or early 2025 with the first 50 participants. This workshop will also include training for those who advise farmers on irrigation measurement and management.

Educational Outreach

A tool has been developed to compare input costs, labor costs, yield adjustments and water savings from different irrigation systems (see https://extension.usu.edu/crops/tools/irrigation-technology-cost-benefit-calculator). This tool allows farmers to input assumptions specific to their field and situation to give them a more accurate understanding of what is expected when investing in different types of irrigation systems or water optimization approaches. It can (and is) guiding farmers in planning future system upgrades to reach management goals they have for their farm. The tool was updated in 2023 with current prices and with additional options. The tool is being used by the Utah Department of Agriculture and Food's Water Optimization Program, Utah Water Rights, and several agencies and organizations in Utah. It is also being used heavily in the demand management assessments that Jacobs Engineering and M.Cubed are developing for CRAU and CUWCD. We have had several meetings with these partners to evaluate how to estimate water saving potential from various management changes throughout the Colorado River Basin.

Another tool that we developed in 2023 to assist farmers and water managers in knowing how irrigation system changes might impact water depletions, was the irrigation system depletion change estimation tool. This tool is in the beta version stage and has been shared internally with several agencies. It will be published early in 2024 after final edits are applied.

Fact sheets addressing water optimization, water flow measurements, precision irrigation in center pivots, and water quality were published in 2023. All these documents are valuable resources to current participants in understanding the need for careful practice in water optimization, properly measuring water flow and irrigation water for improved

management, and the opportunities of precision technology within the industry. Current fact sheets are linked below, and future fact sheets will be published for the benefit of farmers and irrigation management.

- Understanding Irrigation Water Optimization
- Accurate Irrigation Water Flow Measurement in Pipes
- Irrigation Water Quality Sampling Guide
- Precision Irrigation Guide for Center Pivots

Presentations have been and will be scheduled to continue educating those within the agricultural industry about the program. A partial list of presentations is below.

- Sep 29, 2023. "AG-DRIP Program Highlights". Utah Agriculture Water Optimization Task Force. Taylorsville, UT (25 attendees).
- December 19, 2023. "AG-DRIP Program Highlights." Utah Farm Bureau Federation Water Academy, Sandy, UT (~50 attendees).
- Jan 11, 2024. "Agricultural Water Demonstration, Research, and Implementation Program". Uintah Basin Water Summit. Vernal, UT (~200 attendees).
- Jan 17 – Feb 21, 2024. Presentations at Utah State University Extension Crop Schools in Utah (~100).
- Feb 14, 2024. "Agricultural Water Demonstration, Research, and Implementation Program Highlights". Carbon County Crop School. Price, UT (xx attendees)

2024 Participant Goals

We are actively recruiting for the next round of participants by advertising at meetings, newsletters, email list-serves, in-person events, and many other outlets. We aim to enroll 29 farmers in 2024 to reach a total of 50 participants. We are also actively enrolling water managers and aim to have a total of 10 participating companies for 2024. The goal is to enroll participants as soon as possible to allow sufficient time to make arrangements before the irrigation season begins.