

Project Title: Washington State University – Water Irrigation System Efficiency (WSU WISE)

Grantee Entity Name: Washington State University

Period of Performance: 11/18/2016 -9/30/2021

Award Number: 69-3A75-17-24

Summary:

Washington farmers have been adversely impacted by insufficient water, drought conditions and water use curtailments leaving fields under irrigated and threatening productivity.

This project sought to increase irrigation efficiencies throughout Washington by encouraging adoption of proven irrigation monitoring technology, irrigation efficient equipment and conservation practices through the following objectives: (1) Educate and enroll farmers in the Irrigation Scheduler Mobile (ISM) system; a tailored, water-use efficiency monitoring application associated with a water savings value of 20%. (2) Increase water-use efficiency by providing voluntary irrigation assessments and delivering a tailored compilation of recommendations for irrigation system improvements. Quantify changes in water-use efficiency rates of participants. (3) Facilitate the adoption of irrigation equipment upgrades by providing consultations and technical assistance for EQIP grant proposals.

Background/rationale for the project:

Western Washington agriculture has historically benefitted from temperate growing seasons that did not place large requirements on supplemental irrigation. Although once common, it has not been since 1996 that farmers could go an entire growing season without using irrigation equipment (Peters & McMoran) given summer drought corresponding with peak temperatures and growing season as well as decline in the much relied upon winter snowpack accumulation. Population throughout Washington is projected to continue growing and as such, so will the burden on river systems. Irrigation is a necessary component of agricultural production throughout the state, with many farmers employing antiquated irrigation methods with known inefficiencies.

Adoption of new irrigation methods and equipment could mean significant water conservation in a state with lower than average watershed reserves and increasing water demands. The water conservation benefit of adopting new irrigation equipment can be further leveraged by integrating it with comprehensive technological systems such as the Irrigation Scheduler Mobile (ISM). Developed by Washington State University, Irrigation Scheduler Mobile is an electronic irrigation assistance program that facilitates optimum irrigation practices. Farmers enter the crop and soil type and key into the nearest 2 of the nearly 175 weather stations. Based on present and historical weather data, the program algorithm alerts farmers to the irrigation needs of that particular crop in that particular site, increasing irrigation efficiency by 20% while optimizing production.

Based on reductions in snowpack, the new normal of low precipitation during the hottest growing months of the season and the ever-increasing water demands of a growing population, it is imperative that Washington farmers are proactive about water use reduction and irrigation efficiencies. With funding from this Conservation Innovation Grant, WSU Skagit County Extension, in partnership with Growing Veterans, Viva Farms, WSU Colville Reservation Extension, WSU Ferry County Extension, WSU Prosser Irrigated Agriculture Research and Extension Center, WSU Spokane County Extension and WSU Lewis County Extension facilitated

the adoption of efficient irrigation equipment and the Irrigation Scheduler Mobile technology for area farmers through educational demonstrations, onsite consultations and equipment integration support via the WSU Water Irrigation System Efficiencies (WISE) Program.

Methods:

- a) Established a baseline of common irrigation practices to measure program success for each of five counties in the state (Skagit, Lewis, Benton, Spokane, and Ferry)
- b) Developed 5 interactive irrigation education sites through partnerships with farms and agricultural learning centers to illustrate the ease of implementation of Irrigation Scheduler Mobile, including on-farm irrigation workshops. Each participating WSU Extension Office had at least one representative trained at the Irrigation Training & Research Center, completing the Ag Irrigation System Evaluation course in summer 2017.
- c) Enrolled farmers into Irrigation Scheduler Mobile, an electronic irrigation assistance program that facilitates optimum irrigation practices. WSU WISE enrolled and coached new users through their first season using IS at over 3 dozen seminars annually
- d) Conducted irrigation assessments through monitoring efficiency rates before and after irrigation audits per Ag Irrigation System Evaluation curriculum.
- e) Aided in the adoption of irrigation equipment upgrades, providing farmers with specific and tailored assessment recommendations

Deliverables & Results:

1) Establish 6 *hubs of irrigation expertise* throughout the state, located at the following offices: WSU Skagit County Extension, WSU Ferry County Extension, WSU Colville Reservation Extension, Irrigated Agriculture Research and Extension Center WSU Prosser, WSU Spokane County Extension and WSU Lewis County Extension. Each office listed above will have a representative trained at the Irrigation Training & Research Center, *completing the Ag Irrigation System Evaluation course*.

Activity: WSU WISE established the “hubs of irrigation expertise” by partnering with the WSU County Extension offices listed above. Each partnering office participated in WSU WISE meetings (fall 2016 and spring 2017) where WSU’s irrigation specialists presented on Irrigation Scheduler Mobile and other pertinent topics relating to the program. These meetings increased the institutional knowledge of irrigation throughout the Extension network.

Additionally, each partnering hub had a representative attend the Irrigation Systems Evaluation Course at the Irrigation Training & Research Center from California Polytechnic in June 2017. This consisted of 2.5 days of in-class course work and lectures followed by 2.5 days of field practice. Participants conducted irrigation evaluations on drip systems in lemon and avocado orchards. Practicing pressure tests among main and submain irrigation lines as well as catch can

flow tests, WSU WISE participants developed skills necessary to execute irrigation evaluations and determine the *Distribution Uniformity* of irrigation systems using the ITRC evaluation program.

2) Develop a comprehensive database of current irrigation methods and figures on typical irrigation-based water waste rates to use as a baseline to measure program success.

Activity: Developed overviews of irrigated agriculture for five counties across the state (Skagit, Lewis, Benton, Spokane, and Ferry). As of November 2021 all five baseline reports of current irrigation characteristics and methods by county have been accepted for publication via WSU Fast Track, with some pending review (see Outputs).

3) Increased enrollment in ISM following educational workshops about the system at over *36 agricultural conferences* throughout the state. ISM use is associated with an estimated water saving **benefit of 20%**.

Activity: Over the course of the program, WISE partners gave 109 ISM presentations, reaching over 6,000 participants. Furthermore, WSU WISE partners worked to enroll farmers into ISM at each system evaluation (almost three dozen additional interactive presentations). ISM usage increased from 1820 users in 2015 to 1922 users in 2020.

4) Each WSU WISE partner will conduct 5 irrigation assessments within their region annually (*30 annual total, 90 throughout the duration of the program*).

Activity: Between 2017 and 2021, a total of 93 irrigation evaluations were completed by WISE partners. 31 evaluations were completed in 2017, 34 in 2018 and 20 in 2019, 5 in 2020 and 3 in 2021.

5) WSU WISE will identify and partner with EQIP eligible farms to offset the cost of irrigation equipment adoption through *technical assistance in EQIP funding proposals*. WSU WISE aims to pair with 20% of those farms that have completed irrigation assessments on EQIP proposals (*6 annual, 18 throughout program duration*).

Activity: WSU WISE has identified various EQIP eligible farmers throughout the state (2017: 6 Farms; 2018: 7 Farms; 2019: 6 Farms; 2020: 2 Farms) and has offered technical assistance when preparing EQIP funding proposals. Two farmers used WISE resources to assist in applying for EQIP funding.

6) Semiannual reports will articulate progress on WSU WISE goals, objectives and deliverables. Supplemental narratives will be produced to justifying financial allocations and payment requests.

7) A WSU WISE Co-PI will attend at least 1 NCRS or CIG event throughout the program's duration. Significant data, findings and best practices will be shared with NRCS and the greater agricultural community at these events.

Activity: Many NCRS and CIG events were cancelled due to the COVID-19 pandemic. However, PI gave poster presentations on the project at the 2017 ANREP National Extension

Energy Education Summit in Knoxville, TN, the 2017 Tilth conference in Vancouver, WA, the 2018 National Association of County Agriculture Agents Meeting in Chattanooga, TN, and the World Potato Congress in Cusco, Peru in 2018. PI, Co-PI, and other team members presented at the American Society of Agricultural and Biological Engineers (ASABE) Conference in Detroit, MI in August 2018.

8) At the conclusion of the program a WSU Irrigation Fact Sheet will be created to disseminate the information and best practices derived during WSU WISE

Activity: Mohamed, A.Z., R.T. Peters, and D. McMoran. 2020. Management of Traveler Gun Irrigation Systems in the Pacific Northwest. WSU Extension Publication. Pub# FS348E.

http://irrigation.wsu.edu/Content/Fact-Sheets/Traveler_Guns.pdf

Additionally, the following publications were made possible in part by the WISE program:

Sarwar, A., and R.T. Peters. 2021. The More you Expose, The More You Lose: Limiting Center Pivot Irrigation Water Losses. Accepted for publication as a WSU Extension Fact Sheet

Peters, R.T., M.I. Zamoara-Re, and B. Molaei. 2021. Irrigation Management Strategies for Drought. Accepted for publication as a peer reviewed WSU Extension Fact Sheet

Peters, R.T. 2021. Watering Lawns in Washington to Save Water, Save Money, and have a Healthy, Green Lawn. WSU Extension Pub# FS362E

9) A final report addressing project findings, overall measured change in irrigation efficiency by participants and success in meeting program deliverables will be submitted at the end of the project.

Challenges:

1) Partner Loss. This program was written with a reliance on the WSU Extension network to act as hubs for outreach and recruitment of farmers. Six WSU Extension offices, located throughout the state, partnered with this program at the outset to ensure that program efforts were offered to the diverse growing areas within Washington. Over the course of the program, WISE lost 30% of internal partners due to changing careers and retirements. The remaining partners were able to ensure that deliverables were met. However, there are portions of the state that were underrepresented in having participated in irrigation evaluations.

2) Soil Scientist. This grant was written with the intent that the new WSU NWREC soil scientist would join the project team. The position description for new soils position went out as we received the news of funding; however, there was a failed search and the committee had to start the hiring process over again. The chosen soil scientist, Dr. LaHue, postponed his starting date to January 1, 2019 so that he would have ample time to complete his doctorate and eventually declined to work on the WISE project.

3) The COVID-19 pandemic limited safe interaction with the public, including travel to small rural communities and farm visits and working directly with producers and their irrigation

equipment. In compliance with Washington State's Stay Home, Stay Healthy initiative, the project had to utilize electronic communications. As workshops and conferences where farmers are typically recruited for Irrigation Evaluations were cancelled or postponed, statewide outreach efforts were limited.

Outputs:

- WSU WISE website: <https://extension.wsu.edu/skagit/wsu-wise/>
- 109 ISM Presentations from 11/2016 to 8/2021; total of 6,340 participants: <https://s3.wp.wsu.edu/uploads/sites/2073/2021/11/WISE-Events-Nov-2016-Aug-2021-1.pdf>
- 93 Irrigation Evaluations from 2017 to 2021: <https://s3.wp.wsu.edu/uploads/sites/2073/2021/11/WISE-Irrigation-Evaluations-by-System-Type.pdf>
- Irrigation Fact Sheet:

Mohamed, A.Z., R.T. Peters, and D. McMoran. 2020. Management of Traveler Gun Irrigation Systems in the Pacific Northwest. WSU Extension Publication. Pub# FS348E. http://irrigation.wsu.edu/Content/Fact-Sheets/Traveler_Guns.pdf

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Peters, R.T. 2021. Watering Lawns in Washington to Save Water, Save Money, and have a Healthy, Green Lawn. WSU Extension Pub# FS362E

- Baseline Reports:

McMoran, D., A. Mohamed, S. Thorstenson, K. Seymour, and R.T. Peters. 2021. Overview of Irrigated Agriculture in Skagit County, WA. Accepted for publication as a peer reviewed WSU Extension Fact Sheet

McMoran, D., A. Mohamed, S. Thorstenson, K. Seymour, and R.T. Peters. 2021. Overview of Irrigated Agriculture in Benton County, WA. Accepted for publication as a peer reviewed WSU Extension Fact Sheet

McMoran, D., A. Mohamed, S. Thorstenson, K. Seymour, R.T. Peters, and T. Lane. 2021. Overview of Irrigated Agriculture in Ferry County, WA. Accepted for publication as a peer reviewed WSU Extension Fact Sheet

McMoran, D., A. Mohamed, S. Thorstenson, K. Seymour, R.T. Peters, and G. Fredricks. 2021. Overview of Irrigated Agriculture in Lewis County, WA. Accepted for publication as a peer reviewed WSU Extension Fact Sheet

McMoran, D., A. Mohamed, S. Thorstenson, K. Seymour, R.T. Peters, and P. Munz. 2021. Overview of Irrigated Agriculture in Spokane County, WA. Accepted for publication as a peer reviewed WSU Extension Fact Sheet

- NACAA Poster: <https://www.nacaa.com/posters/uploads/1326.pdf>
- 2017 Tilth Conference Poster with Sample WISE Evaluation: (see Addendum 1.)

- Installation of two weather monitoring stations; one on the western side of the state in Snohomish County and one on the eastern side of the state in Ferry County

Discussion of the impact or potential impact of the project to conservation in the US, and potential next steps if relevant:

Over the course of the project, WISE reached over 6,000 participants through in-person and virtual outreach efforts, disseminating knowledge and demonstrations of irrigation efficiency, including to historically underserved farmers in WA. This resulted in increased awareness of irrigation efficiency measures and increased enrollment in the Irrigation Scheduler Mobile program from 1820 users in 2015 to 1922 users in 2020. In addition to those publications outlined in the grant deliverables, the project indirectly supported the publication of several irrigation efficiency factsheets as recorded in the Outputs section. Through the WISE program, Washington State farmers are better equipped to face limited water, drought conditions and water curtailments present and expected given climate change, exacerbated drought, population growth and competing demands. WSU Irrigation specialists will continue to conduct irrigation efficiency evaluations and outreach on this important topic.

Addendum 1. 2017 Tilth Conference Poster with sample WISE Evaluation

WSU WISE: Water Irrigation System Efficiencies Project

Confronting Insufficient Water by Increasing Irrigation Efficiency

McMoran,¹ *DW¹, T. Peters², J. Cowan³, S. Gray⁴, T. Lane⁵, L. McLean⁶, K. Seymour⁷, and M. Zakaria⁸

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⁴County Director, Lewis County; ⁵County Director, Ferry County; ⁶Director, Colville Reservation Extension; ⁷Program Coordinator, WISE; ⁸IAREC Graduate Student.



Funded by USDA-CIG, Washington State University. Water Irrigation System Efficiency (WSU WISE) provides farmers throughout Washington State with resources to **increase water use efficiency** during irrigation events by encouraging adoption of irrigation monitoring technology, efficient equipment and conservation practices. In order to provide specific recommendations to each farmer, WSU WISE offers free irrigation system evaluations for a wide variety of irrigation systems ranging from small scale drip and micro sprinklers to large scale center pivots. Evaluations reveal how much water is actually applied to a field through pressure check points relative to main and sublines, and water distribution as expected by examining irrigation delivery patterns.



Irrigation Evaluation Comparison

Hand Move Sprinkler System on Diversified Vegetable Farm

Hand Move Sprinkler Evaluation 1					Hand Move Sprinkler Evaluation 2										
Left 4	Left 3	Left 2	Left 1	Right 1	Right 2	Right 3	Right 4	Left 4	Left 3	Left 2	Left 1	Right 1	Right 2	Right 3	Right 4
Row 1	1	9	32	21	24	18	14	1	8	34	44	35	55	42	23
Row 2	4	5	7	8	17	16	15	1	7	26	29	47	56	41	26
Row 3	4	7	21	33	43	55	27	1	9	18	19	36	34	33	22
Row 4	0	21	40	58	53	48	19	4	12	21	28	50	45	23	17
Row 5	2	11	28	32	41	22	5	9	7	33	38	53	58	40	14
Row 6	3	7	9	17	25	20	16	6.5	7	38	35	39	41	54	19
Row 7	4	11	24	41	49	43	24	1	12	38	20	29	28	24	18
Row 8	1	24	35	52	59	47	18	0	9	20	23	36	36	40	0.5
Row 9	7	12	22	24	19	20	18	5	6	28	35	47	49	15	0

Findings

Data from Evaluation 1 revealed a poor **DU** of 52.86%. This is due in part to late afternoon wind gusts and the directional orientation of the field related to prevailing winds.

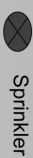
These observations are reinforced when comparing the data to that of Evaluation 2: using the same catch can grid pattern, Evaluation 2 had a **DU** of 64%. What little wind interference occurred was directionally inline with the orientation of the field.

- For this farm, irrigating late at night into early morning and orientating sprinkler lines to that of the prevailing winds will:
- Use water more efficiently and thus require less of it
- Reduce the frequency need of irrigation events
- Meet irrigation needs to produce a strong crop yield

- To measure the **Distribution Uniformity (DU)** of the irrigation system, catch cans were placed in grid pattern off three consecutive sprinkler risers along the irrigation line. After running for one hour, accumulated water was measured.
- Pressure and flow measurements were taken from four different sprinklers along the same line during the irrigation event.

Methods

	Evaluation 1	Evaluation 2
Evaluation Run Time	3pm-4pm	10:30am-11:30am
Pressure Variation	+ 4%	+ 1.4%
Flow Variation	+ 1.7%	0%
Distribution Uniformity	52.88%	64%
Efficiency Score	Poor	Acceptable
	62.5%	73.1%



⊗ Sprinkler