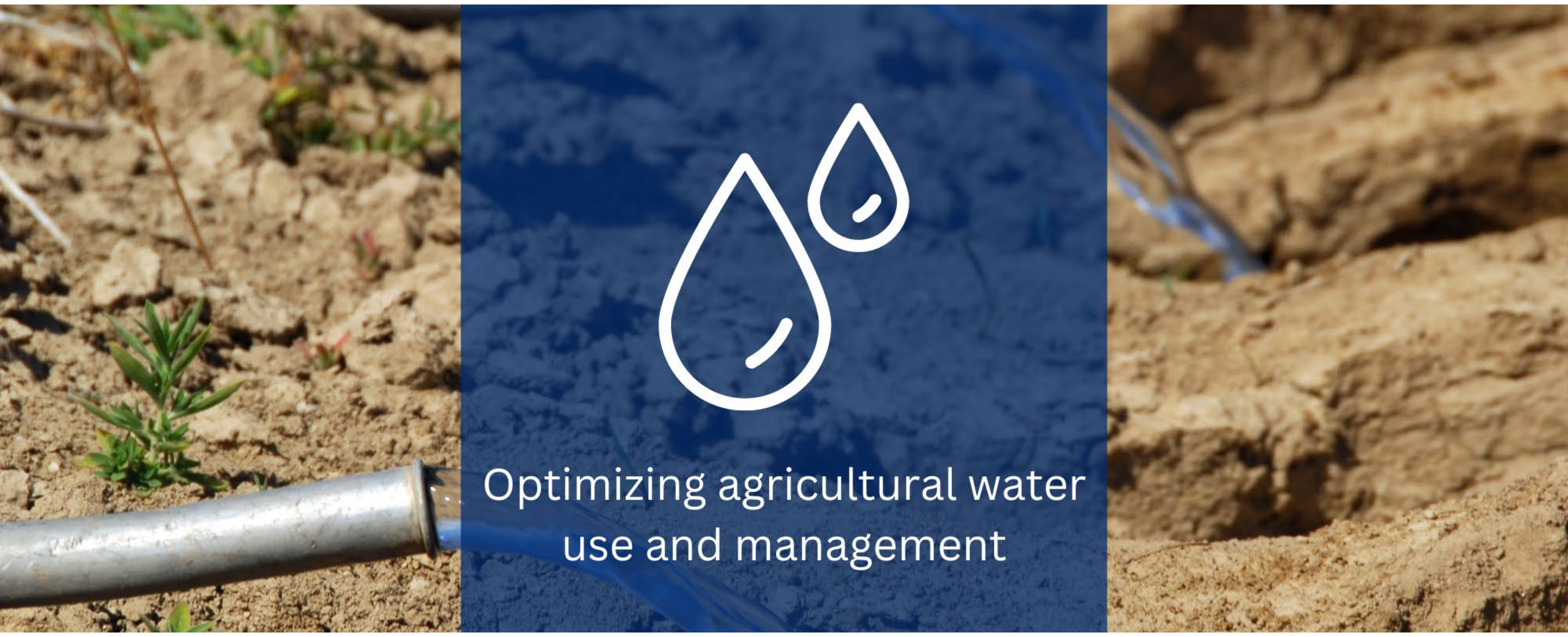
# How ARS Does It:
# Prioritizing Animal, Human, Plant, and Environmental Health

Agriculture is the largest user of water in the United States, accounting for about 70 percent of all freshwater withdrawals, and producers use water to irrigate crops, water livestock, and produce food. However, the United States is experiencing more droughts and water shortages, and in some areas, reservoir water levels have fallen to record lows, forcing water agencies to cut back on water deliveries to famers, leading to crop losses and financial hardships.




To ease these water competition challenges, ARS is developing innovative water conservation practices, improving irrigation efficacy, identifying more water and location-efficient crops, incorporating conservation tillage, and documenting water conservation practices. The following accomplishments in 2022 highlight ARS advancements in irrigation technology and decision support systems to address these challenges.

***New cost-effective approach determines silage quality.*** Analyzing harvested silages for organic acids is critical for assessing silage quality for its value as an animal feed and spoilage risk during storage, but traditional approaches for analyzing silage can be expensive and time consuming. ARS researchers in Madison, Wisconsin, demonstrated that the quantity of silage organic acids can be predicted mathematically by their interactions with visible and near-infrared light wavelengths. This new approach is a low-cost, high-throughput method for rapidly characterizing silage water extracts and can benefit the silage research community by substantially reducing the cost of analysis and increasing throughput. Further development could allow cost-effective, on-farm silage quality diagnostics that save producers money and enable real-time decision-making, including identifying potential forage spoilage and avoiding potential impacts associated with livestock consumption of poor-quality feed. (NP 215)

***Limited irrigation and fertigation can reduce climate impact.*** Irrigated farmland is some of the most productive agricultural land in the United States, but observations indicate that it is challenging to maintain crop yields and nutrient availability when water supplies are limited. ARS researchers in Fort Collins, Colorado, and Colorado State University collaborators tested alternative approaches to limited irrigation and other water saving strategies, including a process called drip fertigation, where nutrients are delivered via precisely-placed irrigation systems. Researchers found that limited irrigation reduced greenhouse gas emissions (GHG) by 15 to 50 percent and conserved water but reduced maize yield in some years. Findings also generally indicated that irrigated drip fertigation deployed in a sandy loam soil with little organic matter resulted in total GHG emissions that were one-tenth of literature-based measurements from sprinkler-irrigated maize systems. Both conserving water and reducing GHG emissions will be increasingly vital in developing sustainable agricultural systems in the arid western United States. These extremely low GHG emission values will be used to further refine the U.S. Agriculture and Forestry Greenhouse Gas Inventory, which catalogs best agricultural management practices. (NP 212)

***Optimal precision placement of crops when managing a no-till system.*** As farmers adopt recommended no-till farming systems, precision placement of various crops within the no-till cropping system can minimize environmental impacts while maximizing crop yields. ARS researchers in El Reno, Oklahoma, used the Multi-objective Evolutionary Algorithm for Soil and Water Assessment Tool (SWAT-MEA) to determine optimal spatial placement of soybeans, winter wheat, grain sorghum, upland cotton, and peanut cropping systems under no-till production in Oklahoma's Fort Cobb Reservoir watershed. Results showed that under optimal crop placement, no-till management maintained crop yields and reduced nitrogen, phosphorus, and sediment losses by 45 percent, 32 percent, and 65 percent, respectively. These results also showed that the SWAT-MEA can potentially be used as a precision agriculture decision-making tool to determine optimal land use and management to minimize environmental impacts while maintaining yields. (NP 211)

***A living mulch system enhances soil infiltration and reduces soil erosion in row crops.*** Corn and soybean farmers are encouraged to use winter cover crops for a variety of reasons, but it is challenging and expensive to replant them every fall. Perennial living mulches have been proposed as way to obtain the benefits of cover crops that need to be planted only once. ARS researchers in St. Paul, Minnesota, completed a 5-year project at two locations in the upper U.S. Midwest that examined the long-term environmental impact of growing corn and soybeans in a perennial living mulch of kura clover. While no differences were found in many soil properties, water infiltration rates were 10-19 times higher in the living mulch system compared to the conventional system. Storm runoff was also measured on sloped plots with both systems, and the living mulch system reduced erosive soil loss by 93 percent, compared to the conventional system. Perennial living mulch systems are a promising management practice for increasing infiltration rates, reducing runoff, and protecting surrounding surface water quality. (NP 211)

Learn more about National Program 211

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