

## Who ARS Serves:

## **Consumers, Farmers, Communities, and Research Partners**

ARS labor-saving tools and technologies continue to improve crop and livestock water management efficiency. The fundamental and applied research on the processes that control water availability and quality is a priority for the health and economic vitality of the American people.



ARS is providing decision support tools such as real-time weather and reservoir monitoring sensors and using forecasting techniques to advance the conservation and preservation of natural resources. ARS research efforts are highlighted by the following accomplishments in 2022.

*Cost-effective, real-time weather and reservoir monitoring sensors.* ARS scientists in Stillwater, Oklahoma, collaborated with Virginia Tech scientists to develop low-cost weather and reservoir-monitoring sensor stations. These stations cost \$250, while commercially available scientific grade weather stations cost approximately \$30,000, so the new stations are 99 percent less expensive, presenting the opportunity to deploy 99 sensors for the previous cost of deploying one sensor. Scientists will be able to deploy sensor networks more densely for developing new and improved decision support tools, models, and applications for forecasting flooding and drought. These sensors provide data and information to a vast array of end users such as farmers, producers, emergency managers, dam owners, investors, and policy makers. This data and information can be accessed for irrigation scheduling, rural and municipal water supply allocations, emergency preparedness, dam operation and maintenance, and developing zoning regulations. (NP 211)

Snowmelt modeling technology to predict water availability in California. Drought and ongoing climate warming have greatly altered snow water supply in the mountainous western United States, requiring new approaches to water supply forecasting that explicitly account for variations in snow accumulation and melt. California receives most of its precipitation during the winter, and mountain snowmelt typically accounts for about one-third of the annual water used by California farms and cities. The California Department of Water Resources (CADWR) initiated a pilot program for incorporating the Automated Water Supply Model/iSnobal snow model developed by ARS researchers in Boise, Idaho, into their operational snow water supply forecasting infrastructure, and ARS researchers provided CADWR engineers with technical support and software troubleshooting. The modeling framework was successfully implemented in real time on CADWR computing resources, and the spatial snowmelt information was integrated into the CADWR operational forecast used to allocate limited water resources. This valuable tool enables CADWR water supply forecasters to readily incorporate complex physically based modeling to forecast reliable estimates of the amount and timing of available snowmelt, which is critical for ensuring sustained production across California. This improved ability to monitor snow depth and predict the volume and timing of spring and summer snowmelt and river flow can greatly aid in early warning of drought or flooding and help optimize planning for agricultural and urban water use. (NP 211)

*Groundwater transfer and injection for augmenting depleted aquifer.* Using groundwater for irrigation has resulted in long-term declines in the Mississippi River Valley alluvial aquifer. The Groundwater Transfer and Injection Pilot project was constructed in Mississippi's Delta region to test the feasibility of withdrawing water near the Tallahatchie River, where it is filtered naturally by passing through sands adjacent to the river, and injecting the water into an area where the aquifer is depleted. ARS researchers in Oxford, Mississippi, studied groundwater levels and quality near the withdrawal and injection sites during short-term experiments and results showed that this technology can increase the amount of water in the aquifer under these regional conditions. Filtration of river water through the sandy sediments adjacent to the river improved its quality and pumping the water into the aquifer increased groundwater levels 1 to 7 feet within a radius of 1 mile from the injection wells. Regional stakeholders have expressed keen interest in this project and are considering the potential for applying this technology to support irrigated agriculture and sustain natural ecosystems. (NP 211)

**BenchBot:** A low-cost autonomous robot for high-throughput phenotyping and building image repositories. High-throughput phenotyping systems for greenhouses and semi-field conditions are critical for plant breeding and building image repositories that use computer vision and artificial intelligence for mapping cash crops, cover crops, and weeds. However, these high-throughput phenotyping systems are costly, resulting in limited use. ARS scientists in Beltsville, Maryland, designed and built BenchBot, a fully autonomous robotic platform, in collaboration with North Carolina State University researchers. BenchBot costs less than \$20,000, significantly less than most commercial and research grade systems that cost millions of dollars. Designs for BenchBot are published on GitHub and are being used for high-throughput phenotyping by ARS, North Carolina State University, and Texas A&M scientists for building a national agronomic plant image repository. BenchBot is a low-cost, user-friendly technology that is making high-throughput phenotyping accossible for researchers. (NP 304)



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Learn more about National Program 304

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