Science Societies

Measuring what matters: How sampling methods shape water quality decisions

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Jake Ladow, Field Operations Lead at the Colorado State University (CSU) Agricultural Water Quality Program, checks a CSU-developed low-cost automated water sampler **(left)** at one of six edge-of-field research plots in northern Colorado. Next to the low-cost sampler is a commercial automated sampler **(right, white enclosure).** Both samplers collect water from a flume installed in the furrow-irrigated corn field to compare how different sampling approaches measure nutrients, sediment, and salts leaving the field during irrigation. Photo by Emmanuel Deleon, CSU Agricultural Water Quality Program.

Farms across the world depend on water from precipitation and irrigation to meet global food, fiber, and fuel needs. However, water that runs off fields during irrigation or storms can carry harmful pollutants into the environment. To monitor the impact of these contaminants, water can be sampled on farms using different methods depending on cost, equipment, and labor.

Researchers at Colorado State University (CSU) wanted to see how four common water-sampling approaches compare in collecting water quality data: (1) A commercial automated sampler, (2) an innovative low-cost automated sampler (developed by the CSU researchers), (3) hourly grab samples taken by hand, and (4) intermittent grab samples. The scientists used the four tools at a northern Colorado farm to measure

multiple characteristics—including nutrients, sediment, and salts—to ensure comparability across methods.

An innovative Bayesian statistical approach was used to fairly compare methods despite the messiness of real-world data. While different sampling approaches showed some biases, the methods produced overall similar results with the CSU-developed low-cost sampler demonstrating that affordable technologies can deliver reliable monitoring. This study highlights that decisions are only as good as the data collected to inform them, emphasizing the need for careful setup, data curation, and analysis to support real-world water quality decisions.

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Brown, A. J., Deleon, E., Wardle, E., Ladow, J. F., & Andales, A. A. (2026). Unveiling biases in water sampling: A Bayesian approach for precision in edge-of-field monitoring. *Journal of Environmental Quality*, *55*, e70149. https://doi.org/10.1002/jeq2.70149

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