# Flexible treatment processes may create water supply that is affordable and benefits crops

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An economic model developed by UCR researchers demonstrates how blending wastewater from various treatment processes could produce irrigation water with nutrients that are beneficial to specific crops and is more affordable. Credit: Quynh K. Tran

Recycled wastewater is increasingly touted as part of the solution to

California's water woes, particularly for agricultural use, as the state's historic drought continues. The cost of treating wastewater to meet state health standards for reuse and to reduce salt levels that damage crops presents a new set of challenges, however.

Researchers at the University of California, Riverside have developed an economic model that demonstrates how flexible wastewater treatment processes which blend varying levels of treated effluent can be optimized to produce a water supply that is affordable, and meets and surpasses a variety of water quality requirements.

This framework is described in a paper, "Wastewater Reuse for Agriculture: Development of a Regional Water Reuse Decision-Support Model (RWRM) for Cost-Effective Irrigation Sources," which appears in the current online issue of the peer-reviewed journal *Environmental Science & Technology*, published by the American Chemical Society.

"While the reuse of treated wastewater is not a new concept, concerns over the rising demand for water from population growth, coupled with both economic and environmental challenges, have made this option more attractive," wrote Quynh K. Tran, a UCR Ph.D. student in chemical and environmental engineering; Kurt Schwabe, professor of environmental economics and policy; and David Jassby, assistant professor of chemical and environmental engineering.

The reuse model the research team developed assumes that wastewater has been treated to meet state standards for removing pathogens and focuses on producing irrigation water with chemical properties tailored for use on specific crops and grasses. Blending wastewater from various treatment processes could produce water with nutrients that are beneficial to specific crops, which would reduce fertilizer costs and increase the affordability of recycled wastewater, the researchers said.

Raw wastewater typically contains high levels of nutrients, specifically nitrogen, phosphorus and potassium, which can be utilized by plants. "However, to meet state and federal water quality regulations, most conventional wastewater treatment plants subject this raw effluent to primary, secondary, tertiary, and disinfection processes, which results in significant removal of nutrients," the team explained.

The researchers identified seven feasible wastewater treatment technologies and 11 wastewater treatment trains currently in use. A treatment train is a sequence of treatments aimed at meeting a specific standard.

Using citrus and turfgrass to test the economic model, the UC Riverside team estimated and compared the costs and water-quality characteristics of treated wastewater under a variety of treatment combinations. They eliminated some treatment combinations as unfeasible because they were unable to produce optimal chemical blends. Other combinations produced blends that were feasible based on their chemical content, but some were not cost-effective for small and medium-sized wastewater treatment plants.

The model demonstrates that "wastewater treatment trains can be optimized to produce irrigation water suitable for a wide range of crops with varying salinity tolerance, reducing the impact on soil and crop quality that is currently experienced by irrigators using conventionally treated wastewater," Tran, Schwabe and Jassby found. "Salinity, heavy metals, and pathogens were minimized to comply with existing regulations and safe agriculture practices.

"By utilizing this blending technique as an alternative irrigation source for agriculture, freshwater resources would be reserved to cope with drought-induced extreme water scarcity."

**More information:** Quynh K. Tran et al. Wastewater Reuse for Agriculture: Development of a Regional Water Reuse Decision-Support Model (RWRM) for Cost-Effective Irrigation Sources, *Environmental Science & Technology* (2016). DOI: 10.1021/acs.est.6b02073

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