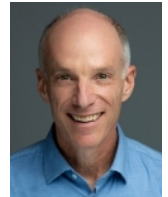


NAWI 3.08 Next-Generation Desalination for Treatment of Agricultural Drainage Wastewater

David Sedlak | University of California, Berkeley



sedlak@berkeley.edu

Challenge

Farmers in arid regions have long been aware of the need to manage salts in drainage from irrigated fields. In California's San Joaquin Valley, salt management has been complicated by the presence of selenium and other naturally occurring toxins, such as arsenic and uranium, in drainage water. The management of salinity is further exacerbated by groundwater overdraft because deeper strata tend to contain more saline groundwater. In addition to salinity management, modern agricultural practices, including pesticide application and intensive dairy farming, have contaminated aquifers with pesticide residues and nitrate. These contaminants are of great importance in the Southern San Joaquin Valley where around 50,000 people who obtain their water from private wells are exposed to one or more contaminants at concentrations above the safe levels established by the USEPA. Over the past two decades, local stakeholders have considered the possibility of using desalination as part of new strategies for managing salts and toxins in the San Joaquin Valley but the approaches have tended to be too expensive or not enough information was available on technology performance. The potential impact of deploying next generation desalination technologies to address problems related to water quality and sustainable land use makes this project an ideal opportunity for NAWI.

Research Approach

The overall goal of this project is to identify approaches that are likely to lead to adoption of desalination and advanced water technologies for treatment and reuse of agricultural drainage water. To achieve this goal, NAWI researchers will employ a multidisciplinary perspective that considers tradeoffs among alternatives and spatial differences in land use across the region. The researchers will:

Analyze irrigation drainage water management strategies, including policy measures and available and emerging desalination technology applications.

Develop a dynamic economic regional framework capable of assessing the costs of various approaches and projecting the likelihood of adoption of desalination and advanced treatment systems.

Identify performance enhancements and policy strategies that will allow desalination and advanced water technology to achieve pipe parity and adoption in the San Joaquin Valley and other important agricultural regions of the United States

Impact

Successful completion of this project will raise awareness among water managers about the potential for desalination to solve problems related to agricultural runoff management, and could make the San Joaquin Valley the first location in the country where next-generation desalination is applied to agriculture at scale. It is anticipated that the outputs of this project will provide a basis for identifying the advances in water treatment technologies that are needed to achieve pipe parity to enable reuse of agricultural drainage and protection of community water supplies from agricultural contaminants.

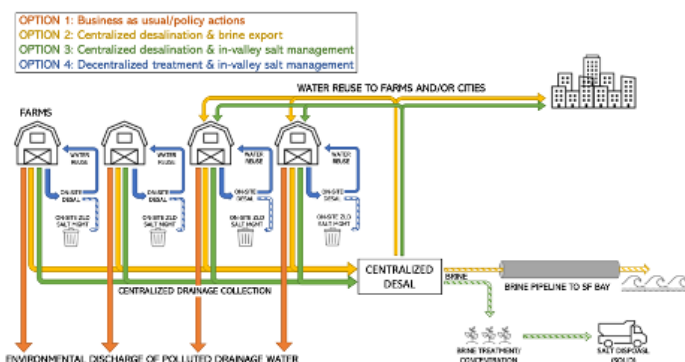


Figure 1. Existing and emerging approaches for managing agricultural drainage in the San Joaquin Valley. Research will focus on ways in which next-generation desalination can help Options 3 and 4 achieve pipe parity.

RESEARCH PARTNERS

Fresno State University: Karl Longley; Lawrence Berkeley National Laboratory: Jenn Stokes-Draut, Nigel Quinn; Meridian Institute: Molly Mayo; University of California, Berkeley: David Sedlak, David Zilberman; University of California, Davis: Thomas Harter.

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Accomplishments & Findings

This research project made significant progress in illuminating the multiple factors that drive adoption of small-scale distributed desalination in agricultural regions. Many of these regions struggle not only with water scarcity but also drinking water quality and soil salinization. Comprehensive solutions that address all three value propositions are likely to have the greatest support from community members.

The research team confirmed that brackish groundwater desalination is already at a price point that is attractive to producers of high value crops such as almonds and pistachios. However, irrigators tend to use large volumes of water during short periods of time, while desalination systems are designed to produce steady flows of water over long periods of time. To ensure adoption, desalination systems serving agricultural operations will need to have access to water storage (e.g., ponds, aquifers) or existing canals or pipelines that can move water over long distances. Alternatively, desalination units will have to be portable enough to be relocated and shared among users.

Brine management remains the key to affordable inland desalination. Beyond a few coastal regions, centralized brine disposal via brine lines that discharge to the ocean will be difficult to finance and build. Deep well injection of brines may be possible in some areas, but it faces permitting challenges. Decentralized brine hauling (e.g., by truck or rail) for disposal and/or valorization in smaller-scale facilities is more likely. Irrespective of the approach, millions of tons of salts would be generated through basin-wide desalination and salt management. Therefore, brine valorization into industrial chemicals will be critical to improving the economics of inland desalination and salt management. NAWI projects 3.15, 3.18, 3.19, and 5.12 have made substantial progress in developing and demonstrating brine valorization technologies.

The same technologies for affordable distributed desalination for agriculture could also address the critical need for an adequate supply of safe and affordable drinking water in agricultural regions. A majority of “at-risk” or

Partner Institutions

University of California, Berkeley
Fresno State University
Lawrence Berkeley National Laboratory
Meridian Institute
University of California, Davis

“failing” small water systems in California (and likely elsewhere in the U.S.) are in agricultural regions. NAWI project 5.10 demonstrated that small-scale, distributed desalination is the most cost-effective way to provide safe drinking water to these communities.

The challenge of effectively managing salt, drinking water quality, and water supply and demand in inland agricultural regions will require a level of collaboration and long-term partnership that can easily stall or unravel. Thoughtful design and implementation of economic systems that illuminate the economic value of water in different locations at different times, salt monitoring and abatement programs, and new technologies that enable autonomous operation of distributed treatment systems for small communities are likely to be key to sustaining long-term economic value in agricultural regions. There is significant interest in using desalination for agriculture globally – the U.S. could be a pioneer in creating and scaling this important technology for global adoption.

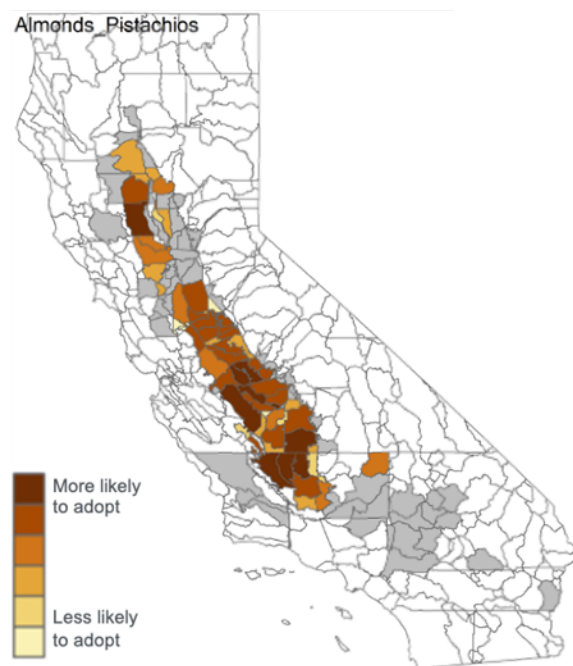


Figure 2. Threshold likelihood for desal adoption in the Central Valley based on crop value and type by county.