RESEARCH BRIEF

APRIL 2020

Stanford WOODS INSTITUTE for the ENVIRONMENT

New Method to Improve Water Demand Management

A new method of consumption change detection can improve water utilities' demand management responses by pinpointing the timing and magnitude of customer-level water use shifts resulting from climate-related mass media and policy events.

Background

Population growth and climate change are among the principal challenges faced by urban water suppliers in the 21st century. Urbanization is projected to add 3 billion people to the world's cities by 2050, putting more pressure on already water-scarce regions, while rising surface temperatures are expected to increase the frequency and severity of droughts, floods and their corresponding disruptions. For water utilities, demand management campaigns and emergency responses that effectively harness user behavior are powerful tools to adapt to this uncertain future.

POINTS FOR POLICY MAKERS

- **Customers were overwhelmingly responsive to severe drought conditions, with 75% noticeably reducing water use at least once during 2013–2016.** The consumption reductions detected were substantial, averaging 35–40% of each customer's baseline consumption and resulting in agency-wide savings of 21% relative to 2002–2012.

- **80% of customers who conserved did so voluntarily, before the mandatory restriction was introduced in May 2015.** The restriction is associated with a less pronounced increase in the likelihood of a consumption decrease but it still accompanied a marked and sustained increase in water savings, suggesting that it triggered more modest but widespread behavior changes.

- **Substantial water use reductions were concentrated in periods of heightened public awareness.** This period is associated with state-level policy actions and drought media coverage; reductions were spread across all three customer types analyzed– high-income single-family residences, low-income single-family residences, and multi-family units.

- **Coordinating conservation campaigns with other local water agencies, as well as timing outreach efforts to coincide with state initiatives could have significant benefit.** In September-October, 2014, 8% of Mesa Water's customers noticeably reduced their water use with minimal involvement by the water utility itself, but the peak did coincide with state-level action to prohibit wasteful water use and a spike in drought-related media coverage. In the future, more focused and sustained public awareness campaigns — coordinated across state and local governments — could be complemented by active collaboration with mass media to enhance public engagement and collective action.

Water conservation efforts can serve both as a cost-effective, long-term source and as a backstop against short-term water supply deficiencies and are recognized as having immense value in a water utility's portfolio of strategies to ensure adequate supply. Messaging campaigns such as rebates for water-efficient retrofits, mandatory outdoor watering restrictions, block rate tariffs, and dynamic pricing among others have proven effective. Climate crisis and emergency measures have also led to heightened public awareness and behavior change that are often further amplified by mass media. Although decision makers increasingly recognize the need to consider these external consumption drivers in water supply planning decisions, their influence is often hard to evaluate.

Utilities have relied on metering data and new computing tools to help predict household water and energy use with greater accuracy. But a new method developed by Stanford scholars uses machine learning and change detection to pinpoint the timing and magnitude of customer-level water use shifts. Analyzing water consumption at this level of detail can help water supply planners and decision makers monitor the influence of multiple types of shocks and interventions on their service areas.

The research team examined customer water use behavior in the Mesa Water District over the course of the 2012-2016 California drought. The findings show that using only existing billing data and freely available climate and socio-economic data, water suppliers can gain insights into the influence of various internal and external events on a city-wide scale and can also categorize customers according to how their responses to these events evolve over time. For example, environmentally conscious and informed consumers who saved early in the drought period make good targets for water efficiency incentives to achieve longer-term savings, while those who were non-responsive or increased their water use could reveal where violations of a watering restriction are more likely, allowing utilities to allocate compliance and enforcement efforts more efficiently in the future.

Stanford WOODS INSTITUTE for the ENVIRONMENT

ABOUT THE AUTHORS

Jose Bolorinos

Jose Bolorinos is a Ph.D. candidate in the Department of Civil and Environmental Engineering, Stanford University.

Newsha Ajami

Newsha Ajami is the Director of Urban Water Policy, Water in the West and a Senior Research Engineer with Stanford Woods Institute for the Environment.

Ram Rajagopal

Ram Rajagopal is an Associate Professor of Civil and Environmental Engineering and a Senior Fellow at the Precourt Institute for Energy.

This Brief is based on the paper **Consumption Change Detection for Urban Planning: Monitoring and Segmenting Water Customers During Drought** published in *Water Resources Research* (2020).

FOR MORE INFORMATION

Office of External Affairs
Stanford Woods Institute for the Environment
woods-extaffairs@stanford.edu
woods.stanford.edu