Researchers combine Zillow and census data to determine residential water needs

November 18 2020

Credit: Unsplash/CC0 Public Domain

The gateway to more informed water use and better urban planning in your city could already be bookmarked on your computer. A new Stanford University study identifies residential water use and

conservation trends by analyzing housing information available from the prominent real estate website Zillow.

The research, published Nov. 18 in *Environmental Research Letters*, is the first to demonstrate how new real estate data platforms can be used to provide valuable water use insights for city housing and infrastructure planning, drought management and sustainability.

"Evolving development patterns can hold the key to our success in becoming more water-wise and building long-term water security," said study senior author Newsha Ajami, director of urban water policy at Stanford's Water in the West program. "Creating water-resilient cities under a changing climate is closely tied to how we can become more efficient in the way we use water as our population grows."

It's estimated that up to 68 percent of the world's population will reside in urban or suburban areas by 2050. While city growth is a consistent trend, the types of residential dwellings being constructed and neighborhood configurations are less uniform, leading to varying ways in which people use water inside and outside their homes. The people living within these communities also have different water use behaviors based on factors such as age, ethnicity, education and income. However, when planning for infrastructure changes, decision-makers only take population, economic growth and budget into account, resulting in an incomplete picture of future demand. This, in turn, can lead to infrastructure changes, such as replacing old pipes, developing additional water supply sources or building wastewater treatment facilities, that fail to meet community needs.

Zillow and other real estate websites gather and publish records collected from different county and municipal agencies. These websites can also be updated by homeowners, making them rich sources of information that can otherwise be difficult and timely to obtain. The Stanford

researchers used data from Zillow to gather single-family home information, including lot size, home value and number of rooms in Redwood City, California, a fast-growing, economically diverse city with various styles of houses, lots and neighborhoods. Then, they pulled U.S. Census Bureau demographic information for the city, looking at factors including average household size and income along with the percentage occupied by renters, non-families, college educated and seniors.

Coupling the Zillow and census data and then applying machine learning methods, the researchers were able to identify five community groupings, or clusters. They then compared the different group's billing data from the city's public works department to identify water usage trends and seasonal patterns from 2007 to 2017 and conservation rates during California's historic drought from 2014 to 2017.

"With our methods incorporating Zillow data we were able to develop more accurate community groupings beyond simply clustering customers based on income and other socioeconomic qualities. This more granular view resulted in some unexpected findings and provided better insight into water-efficient communities," said lead author Kim Quesnel, a postdoctoral scholar at the Bill Lane Center for the American West while performing the research.

They found the two lowest income groups scored average on water use despite having a higher number of people living in each household. The middle-income group had high outdoor water use but ranked low in winter water use, signaling efficient indoor water appliances—such as low-flow, high-efficiency faucets and toilets—making them an ideal target for outdoor conservation features such as converting green spaces or upgrading to weather-based or smart irrigation controllers.

The two highest income groups, characterized by highly educated

homeowners living in comparatively larger homes, were the most dissimilar. One cluster—younger residents on smaller lots with newer homes in dense, compact developments—had the lowest water use of the entire city. The other high-income cluster consisting of older houses built on larger lots with fewer people turned out to be the biggest water consumer. The finding goes against most previous research linking income and water use, and suggests that changing how communities are built and developed can also change water use patterns, even for the most affluent customers.

All groups showed high rates of water conservation during drought. Groups with the highest amount of savings (up to 37 percent during peak drought awareness) were the two thirstiest consumers (the high-income, large-lot and middle-income groups) demonstrating high potential for outdoor water conservation. Groups with lower normal water usage were also able to cut back, but were more limited in their savings. Understanding these limitations could inform how policymakers and city planners target customers when implementing water restrictions or offering incentives such as rebates during drought.

This research lays the framework for integrating big data into urban planning, providing more accurate water use expectations for different community configurations. Further studies could include examining how data from emerging online real estate platforms can be used to develop neighborhood water use classifications across city, county or even state lines. An additional area of interest for the researchers is examining how water use consumption is linked to development patterns in other kinds of residential areas, for example in dense cities.

"Emerging, accessible data sources are giving us a chance to develop a more informed understanding of water use patterns and behaviors," said Ajami. "If we rethink the way we build future cities and design infrastructure, we have the opportunity for more equitable and

affordable access to water across various communities."

More information: *Environmental Research Letters* (2020). DOI: 10.1088/1748-9326/abb7ae

Provided by Stanford University