Future Of Western Water Supply Threatened By Climate Change

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As the West warms, a drier Colorado River system could see as much as a one-in-two chance of fully depleting all of its reservoir storage by mid-century assuming current management practices continue on course, according to a new University of Colorado at Boulder study.

The study, in press in the American Geophysical Union journal, Water Resources Research, looked at the effects of a range of reductions in Colorado River stream flow on future reservoir levels and the implications of different management strategies. Roughly 30 million people depend on the Colorado River -- which hosts more than a dozen dams along its 1,450 journey from Colorado's Rocky Mountains to the Gulf of California -- for drinking and irrigation water.

The Colorado River system is presently enduring its 10th year in a drought that began in 2000, said lead study author Balaji Rajagopalan, a CU-Boulder associate professor of civil, environmental and architectural engineering. Fortunately, the river system entered the drought with the reservoirs at approximately 95 percent of capacity. The reservoir system is presently at 59 percent of capacity, about the same as this time last year, said Rajagopalan, also a fellow at CU-Boulder's Cooperative Institute for Research in Environmental Sciences.

The research team examined the future vulnerability of the system to water supply variability coupled with projected changes in water demand. The team found that through 2026, the risk of fully depleting reservoir storage in any given year remains below 10 percent under any scenario of climate fluctuation or management alternative. During this period, the reservoir storage could even recover from its current low level, according to the researchers.

But if climate change results in a 10 percent reduction in the Colorado River's average stream flow as some recent studies predict, the chances of fully depleting reservoir storage will exceed 25 percent by 2057, according to the study. If climate change results in a 20 percent reduction, the chances of fully depleting reservoir storage will exceed 50 percent by 2057, Rajagopalan said.

"On average, drying caused by climate change would increase the risk of fully depleting reservoir storage by nearly ten times more than the risk we expect from population pressures alone," said Rajagopalan. "By mid-century this risk translates into a 50 percent chance in any given year of empty reservoirs, an enormous risk and huge water management challenge," he said.

But even under the most extensive drying scenario, threats to water supplies won't be felt immediately. "There's a tremendous storage capacity on the Colorado River that helps with the reliability of supply over periods of a just few years," said Rajagopalan.

Total storage capacity of reservoirs on the Colorado exceeds 60 million acre feet, almost 4 times the average annual flow on the river, and the two largest reservoirs -- Lake Mead and Lake Powell -- can store up to 50 million acre feet of water. As a result, the risk of full reservoir depletion will remain low through 2026, even with a 20 percent stream flow reduction induced by climate change, said Rajagopalan.

Between 2026 and 2057, the risks of fully depleting reservoir storage will increase seven-fold under the current management practices when compared with risks expected from population pressures alone. Implementing more aggressive management practices -- in which downstream releases are reduced during periods of reservoir shortages -- could lead to only a two-fold increase in risk of depleting all reservoir storage during this period, according to the study.

The magnitude of the risk will ultimately depend on the extent of climate drying and on the types of water management and conservation strategies established, according to the CU-Boulder study.

"Water conservation and relatively small pre-planned delivery shortages tied to declining reservoir levels can play a big part in reducing our risk," said Ken Nowak, a graduate student with CU-Boulder's Center for Advanced Decision Support for Water and Environmental Systems, or CADSWES, and a study co-author.

"But the more severe the drying with climate change, the more likely we will see shortages and perhaps empty reservoirs despite our best efforts." Nowak said. "The important thing is not to get lulled into a sense of safety or security with the near-term resiliency of the Colorado River basin water supply. If we do, we're in for a rude awakening."

"This study, along with others that predict future flow reductions in the Colorado River Basin, suggests that water managers should begin to re-think current water management practices during the next few years before the more serious effects of climate change appear," said Rajagopalan.

Titled "Water Supply Risk on the Colorado River: Can Management Mitigate?" the study was conducted with support from the Western Water Assessment – a joint venture of CU-Boulder and the National Oceanic and Atmospheric Administration, as well as CADSWES and the Bureau of Reclamation.

Other study authors included James Prairie of the Bureau of Reclamation, Martin Hoerling and Andrea Ray of NOAA, Joseph Barsugli and Bradley Udall of CIRES and Benjamin Harding of AMEC Earth & Environmental Inc. of Boulder.

SOURCE: University of Colorado at Boulder