Hotter temperatures, less water present challenges for policy makers, agricultural stakeholders

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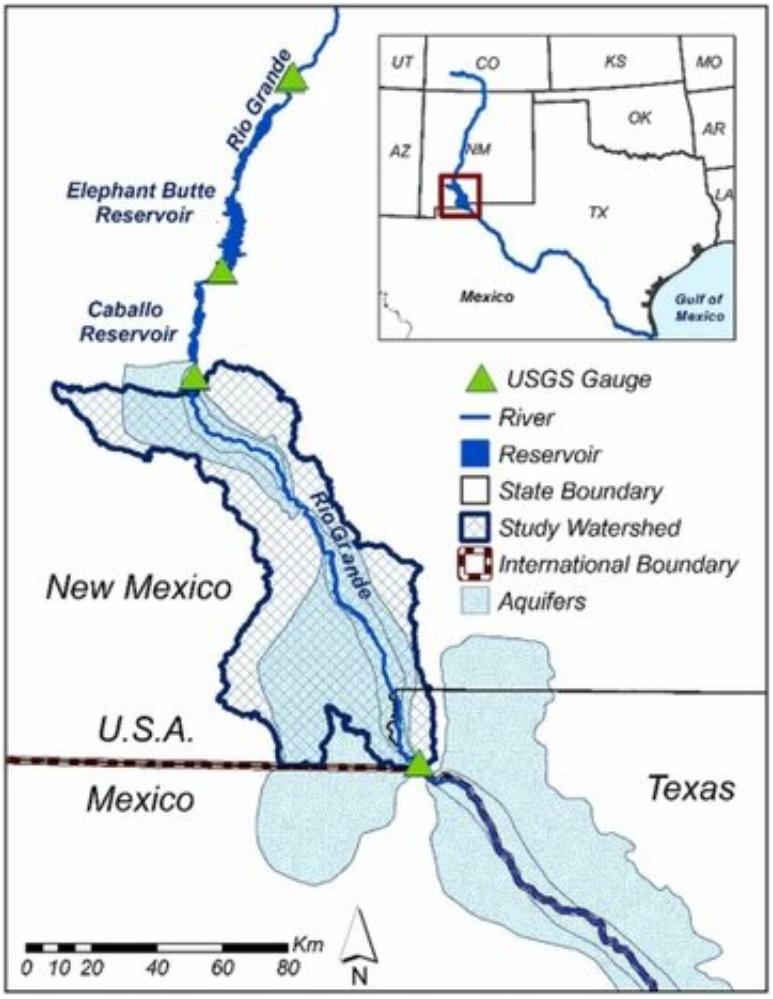

Study watershed in the New Mexico-Texas portion of the Rio Grande Basin. Credit: *Journal of Hydrology: Regional Studies* (2022). DOI: 10.1016/j.ejrh.2022.101307

Climate model projections indicate that New Mexico's future will be warmer and drier, with diminished water supply from the Rio Grande, presenting extreme challenges for policy makers and agricultural stakeholders. A new study titled "Adapting irrigated agriculture in the Middle Rio Grande to a warm-dry future" analyzed the long-term tradeoffs of land and water management interventions that could help irrigated agriculture adapt to growing water scarcity in a desert environment.

David Gutzler, a professor in the Department of Earth & Planetary Sciences at The University of New Mexico (UNM), along with UNM students and collaborators at other regional universities led by the University of Texas-El Paso, delved into the potential impacts of various intervention scenarios on agricultural water supplies in the Rio Grande Valley downstream of Elephant Butte Reservoir.

This research has a big impact on New Mexico because while this study focused on hydrology and climate change, there is also a big component of water management associated with interstate and international agreements to share water. The research was carried out with the engagement of communities that share river water and groundwater in southern New Mexico, western Texas, and across the border in the Mexican state of Chihuahua.

The research analyzed 19 different intervention scenarios, including the implementation of deficit irrigation, changes in cropping patterns using existing crops, and the introduction of new drought- and salt-tolerant crop alternatives. Hydrological simulations were conducted using the soil and water assessment tool (SWAT) model, considering the limitations of the model in performing scenario simulations.

"We carried out a six-year effort with a big interdisciplinary team, including hydrologists, economists, and agriculture experts, to explore

the water future of the transboundary region along the Rio Grande, and to think about potential ways that the community could adapt to projected diminished water supplies," said Gutzler.

"The principal UNM-based component of the research was to make projections of future river flows into Elephant Butte reservoir. We started with US Bureau of Reclamation model projections of natural river flows in a future climate warmed by increasing greenhouse gases. But we couldn't use the natural flow projections directly."

"The actual Rio Grande flow that reaches Elephant Butte is nowhere near natural because we're withdrawing lots of the water upriver, putting it to beneficial use in Colorado and northern New Mexico. So, our research came up with a way to turn the simulated natural flows reaching the reservoir into something more realistic, accounting for upstream water withdrawals."

Gutzler and UNM graduate student, Nolan Townsend, did this in a purely statistical way. They adjusted the average simulated flow during a historical period by cutting the flow by a certain fraction to match the corresponding long-term average in observations. They applied the historical adjustment statistics to future flows, effectively assuming that the upstream water management implicit in the statistics does not change in future decades. They also kept current (as of 2020) management rules for releasing water from the reservoir unchanged.

This procedure yields projections for how much water is available from Elephant Butte storage for irrigated agriculture and for the cities of El Paso and Juarez, and how much water is available to maintain groundwater south of Elephant Butte, assuming that water management rules currently in place are not changed.

Gutzler emphasized that there are multiple ways water management

policies could change. A primary result of this study indicates that if the rules do not change then water supplies will be completely unsustainable in a warming climate. The study, therefore, emphasizes the necessity of changing water management rules to address the imminent water scarcity issues. As Gutzler says, "If we don't change the rules, we're going to run out of water down there."

However, the study acknowledges the complexity and challenges associated with implementing new water management strategies. Gutzler notes that political factors, historical treaties, and financial considerations will play a significant role in shaping future water policies.

"Nevertheless, we're at the point when the availability of water does not reliably meet the demand for water under current management rules," said Gutzler. "I think we can present that with confidence. There are multiple ways to change the water management system that may or may not fix the shortfall."

Gutzler explains that there are also alternative ways to generate water supplies for the region, but he emphasizes that some of these alternatives are probably unrealistic. He states that technically it is possible to build a pipe from the Mississippi River and bring in water; however questions arise of who is going to pay for this, and would people elsewhere be okay with having their water piped away to the Southwest?

Another alternative to generate new water is desalination. However, this process can cause environmental problems such as what to do with the leftover brine. This process is also very expensive compared to the current water supplied by the river.

"One could also envision new rules that would maintain some level of river flows for environmental purposes. And we can quantify that. What

would it take to keep water in the river? And we can also estimate what that would cost in terms of foregone agricultural production."

Gutzler says that there are different watering patterns that might be affected. He talks about how agricultural farmers can change their crops from cotton or pecans to pistachios as an example and what the effect would be on the total water supply.

"The summary result was that there are strategies that could be used by farmers to reduce consumption of water and still produce crops … There are lots of ways that farmers could choose to adapt and the folks that manage water allocations in our study region could choose to adapt by limiting supplies."

The results suggest that irrigated agriculture in the Middle Rio Grande can be adapted to a warmer and drier future, but it will require a combination of management innovations by growers, alternative crops, and more efficient irrigation technologies. The study highlights the importance of long-term planning and collaboration among stakeholders to ensure sustainable water management in the region.

Gutzler concludes, "In academia, we are in the business of assessing options and saying, here's what's feasible, and here's what's likely to happen in terms of water futures if you do option A and don't do option B. Our hope is that studies like ours can help inform policymakers about their best options in this contentious discussion."

The study sheds light on the urgent need to adapt irrigated agriculture in the Middle Rio Grande to a warm-dry future, emphasizing the importance of proactive measures to address water scarcity challenges in the region. "Contention over water supplies is not going to go away and I hope exercises like ours can help to inform policymakers and water users what their best options might be," added Gutzler.

The findings are published in the *Journal of Hydrology: Regional Studies*.

More information: Maryam Samimi et al, Adapting irrigated agriculture in the Middle Rio Grande to a warm-dry future, *Journal of Hydrology: Regional Studies* (2022). DOI: 10.1016/j.ejrh.2022.101307

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