# Cooperation rewards water utilities

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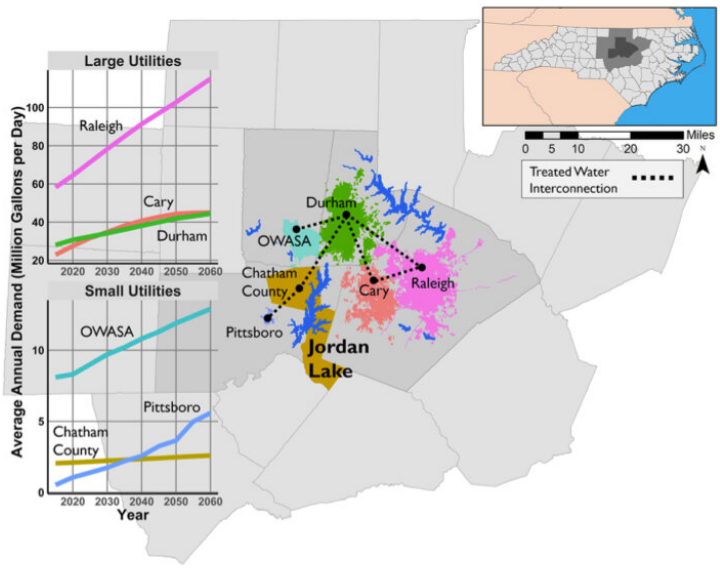


A new study found that agreements between water utilities can help mitigate their risks, in research that used XSEDE-allocated supercomputer simulations of water supply of six population centers (colors) in the North Carolina Research Triangle. Water demands in annual average millions of gallons per day are given from 2015 to 2060 on inset plots based on utility projections. Credit: Gorelick et al.

Mark Twain once said, "Whisky is for drinking, and water is for fighting over!" But what if cooperation yielded more benefit than just going it alone, when it comes to urban water utilities?

A new study of water supply in the North Carolina Research Triangle found that agreements between water utilities can help mitigate their risks.

The research used supercomputer allocations on the Stampede2 system of the Texas Advanced Computing Center awarded by the Extreme Science and Engineering Discovery Environment (XSEDE), which is funded by the National Science Foundation.

The findings are generalizable to any place where water providers allocate regional water resources among users that face challenges in supply and demand and in affordably financing infrastructure improvements.

"We found that cooperation amongst utilities could be beneficial to both their water supply and financial needs compared to more traditional independent planning and management," said David Gorelick, a postdoctoral research associate at the University of North Carolina, Chapel Hill. Gorelick is with the Center on Financial Risk in Environmental Systems, Department of Environmental Sciences and Engineering, Gillings School of Global Public Health.

The study was published March 2022 in *Water Resources Research*, a journal of the American Geophysical Union.

The authors started with a computational model they developed together with regional utilities in North Carolina.

"Their participation gives us a lot of confidence that our results will be used at least to inform their behavior and to help avoid some more significant pitfalls when it comes to making big, long term, hundred-million-dollar financial decisions concerning water infrastructure such as new reservoirs or wastewater treatment plants," Gorelick said.

The model accurately simulates their risk management and long-term infrastructure planning decisions out until 2060.

"This work is not possible without XSEDE supercomputing resources," said study co-author David Gold, a Ph.D. candidate in the Department of Civil and Environmental Engineering at Cornell University.

Gold and colleagues evaluated the water supply system of the North Carolina Research Triangle of about two million residents, bounded by Chapel Hill, Durham, and Raleigh, over millions of future states out to 2060. This allowed discovery of water management strategies that are robust to a broad set of future conditions.

"Without supercomputing capabilities, we're flying blind in terms of how the water supply system reacts to different types of uncertainties, whether it's population growth or changing climate," Gold said.

"It's been expansive for us to be able to use Stampede2," Gold added. "If we were to try to run these simulations on our desktop, it would take us over 15 years to do all the simulations that we ran using Stampede2 over just the course of a few hours."

A utility-scale computational model of the region was thus developed, using the WaterPaths stochastic simulation software, a utility planning and management tool. The risk-of-failure was evolved based on reservoir capacity dynamics that change on hydroclimatic conditions, human demands, and management decisions that combine weekly portfolio management with long-term annual infrastructure investments.

Some of the risks of inter-utility agreements include exposure to asymmetric partner growth or the inflexibility of the agreement structure itself to respond to the ups and downs of supply and demand.

Interestingly, the authors hypothesized that more flexible agreements might benefit partners more by allowing them to adapt to changing conditions.

"In fact, we found that utilities experienced more financial risk in these cases," Gorelick said. The study found that with less flexible agreements, utilities are limited to mitigating their own risks. But when agreements can be updated over time, each utility is more exposed to the risks and the uncertainties of their partners.

"We found that cooperation is a good thing. But the type and the manner in which cooperation occurs can be very important for water utilities, and thus the water rates that all of us pay to get our water bills," Gorelick said.

A simple example of an agreement studied in the paper was a fixed allocation agreement, such as that for a new reservoir or wastewater treatment plant. Because municipalities and local governments in the U.S. can enact inter-local agreements, utilities can partner together and be allocated fixed allocations of storage or treatment capacity in a shared project at the outset.

If one utility, for instance, pays for 20% of the development of that plant, they are allowed to use 20% of its capacity.

"Why these sorts of agreements matter, and why we wanted to test at least a couple in this study is that the agreements are widespread and very customizable from place to place," Gorelick said.

Thus far, there have been very few research efforts to assess their performance in terms of utility supply and financial objects.

Said Gold: "Today, our water systems face greater challenges than ever.

But, we also have tools that we've never had before, in terms of supercomputers. By using resources, such as those available at XSEDE, we are able to level the playing field a bit. When we think about the challenges and uncertainties coming from population growth and changing climate, these computer resources allow us insight into the potential effects of these changes and the support to develop sustainable management strategies that can keep our water supply reliable for years to come."

**More information:** David E. Gorelick et al, Impact of Inter-Utility Agreements on Cooperative Regional Water Infrastructure Investment and Management Pathways, *Water Resources Research* (2022). DOI: 10.1029/2021WR030700

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