New review of world water resources provides sustainable management strategies

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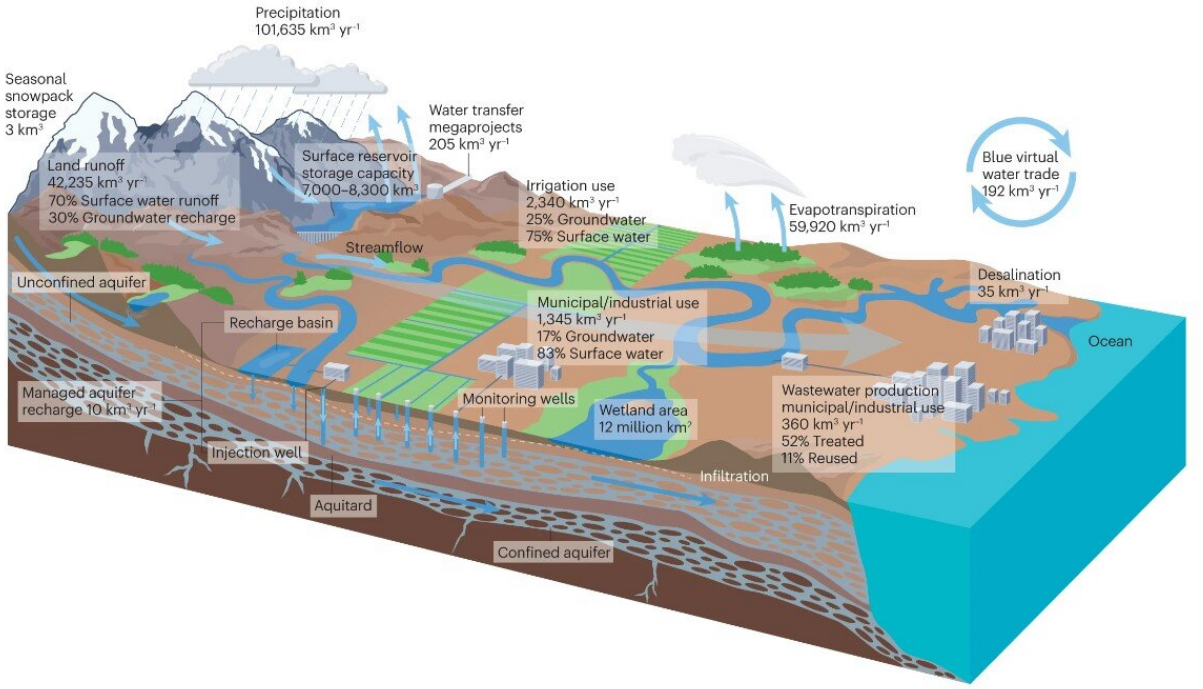

A figure from the review study illustrating global annual water storage and fluxes. Credit: *Nature Reviews Earth & Environment* (2023). DOI: 10.1038/s43017-022-00378-6

A recent review study led by The University of Texas at Austin provides an overview of the planet's freshwater supplies and strategies for sustainably managing them.

Published in *Nature Reviews Earth & Environment*, the study highlights the connections between surface and groundwater and calls for diversified strategies for managing them both.

"I like to emphasize a lot of solutions and how they can be optimized," said lead author Bridget Scanlon, a senior research scientist at the UT Bureau of Economic Geology, a research unit of the Jackson School of Geosciences.

The study draws on data from satellites, climate models, monitoring networks and almost 200 scientific papers to analyze Earth's water supply, how it's changing in different regions and what's driving these changes. The study's co-authors include almost two dozen water experts from around the world.

According to the research, humans primarily rely on surface water. Globally, it accounts for 75% of irrigation and 83% of municipal and industrial supply annually. However, what we see at the surface is tightly connected to groundwater flow. In the United States, about 50% of annual streamflow starts as groundwater. And globally, surface water that seeps into the ground accounts for about 30% of annual groundwater supplies.

Human intervention can strongly influence the exchange in water between surface and groundwater sources. About 85% of groundwater pumped by humans in the U.S. is considered "captured" from surface water, which leads to declines in streamflow. At the same time, irrigation sourced from surface water can increase groundwater recharge as irrigated water seeps through the ground back to aquifers.

The study cites numerous examples of human activity affecting this flux between surface water and groundwater supplies. For example, surface water irrigation recharged aquifers in the early to mid-1900s in the

Northwestern U.S.'s Columbia Plateau and Snake River Plain, while global models show that groundwater pumping has greatly reduced the volume of water going to streams, with 15-21% of global watersheds at risk because of the reduced flows.

Despite their inherent connection, surface water and groundwater are frequently regulated and managed as separate resources. According to the researchers, future water resilience depends on recognizing that surface water and groundwater behave as a single resource—and acting on that knowledge.

The study describes different ways for managing water through both natural and engineered solutions that can help increase water supplies, reduce demand, store water and transport it. According to Scanlon, one of the best ways to adapt to increasing climate extremes is storing water during wet times and drawing on it in times of drought.

"We have droughts and we have floods," she said. "We are trying to manage those extremes and a way to do that is to store water."

Annually, the world stores about 7,000-8,300 cubic kilometers, or about two times the amount of water in Lake Michigan, in surface reservoirs. The researchers said it was important to continue developing groundwater supplies, too, because they are more resilient than surface reservoirs during long-term droughts. Managed aquifer recharge can help cities build up their groundwater supplies by collecting surface water and diverting it underground into aquifers. Globally, about 10,000 cubic kilometers of water is stored this way each year.

"This type of integrated research, linking surface and groundwater, is exactly what is needed to develop lasting solutions to issues such as fresh water use," said Scott Tinker, the director of the Bureau of Economic Geology. "Too often studies are done in isolation, and well-intended

applications have unintended outcomes."

Matthew Rodell, a hydrologist at NASA Goddard Space Flight Center who was not involved in the study, said that the paper offers a useful compendium of research results and potential solutions for managing water supplies while also keeping water quality—a characteristic that's more difficult to monitor remotely than quantity—in mind.

"Water quality is one of the next targets in terms of being able to manage water resources," he said. "I like that this was incorporated as well."

More information: Bridget R. Scanlon et al, Global water resources and the role of groundwater in a resilient water future, *Nature Reviews Earth & Environment* (2023). DOI: 10.1038/s43017-022-00378-6

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