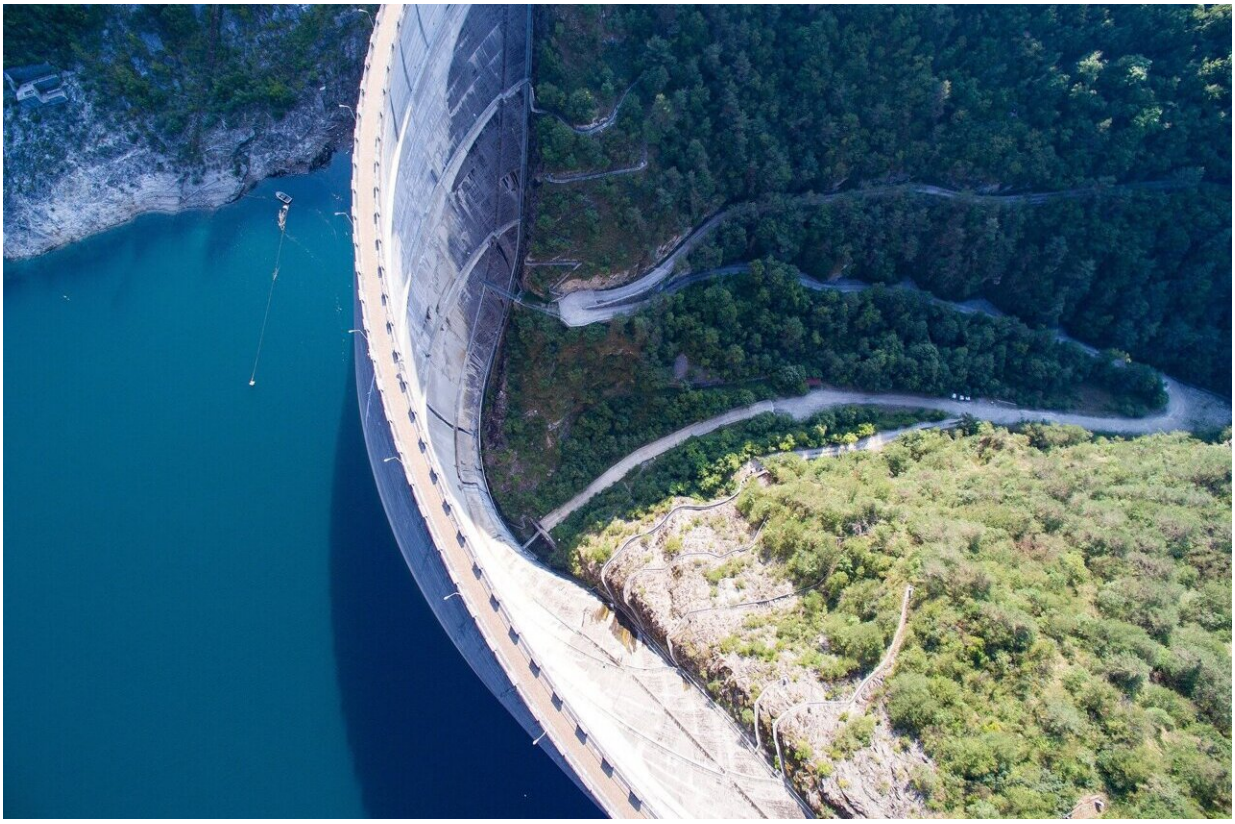
Dams could play a big role in feeding the world more sustainably, researchers find

November 14 2022



Credit: Pixabay/CC0 Public Domain

A bogeyman to many environmentalists, dams could actually play a significant role in feeding the world more sustainably, according to new Stanford University research. The study, published the week of Nov. 14

in *Proceedings of the National Academy of Sciences*, quantifies for the first time how much water storage would be required to maximize crop irrigation without depleting water stocks or encroaching on nature, and how many people this approach could feed.

While the researchers find that dammed reservoirs could be used to store more than 50% of the water needed for such irrigation, they emphasize that large reservoirs are only part of the solution and recommend evaluating alternatives to building new dams due to their damaging impacts on river ecosystems.

"There is an urgent need to explore alternative water storage solutions, but we have to acknowledge that many dams are already in place," said study lead author Rafael Schmitt, a research engineer with the Stanford Natural Capital Project. "Our research illuminates their crucial role in ensuring food security in the future."

Typical agricultural practices in many parts of the world deplete and pollute water resources, damage natural landscapes, and together generate one-fourth of global greenhouse gas emissions. Two-thirds of global cropland depends on rainfall and often makes up for its absence by using non-sustainable water resources, such as non-renewable groundwater, or impeding environmental flows.

Sustainable irrigation's potential

The researchers analyzed the amount of freshwater in surface and groundwater bodies generated and renewed by natural hydrological cycles, as well as water demands of current crop mixes on irrigated and rainfed lands. They estimated that the full potential of storage-fed irrigation could feed about 1.15 billion people. If all 3,700 potential dam sites that have been mapped for their hydropower potential were built and partially used for irrigation, the world's dams could supply enough

water storage to irrigate crops for about 641 million people or 55% of the total.

Despite dams' potential, the researchers caution against relying on them as a significant part of the sustainable irrigation solution, citing dams' socio-environmental consequences, such as fragmentation of rivers, with impacts on fish migration and sediment transport, and displacement of people. Dams are also less appealing for irrigation storage because of water loss, expense, and ecological damage related to the need for conveyance to distant agricultural fields, as well as higher levels of evaporation across large reservoirs' large water surfaces.

"Amongst all supply and demand side options to increase food and water security, building more dams should be the last resort," the researchers write.

Alternative solutions to provide more environmentally sound water storage for irrigation include water harvesting with small dams, recharging groundwater systems with excess surface water from winter storms or spring snow melt, and better management of soil moisture on farm fields. These decentralized approaches lose less water due to evaporation, require less conveyance infrastructure, and often create co-benefits for local communities and wildlife.

Additionally, the researchers highlight that the demand for stored water can be reduced through better irrigation techniques, or adoption of crops that are better aligned with water availability. With storage being such a bottleneck for future agriculture, better land management that reduces erosion—and thus sedimentation and storage loss—in existing reservoirs is an additional priority.

"Nutritional security is a core challenge for sustainable human development," said study senior author Gretchen Daily, co-founder and

faculty director of the Stanford Natural Capital Project. "Our study highlights the urgent need and opportunity for nature-positive investments into irrigation and water management to reduce harmful impacts of agriculture while supporting other vital benefits of farmland and freshwater ecosystems."

More information: Schmitt, Rafael J. P. et al, Global expansion of sustainable irrigation limited by water storage, *Proceedings of the National Academy of Sciences* (2022). DOI: 10.1073/pnas.2214291119. doi.org/10.1073/pnas.2214291119

Provided by Stanford University