Scientists develop tool to predict dam removal costs by analyzing 55 years of past removals

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Wellington Dam, Western Australia. Credit: Unsplash/CC0 Public Domain

Scientists have analyzed more than 650 dam removal projects over 55 years in the United States totaling $1.52 billion inflation-adjusted dollars

to develop a tool to better estimate the cost of future dam removals.

The analysis arrives at a time of increasing awareness of the disruptive impact dams can have on ecosystems, while thousands of dams are increasingly being removed because they are aging, unsafe, no longer serving their original purpose or in need of costly repairs and maintenance.

"We are transitioning from a period of building dams to one that includes removing dams," said Jeffrey Duda, a research ecologist with U.S. Geological Survey's Western Fisheries Research Center. "But estimating costs of removing dams is a challenge, which makes it difficult to weigh when dam removal may be a viable alternative."

Duda and scientists from the USGS, Oregon State University, the Bureau of Reclamation, U.S. Army Corps of Engineers, and the University of Georgia, begin to unravel those challenges in a paper just published in *Frontiers in Ecology and Evolution*.

"The results help us get beyond the common perception of 'every dam removal is different,'" said Desiree Tullos, a water resources engineer at Oregon State. "That's still true, but these databases give us a sense of the common and divergent features of dam removals across the U.S.

"When working through detailed costs with practitioners, we found that height isn't always the best predictor of cost. Other factors like site restoration, mitigation of potential negative impacts of dam removal and sediment management can be major cost drivers, and those are often dependent on the preferences of local regulators and interested parties."

The number of dams removed in the United State has increased significantly the past 50 years. For four 10-year periods beginning in 1976 and ending in 2015, the number of dams removed jumped from 45

to 139 to 313 to 637, according to past research by Duda, Tullos and others.

Now, as part of the 2022 Bipartisan Infrastructure Law, the federal government is awarding $733 million for dam safety projects, including dam removals. A recent estimate predicted that by 2050 between 4,000 and 32,000 more dams will be removed in the United States.

For the new paper, the researchers compiled reported costs for 668 dams removed from 1965 to 2020 in the United States. When adjusted for inflation into 2020 dollars, the projects totaled $1.52 billion dollars.

They divided the dams removed into three height categories: less than 5 meters, between 5 and 10 meters and greater than 10 meters. The median cost respectively for the three categories was $157,000, $823,000 and $6.2 million.

They also analyzed geographic differences in dam removals. The northeast accounted for the most dam removals with 277, followed by the Midwest (222), Southwest (78), Northwest (50) and Southeast (41). More than 80% of the dams were five meters or less.

The Northwest accounted for the highest cost, totaling $775.8 million, more than triple the second-place Midwest. The cost in the Northwest is influenced by several recent large-scale projects on the Elwha and Clark Fork rivers in Washington and Montana.

The researchers also estimated the main cost drivers of dam removal. Dam height was the strongest predictor, followed by average river discharge and project complexity, which accounts for costs associated with construction and sediment management, mitigation for dam removal effects and post-removal outcomes like replanting vegetation in former reservoir surfaces. Regional differences and dam material were

also significant but less important factors.

In the coming years, the researchers plan to incorporate additional data as new projects and reported costs become available, with a goal of further refining the predictive accuracy of a machine-learning model.

"The model is going to get better and better and further help decision-makers as they grapple with how to manage the large number of dams approaching obsolescence," Duda said.

Other co-authors of the paper are Suman Jumani, Daniel Wieferich, S. Kyle McKay, Timothy Randle, Alvin Jansen, Susan Bailey, Benjamin L. Jensen, Rachelle Johnson, Ella Wagner, Kyla Richards, Seth Wenger, Eric Walther and Jennifer Bountry.

Tullos is affiliated with Oregon State's colleges of engineering and agricultural sciences.

More information: Jeffrey J. Duda et al, Patterns, drivers, and a predictive model of dam removal cost in the United States, *Frontiers in Ecology and Evolution* (2023). DOI: 10.3389/fevo.2023.1215471

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