frontiers | Frontiers in Earth Science

TYPE Editorial
PUBLISHED 05 December 2023
DOI 10.3389/feart.2023.1330621

OPEN ACCESS

EDITED AND REVIEWED BY
Wouter Buytaert,
Imperial College London,
United Kingdom

*CORRESPONDENCE
Wei Ge,
gewei@zzu.edu.cn

RECEIVED 31 October 2023
ACCEPTED 21 November 2023
PUBLISHED 05 December 2023

CITATION
Ge W (2023), Editorial: Risk assessment and management of water conservancy projects.
Front. Earth Sci. 11:1330621.
doi: 10.3389/feart.2023.1330621

Editorial: Risk assessment and management of water conservancy projects

Wei Ge*

School of Water Conservancy and Transportation, Zhengzhou University, Zhengzhou, China

KEYWORDS

water resources allocation, flood risk control, hydraulic structural safety, risk criteria for reservoir dams, comprehensive risk management

Editorial on the Research Topic
Risk assessment and management of water conservancy projects

Water conservancy projects refer to various types of artificially constructed projects that promote water benefits and eliminate water hazards, mainly including dams, dikes, hydropower stations, channels, water gates, and so on. Water conservancy projects play extremely important roles in flood control (Ge et al., 2022), power generation, irrigation, water supply and shipping, and in promoting social and economic development and reducing carbon emissions. The construction, operation and decommissioning of water conservancy projects all have huge impacts on society and the environment (Zhang et al., 2022). In addition, due to the natural and human factors, such as super standard flood (Wu et al., 2021; Liu et al., 2022), natural aging (Zhang et al., 2023a), earthquake and improper management caused by extreme meteorological conditions, water conservancy projects are always faced with the risk of failure. The effective quantification of the water conservancy project risks and proposing corresponding management and control measures have always been a concern of researchers (Wang et al., 2023).

Experiments, theories and numerical methodologies are essential for quantitative characterization of water conservancy project risks. Hence, this Research Topic concentrates on the contributions regarding novel methodologies and applications to characterize the water conservancy project risk levels aiming at targeted management and control measures. After peer review, fifteen research articles were accepted and published, which can be helpful for improving the development of risk assessment methods, promoting the cross and integration of different subjects.

The main contributions of this Research Topic are mainly reflected in five aspects:

- Coordinated allocation and management of water resources

Taking the minimum relative water shortage rate as the objective function, an optimal allocation model (Chai et al.) of water resources was established, which solved the coordinated allocation of water resources between conventional and unconventional water resources. In addition, from the perspective of social welfare and water quality utility, a comprehensive optimization and coordination decision model (Jiao et al.) for water transfer was proposed, in which the cost-sharing contract was designed, and the Stackelberg game method was used to optimize the decision-making and coordination of the water supply chain, providing valuable references for water transfer decision-making.

- Flood risk control of reservoir dams

In view of the possible flood risk and catastrophic consequences caused by high dam failures induced by early impoundment, a multi-objective decision model which considers the failure probability, life loss, and early impoundment revenues brought by earlier power generation was proposed to acquire the satisfied initial impoundment scheme (Liu et al.). Based on the analysis of the uncertainty of flood volume and peak, a general risk analysis framework that integrates the Monte Carlo sampling method and the most likely event selection method was proposed to calculate the risk of operating a single reservoir (Du et al.).

- Analysis of hydraulic structural safety

Combined with indoor geotechnical tests, cloud theory was used to describe the distribution types of soil shear strength indicators, and a cloud model-Monte Carlo coupling method was proposed to analyze the stability of dam slopes (Han et al.). Furthermore, considering the effect of wetting deformation of coarse-grained materials on the safety of earth- dams during initial water storage, the P-Z (Pastor-Zienkiewicz) wetting model was established based on the P-Z model in the elastic-plastic theory and the wetting model formula. And then the BP (Back propagation) artificial neural network was introduced to establish the artificial neural network wetting deformation prediction model (Zhang et al.) based on the P-Z model. Finally, a novel prediction model, Levy flight-based grey wolf optimizer optimized support vector regression (LGWO-SVR) (He and Wu), was proposed to forecast the displacements of hydropower dams.

- Risk criteria for reservoir dams

Drawing on research ideas of ecological economics on ecosystem service values and equivalent factor methods, environmental values and effectively connected environmental criteria with existing standards were quantified using the ALARP (As low as reasonably practicable) principle and the F-N (Accumulated frequency—Number of fatalities) curve. Considering the differences in environmental and economic conditions in different regions, a risk preference matrix was established to determine the risk preference of each region and formulate the dam failure environmental risk criteria (Li et al.) for China, which presents a preliminary exploration of the formulation of dam failure environmental risk standards.

- Comprehensive risk management of water conservancy projects

A new model, which is based on the Shapley Value and the Utility Theory, was proposed to solve the risk sharing (Liu et al.) in quasi-public-welfare water conservancy public-private-participation (PPP) projects, encompassing a comprehensive analysis of multiple factors, such as the proportion of capital contribution, bargaining position, risk management capabilities, and risk-taking willingness of heterogeneous subjects. In addition, complex network theory and network immune strategies were used to identify relevant risks in urban river ecological governance projects (Xu et al.) and develop the corresponding risk response strategies, in which network global efficiency was set as a metric to assess the network's robustness under random and targeted attacks. The results revealed that the degree value attack immune strategy performed optimally under targeted attack scenarios.

Author contributions

WG: Writing–original draft, Writing–review and editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This research was funded by the National Natural Science Foundation of China (Grant Nos 52079127, 52179144, U2243244, and U2040224), the Natural Science Foundation of Henan Province (Grant No. 232300421067), and the Program for Science and Technology Innovation Talents in Universities of Henan Province (HASTIT) (Grant No. 22HASTIT011).

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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