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Editorial: Water and ecological systems: Response, management, and restoration

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Editorial on the Research Topic
Water and Ecological Systems: Response, Management, and Restoration

Climate change and human activities have induced significant alterations in global hydrological and ecological systems, leading to different hydrological responses and water demands in different regions. In order to better manage water resources and restore ecological systems, it is important to understand how these responses are affected by global change. The articles in this Research Topic explore various aspects of the hydrological and ecological response to global change and their implications for water resources management and ecological restoration. This Research Topic features 14 articles that cover a wide range of topics in the field of water resources and ecology. The main themes of the issue include water supply, ecological impact, vegetation responses, industrial structure, hydrological drought, water consumption patterns, bibliometric analysis, allocation of water resources, river temperature analysis, effects of total dissolved gas, food web structure and function, coal ash loaded nano iron, spatial patterns of macrobenthos taxonomic and functional diversity, and response relationships between environmental DNA and biomass. Some of the specific studies that address these themes include "A new method for estimating multi-source water supply considering joint probability distributions under uncertainty" which explores a new method for water supply estimation, "Analysis on the ecological impact of the Xiaolangdi Reservoir on the Yellow River Delta wetland and coastal areas" which examines the impact of a reservoir on the environment, and "Study on the propagation probability characteristics and prediction model of meteorological drought to hydrological drought in the basin based on copula function" which investigates the relationship between meteorological drought and hydrological drought. These studies demonstrate the breadth and depth of research in the field of water resources and ecology and provide valuable insights for further exploration and understanding and can be divided into four categories (i) water supply and distribution, (ii) environmental impacts and evaluation, (iii) water quality and drought analysis, (iv) biodiversity and food web analysis, and (v) bibliometric analysis and water treatment and technology.

Water supply and distribution

Four articles address various aspects of water management and distribution. For instance, efficient water management strategies are crucial for addressing water scarcity, which is a significant challenge for many countries, as highlighted by the extensive analysis of Kuwait's water resources and management strategies (Tariq et al., 2022). Therefore, the findings from Wei et al. and the Kuwait study can inform practical suggestions for water-resource planning and management not only in China and Kuwait but also in other regions facing similar challenges. By applying the new method for estimating multi-source water supply in Xiong'an New Area, China, Wei et al. demonstrate the potential of innovative approaches to improve water management and increase the availability of water resources. Such methods can contribute to the sustainable management of water resources and the promotion of economic and social development in regions facing water scarcity. Sun and Li explore the classification of water consumption patterns in 110 cities in the Yangtze River Economic Belt and provide targeted water-saving policies based on these patterns. Understanding water consumption patterns and identifying effective policies to promote water conservation are critical for sustainable urban development, as shown by the declining water consumption in some of the major Spanish cities, which is attributed to a combination of economic, technological, and behavioural factors, as well as the impact of contingent events such as droughts and economic crises (Sauri, 2019). Meanwhile, Zhang et al. focus on the optimization of water resource allocation in the lower Yellow River area, considering the uncertainty of water resources, water demand, and water requirements of different users. This highlights the need to balance economic development with environmental sustainability, which is also addressed in the article on the stochastic convergence of ecological footprints within BRICS countries (Wu, 2022). The findings from both articles suggest that achieving sustainable development requires considering ecological factors in decision-making processes, to ensure the availability of water resources for future generations and address public health concerns. Those articles illustrate the diverse topics covered in this Journal Research Topic and highlight the importance of addressing the challenges in water supply and distribution for sustainable water management.

Environmental impacts and evaluation

In three articles, the authors are concerned with the environmental impacts and evaluations of human activities on the environment. Shang et al. focus on the impact of the Xiaolangdi Reservoir on the deltaic coastal wetland ecosystem and propose a method for quantitative analysis. The results show that the Xiaolangdi Reservoir has had a positive effect on the ecosystem by reducing drying up days, increasing the assurance rate of ecological base flow, and increasing the volume of water flowing into the sea. This study shares similarities with recent research conducted by Mishra et al. (2021b), Mishra et al. (2021c), Mishra et al. (2021d) in the field of shoreline changes, which also aims to understand the impact of large-scale projects on the natural environment. Zhou et al. evaluate the relationship between vegetation dynamics and meteorological drought in the Pearl River Basin, using NDVI and SIF to assess changes in vegetation cover and photosynthetic capacity. The authors also explore the teleconnection factors that may impact the relationship between drought and vegetation, such as climate patterns and solar activity. This research is significant, as drought is a global concern that affects various ecosystems and has been recently discussed in several articles, including Oliveira et al. (2022), de Oliveira et al. (2022), Santos et al. (2017, Santos et al. (2019), Santos et al. (2021), Silva et al. (2021), and Zerouali et al. (2021), which highlights the need to understand the impact of drought on vegetation and explore the factors that influence this relationship. The insights from this research can inform the development of policies and strategies that promote ecosystem resilience and address the challenges of water scarcity and climate change. Bu et al. focused on improving water environment capacity (WEC) by adjusting the industrial structure and analysing economic changes. The authors estimate economic efficiency, water use efficiency, and water treatment efficiency and divide the industry into three types based on their environmental risk. The results show that adjusting the industrial structure has a positive impact on the WECs of various pollutants. This study is significant, as it highlights the importance of industrial structure adjustment for improving water environment capacity and reducing environmental risk, which is consistent with recent research on the mechanisms of industrial structure optimization and population agglomeration on carbon emissions, such as the article on carbon emissions in China (Liang et al., 2022), which shows the direct and indirect effects of industrial structure optimization and population agglomeration on carbon emissions and highlights the double threshold effect of population agglomeration on the carbon emission reduction effect of industrial structure optimization.

Water quality and drought analysis

The main theme of water quality and drought analysis is the study of various factors that affect water quality and drought conditions. In this context, several studies have been conducted to understand and mitigate the impact of such conditions. For example, Wang et al. studied the probability characteristics of meteorological drought transmission to hydrological drought by using Standardized Precipitation Index (SPI) and Standardized Streamflow Index (SSI) and proposed a hydrological drought prediction model based on the SPI-P(SSI|SPI) relation curve. This research is particularly relevant, as drought and SPI have been a recent topic of discussion in research worldwide, as demonstrated by the recent research of Brasil Neto et al. (2020), Brasil Neto R et al. (2021), Brasil Neto R M et al. (2021), 2022), Brito et al. (2021), da Silva et al. (2020), and Dantas et al. (2020). These studies have made significant contributions to the understanding of drought and SPI, which can inform the development of policies and strategies that promote water resource management and ecosystem resilience in the face of climate change. Seyedhashemi et al. (2021) investigated the thermal signatures of dams and ponds and their impact on stream temperature at the regional scale, shedding light on an important factor affecting water temperature dynamics. Moulin et al., on the other hand, utilized Independent

Component Analysis (ICA) to identify the primary factors influencing water temperature and improve the accuracy of water temperature forecasting, providing a complementary approach to understanding the complex dynamics of water temperature. Broadhurst et al. (2021) investigated the use of environmental DNA (eDNA) in mapping mammalian distributions and diversity in rivers. Similarly, Govindarajan et al. (2021) explored the potential of eDNA to detect animal taxa in the mesopelagic zone. In contrast, Huang et al. evaluated the persistence of eDNA under different flow conditions in aquatic ecosystems with high dams, providing important insights into the applicability of eDNA in such environments and complementing the findings of the other two studies. These studies demonstrate the importance of understanding various factors that impact water quality and drought conditions and the role of innovative techniques in improving our understanding of these factors.

Biodiversity and food web analysis

Articles Yang et al., Fu et al., and Zhang et al. all focus on the study of biodiversity and food web analysis, each exploring different aspects of the topic. Yang et al. focus on the analysis of the food web dynamics of Lake Baiyangdian in northern China over five representative years (1958, 1980, 1993, 2009, and 2019) by using a Bayesian isotope mixing model combined with a food web energetics model. The article argues that combining unweighted and weighted indicators is important for understanding the responses of highly aggregated food webs to changing hydrological regimes and water quality, and for improving the management and restoration of shallow lake ecosystems (Lynam et al., 2017; Bartley et al., 2019). Fu et al. study the macrobenthos biodiversity patterns in the river-lake ecotones along the Fu River-Baiyangdian Lake gradient in northern China (Wang et al., 2019; Mishra et al., 2022b). The article found that water depth, water transparency, TN, and TP were the main drivers of macrobenthos taxonomic and functional diversity, while sediment Cd, Cr, Cu, Pb, and Zn contents also had an impact on macrobenthos diversity (Li et al., 2019; Mosbahi et al., 2019). The article suggests that functional diversity approaches based on biological traits can complement taxonomic approaches in river-lake ecotones. Zhang et al. focus on the relationship between environmental DNA (eDNA) concentration and biomass in a typical fish species of rivers in southwest China. The article found that water pH and temperature had a great influence on eDNA concentration and that environmental factors need to be considered when using eDNA concentration to estimate biomass.

Bibliometric analysis and water treatment and technology

Finally, Yang et al. and Zhang et al. address topics related to water treatment and technology. Yang et al. focus on the bibliometric analysis of Water Resources Carrying Capacity, demonstrating the power of bibliometric analysis as a tool for understanding the current state and progress of research in this area. Recent studies have increasingly used bibliometric analysis as a powerful tool to assess trends and impacts in research, as exemplified by the works of Mishra et al. (2020), Mishra et al. (2021a), Mishra et al. (2022a). In their study, the authors propose a four-staged bibliometric analysis method and conduct a comprehensive analysis of 271 records. Their findings reveal that China is a major contributor to research in this area, with a focus on modelling and system dynamics, linked to population carrying capacity, groundwater resources, urbanization, and water shortage. The authors divide the research progress into five stages and suggest that the method proposed can serve as a reference for future bibliometric studies. On the other hand, Zhang et al. focus on the use of ceramsite composite made from coal ash and modified by nano-iron to remove phosphorus in the water. Maamoun et al. (2018) also seek to improve the removal efficiency of phosphorus, an important pollutant in water. However, the results of the study of this Research Topic show that the modified ceramsite has a good removal effect on phosphorus, with a removal rate of over 99%. This study provides a new method for utilizing coal ash as a resource and a novel approach for improving filler in bioretention facilities.

Thus, the articles in this collection are expected to provide valuable information and insights for communities, basins, and government agencies involved in water and ecosystem management and to support the development of strategies for adapting to the changing world. In conclusion, the articles present a comprehensive and multidisciplinary approach to understanding the hydrological and ecological response to global change and its implications for water resources management and ecological restoration. By drawing on a wide range of sources and methodologies, the articles offer new insights into the challenges and opportunities associated with water and ecosystem management in the context of global change. They offer practical guidance and support to communities, basins, and government agencies in their efforts to develop strategies for adapting to the changing world. These articles are an important contribution to the field of hydrology, ecology, and water resources management and will be of interest to researchers, policymakers, and practitioners in these fields.

Author contributions

CG: Writing—original draft preparation. CG, CL, and QL: Writing—reviewing and editing.

Conflict of interest

The authors declare 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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