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A decade of shifting priorities between economic growth and eco-environmental protection along China's Yangtze River waterfront

Xuejun Duan,[1,2] Hui Zou,[1,2] Chunqiao Song,[1,2] Wei Yan,[1,2] and Lei Wang[1,2,*]

[1]Key Laboratory of Lake and Watershed Science for Water Security, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, Nanjing 211135, China
[2]University of Chinese Academy of Sciences, Nanjing 211135, China
*Correspondence: wanglei@niglas.ac.cn

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Riverfronts have long underpinned human settlement, economic development, and civilization by concentrating water resources, fertile land, transportation corridors, and ecological functions. In this study, waterfront is viewed as a type of resource, defined as the land–water interface zone along large rivers. It includes natural waterfront (e.g., wetlands, point bars, and natural riparian zones) and artificial waterfront (e.g., industrial, port, and urban waterfronts). Across history, riverfronts have supported agriculture, urbanization, industry, shipping, and landscape formation. Along major rivers such as the Danube, Rhône, Rhine, and Yangtze, riverfront development has facilitated the emergence of world-class port systems and industrial–urban corridors, becoming critical engines of regional and national growth.

The Yangtze River, the world's third longest river, plays an exceptional role in both ecological security and economic production in China. It provides drinking water for approximately 400 million people and supports the world's largest inland port–based industrial system. The river articulates the Yangtze River Economic Belt (YREB), which occupies nearly one-fifth of China's national territory and contributes more than 45% of the country's GDP and population. Over the last four decades, the Yangtze riverfront has emerged as China's most intensive hotspot of industrialization and urbanization. As a result, its development intensity now exceeds that of other major river systems worldwide. Existing research has explored waterfront governance in the YREB, with early studies focusing on land use change and port development, while recent works have gradually shifted to ecological restoration and integration.[1] Theoretically, this commentary is grounded in classic theories of collaborative river basin governance, which emphasizes cross-jurisdictional coordination for transboundary environmental issues, and socio-ecological transformation theory, which highlights the transition from development-oriented to ecology-oriented development patterns.

PRO-GROWTH RIVERFRONT DEVELOPMENT AND ECOLOGICAL COSTS

Since the late 1970s, China's reform and opening-up policies have driven rapid riverfront development under strongly pro-growth strategies at both central and local levels. Nationally, the Yangtze River basin was designated as one of the two strategic backbones of China's spatial development framework. Key regions, including Shanghai's Pudong New Area, major riverside cities, and the Yangtze River Delta were opened to global markets. Large-scale waterway engineering projects further enhanced navigation capacity, enabling 50,000-ton seagoing vessels to reach Nanjing, 5,000-ton ships to access Wuhan, and 3,000-ton vessels to navigate as far upstream as Chongqing.

At the local level, development strategies varied across provinces and cities but converged around maximizing riverfront land value. Following China's accession to the WTO in 2003, inter-city competition for footloose global capital intensified. Riverfronts became prime locations for ports, heavy industries, and urban expansion. By the mid-2010s, 342 national- and provincial-level economic development zones had been established along the river. This expansion peaked around 2016, when 35.9% of the natural riverfront had been urbanized, with more than half converted for ports, industrial facilities, and urban settlements. Among the eight provincial-level jurisdictions, Jiangsu exhibited the highest riverfront development rate (59.2%), followed by Shanghai (50.1%) and Jiangxi (38.8%). While these investments delivered substantial economic gains, they also imposed severe ecological pressures.

Riverfront development rights were largely decentralized, and integrated planning across administrative boundaries was absent. Local governments prioritized short-term economic returns, often neglecting coordination among upstream and downstream sections, and between industrial development and ecological protection.[1] As a consequence, ecological degradation

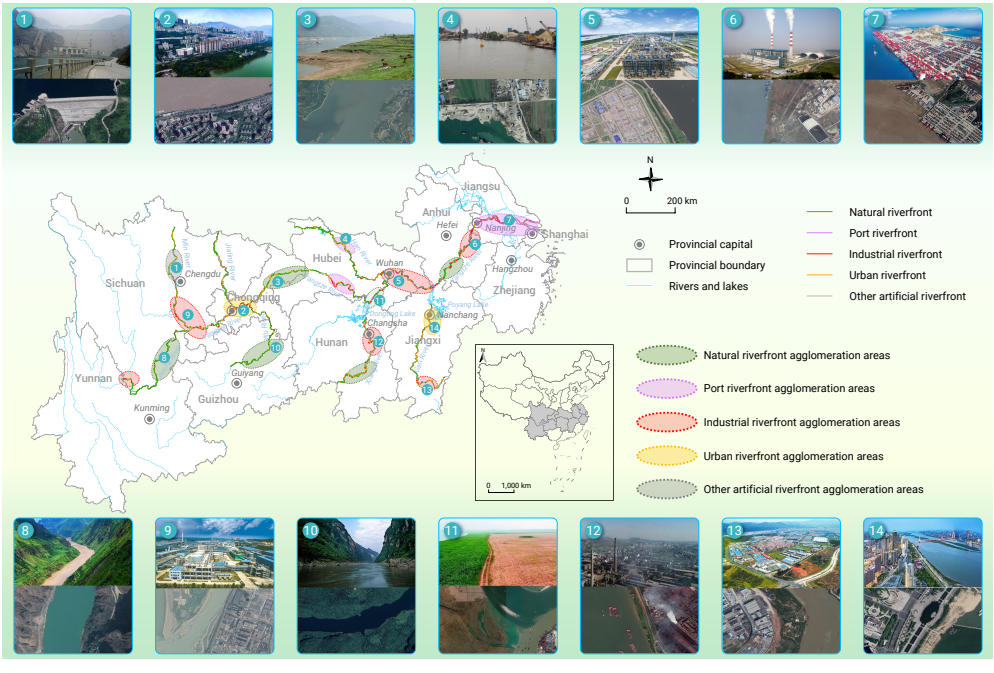

Figure 1. The spatial pattern of waterfront types of main rivers in the YREB.

accumulated across the watershed.[2-3] Natural wetlands, critical for non-point source pollution filtration and aquatic habitats were widely occupied. Between 2000 and 2015, the number of central river bars larger than 1 km^2 declined from 95 to 88. Iconic endemic species suffered dramatic losses, such as the Yangtze river dolphin and paddlefish became extinct, while the Chinese sturgeon and finless porpoise entered endangered status.[2] A series of environmental crises eventually exposed the systemic risks of this development model. Most notably, a blue-green algae outbreak contaminated drinking water sources in Wuxi, disrupting water supply for more than two million residents. Such events elevated environmental protection from a sectoral concern to a national governance issue.

A STRATEGIC SHIFT TOWARD RIVERFRONT PROTECTION AND RESTORATION

Against this backdrop, a major policy turning point occurred in 2016, when China launched the Yangtze River Protection Strategy (YRPS). It explicitly rejected further large-scale development and emphasized ecological restoration as a long-term national priority. This shift was unprecedented in both scope and political commitment, fundamentally reshaping riverfront governance. National-level coordination mechanisms were established, marking a departure from fragmented, locally driven development. More broadly, the Yangtze River case became emblematic of China's evolving development philosophy toward ecological civilization.[4] Over the past ten years, three major approaches have structured the transition from growth-oriented exploitation to conservation-oriented governance.

Controlling development and restoring natural riverfronts

The first approach focused on curbing riverfront development and restoring natural riverbanks. Previously treated as ordinary developable land, riverfronts were reclassified as critical ecological infrastructure. In 2016, national agencies initiated campaigns to close informal and inefficient wharves, promote land use efficiency, and reclaim space for ecological restoration. For example, the Ministry of Ecology and Environment (MEE) strengthened protection measures and introduced ecological compensation mechanisms for drinking water source areas and nature reserves. Meanwhile, the Ministry of Agriculture implemented a comprehensive fishing ban across the Yangtze watershed, culminating in a 10-year moratorium starting in 2020, supported by a RMB 20.66 billion compensation program for affected fishing communities.

As a result, more than 1,300 informal wharves were demolished, and approximately 500 km of riverfront were restored to natural conditions according to the report of the Ministry of Transport. For the first time in decades, the decline of natural riverfront length was reversed in 2020, with port and industrial riverfront areas decreasing by 1.7%. Nevertheless, restoration efforts faced substantial challenges, given persistent development pressures and the high costs of riverfront land use change.

Promoting green development and regulating pollution

The second approach emphasized pollution control and green transformation of riverfront industries. Targeted policies were introduced to phase out highly polluting enterprises within 1 km of the riverfront from the water. Over 3,000 small and heavily polluting factories were closed, while remaining enterprises became subject to stricter monitoring of wastewater and emissions. The MEE also coordinated the spatial reorganization of drinking water intakes and sewage outlets along the river to overcome administrative fragmentation.

A major institutional milestone was the enactment of the Yangtze River Protection Law in 2021—the first Chinese legislation dedicated to ecological protection of a specific river basin. These regulatory efforts yielded measurable improvements in water quality. By 2025, nearly 96.5% of national monitoring sections along the main river met or exceeded Category III standards according to the MEE, indicating potable water quality, while in 2016, this figure was only 67%.

Ecological engineering and wetland restoration

The third approach involved large-scale ecological engineering and wetland restoration projects. Across the YREB, cities invested heavily in converting degraded riverfronts into ecological corridors, wetlands, and parks. Examples include multibillion-yuan investments in upstream cities such as Yibin, midstream transformations of former sand and gravel wharves in Jiujiang, and integrated riverfront management initiatives in Wuhu City. These efforts contributed to observable ecological recovery, including increased the finless porpoise—a key indicator species of river ecosystem health.[5]

PERSISTENT CHALLENGES AND FUTURE DIRECTIONS

Persistent challenges

Despite notable progress, significant challenges remain. First, the cross-provincial ecological compensation mechanism remains incomplete in the upper researches, failing to fully incentivize local governments to prioritize long-term ecological conservation over short-term economic growth. Second, as scattered small-scale restoration projects fail to form connected ecological corridors, limiting the effectiveness of habitat protection. Third, there is no mechanism to ensure investment return in ecological restoration, and the lack of multi-source and sustainable funding is a critical issue for sustaining riverfront redevelopment and ecological restoration. Lastly, cross-jurisdictional coordination mechanisms are still insufficient, leading to inconsistent regulatory standards for waterfront development and restoration across borders, which hinders integrated basin governance.

Future directions

A cross-reach comparison reveals distinct waterfront development models and ecological protection priorities across the YREB. In the upper reaches, the dominant development model is low-intensity ecological agriculture and ecotourism, with the primary protection priority being headwater ecosystem conservation to maintain ecological integrity. In the middle reaches, the development model features a mix of agricultural production and port logistics, where wetland restoration and habitat connectivity are the core protection priorities. In the lower reaches, high-density urban-industrial development prevails, and the protection priority shifts to intensive land-use optimization, industrial pollution reduction, and urban ecological restoration to balance development and environmental quality.

As China continues to urbanize and industrialize, balancing economic development with ecological protection remains a central governance challenge. The Yangtze riverfront illustrates both the possibilities and limitations of a rapid policy-driven priority shift. A more integrated, ecosystem-based, and financially sustainable governance framework will be essential—not only for the Yangtze, but also as a reference for other developing regions confronting similar trade-offs between growth and environmental stewardship.

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AUTHOR CONTRIBUTIONS

All authors contributed to the writing and editing process. All authors contributed to the manuscript and approved the final version.

DECLARATION OF INTERESTS

The authors declare no competing interests.

DATA AND CODE AVAILABILITY

All data supporting the key findings of this study are available in the article.