A new concept of river and lake regulation: “Bi Dao”

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Abstract. The aquatic environmental regulations at home and abroad is rarely considered from the perspective of water body and water bank treatments together and coordinated economic and cultural development. To improve the environmental quality of waterfront cities and activate and revitalize their vitality in waterfront areas, it is necessary to make full use of the water system and its surrounding green space, to get through the waterfront slow-moving system, and connect various natural and human elements along the waterline. Li Xi, the Secretary of Guangdong Province, China, proposed the concept of “Bi Dao”. “Bi Dao” is a comprehensive regulation concept that integrates natural elements and economic and social attributes with water as the main focus. “Bi Dao” is constantly evolving, innovating and enriching in practice and provides a useful tool for exploration and practice in China's environmental regulation efforts. “Bi Dao” will improve the quality of cities on both sides of the river or lake and lead to industry transformations and upgrades, which will promote economic and social development and improve the level of ecological civilization.

1. Introduction

China’s requirements for aquatic environmental regulations are increasing. Many of these efforts have drawn on advanced international experiences and continue to explore, develop, and innovate.[1-3] At present, the regulation of rivers and lakes is mostly concentrated in waterfront greenways, ecological corridors, waterfront landscape construction, and river and lake environmental management.[4-6] It is rarely considered from the perspective of water body and water bank treatments together and coordinated economic and cultural development. Fortunately, Li Xi, the Secretary of Guangdong Province, China, proposed the concept of “Bi Dao”. “Bi Dao” is constantly evolving, innovating and enriching in practice and provides a useful tool for exploration and practice in China's environmental regulation efforts. This paper offers a brief introduction to "Bi Dao".

2. The rich connotation of "Bi Dao"

“Bi Dao” is a comprehensive regulation program that integrates natural elements and economic and social attributes with water as the main focus (Figure 1 shows). It coordinates various elements of the landscape, forests, and grasslands, taking into account environmental, safety, cultural, landscape, economic, and other functions. It optimizes patterns of ecological, production, and living space through systematic thinking, and creates ecological corridors with "clear waters and green shores, plentiful water, fishes, egrets and lush grass". It provides functions and connotations of leisure,
entertainment, tourism, culture, and inherited history, and generates a good space for people to live a good life.

“Bi Dao”, in a narrow sense, refers to the green space surrounding waters and shores. Broadly speaking, it refers to a comprehensive green open space that integrates water and water networks to coordinate overall protection, system restoration, and management of landscapes, forests and lakes, and optimize production, living, and ecological spatial patterns. It helps form a green production lifestyle and a healthy and sustainable economic development path.

Figure 1. The rich connotation of "Bi Dao"

3. Main classifications of "Bi Dao"

3.1. Urban "Bi Dao"
This relies on the rivers and lakes flowing through the downtown area of a metropolis, the important functional groups of the city, various types of green open spaces, important natural and humanistic nodes, and more. It provides urban residents with waterfront places for leisure, recreation, etc. Figure 2 shows urban "Bi Dao" schematic diagram.

Figure 2. Urban "Bi Dao" schematic diagram
3.2. **Town type "Bi Dao"**
This refers to rivers and lakes that flow through other urban areas outside the downtown area of a metropolis, and various types of green open spaces where important natural, human, functional nodes, etc. are connected in series. It provides public open spaces for people to enjoy aquatic recreation, fitness, and leisure.

3.3. **Country type "Bi Dao"**
This refers to rivers and lakes that flow through rural settlements, green open spaces surrounding farmland, and forests, where important humanistic nodes are connected in series. It provides the public with open spaces for agricultural irrigation, aquatic recreation, fitness, and leisure.

3.4. **Natural ecological type "Bi Dao"**
This refers to rivers and lakes that are highly sensitive to the environment. The riversides and lake water systems are places of natural protection, scenic spots, etc., or steep mountains. The space is relatively narrow and it may be difficult to create a recreation system, but there is value in the landscape, open space, and scientific and tourism potential. To protect the ecology through measures such as repairing human walkways, it would be appropriate to construct a recreation system in which people and nature live in harmony.

4. **Design ideas for “Bi Dao”**
Improvements in the aquatic environment, water security, and ecological restoration are the basic conditions for “Bi Dao”. To improve the environmental quality of waterfront cities and activate and revitalize their vitality in waterfront areas, it is necessary to make full use of the water system and its surrounding green space, to get through the waterfront slow-moving system, and connect various natural and human elements along the waterline. Finally, by promoting optimized and upgraded industrial structure and accumulating high-quality industries, a waterfront industry belt with unique characteristics will be created.

5. **Design elements for “Bi Dao”**

5.1. **Smooth flood channels**
This includes flood protection (tidal) and safety, facilities safety, and human activity safety. It requires the construction of a water safety system within the boundaries of the design. For rivers that do not meet flood control standards or need to improve fortification standards, flood control capacity should be improved. Measures such as dispatching and storage of waters, adding storage facilities, widening flood sections, and reinforcing dykes should be taken. Buildings that affect the flood safety of rivers and lakes should be demolished and comprehensive measures such as salvaging garbage floats, river clearing, and construction of safety management facilities should be taken to ensure flood discharge safety.

5.2. **Healthy ecological corridors**
This includes improvements to the aquatic environment, environmental protection, and ecological restoration. It requires the construction of a functional aquatic ecological system within the design of the “Bi Dao”. Water environmental quality should be maintained and upgraded to meet the corresponding standards.

5.3. **Beautiful recreational greenways**
This usually refers to recreation corridors along the river, the lake, the waterfront, for pedestrians and bicycles, and associated leisure spaces. It requires the construction of a linear slow-moving system within the design of the “Bi Dao”. A slow-moving system design should provide ecological protection, connectivity, security, convenience, and added features.
5.4. Green and sustainable industrial corridors
This requires the construction of a slow-moving road connecting line and industrial display space parallel to the green industrial belt around the road. River basin development should be integrated with water management and governance. Environmental infrastructure construction should be promoted along the river basin, landscape and cultural facilities should be built, transportation and municipal facilities should be optimized, and upgrades should be made for urban renewal and industrial parks. Finally, industrial upgrades, intensive land use, living conditions, and urban functions should be improved. The design should be combined with urban renewal to guide the transformation of old urban renewal areas into innovative ones. It should also propose waterfront open space that needs to be preserved during renovations to the waterfront city interface to promote industrial upgrades and improve living conditions. Figure 3 shows one of schematic diagram of green and sustainable industrial corridors.

![Image of green and sustainable industrial corridors]

Figure 3. Schematic diagram of green and sustainable industrial corridors

5.5. Unique cultural channels
This requires the construction of a slow-moving road connecting line and cultural display space and facilities in the waterfront area, and the surrounding areas and resources. The design should reflect cultural characteristics and connect resources and facilities. Cultural resources include ancient buildings, ancient towns, scenic spots, cultural parks, theme parks, folk cultural areas, tourist areas, and art districts.

6. Conclusion
As a new concept for river and lake management, “Bi Dao” needs to be innovatively developed and enriched through practice. It refers to green open space that integrates water and water networks to coordinate the overall protection, system restoration, and management of landscapes, forests, and lakes, and to optimize production, living spaces, and ecological spatial patterns. It generates a green production lifestyle and represents a healthy and sustainable economic development path. At present, pilot projects for the application of “Bi Dao” are being carried out in different cities in Guangdong Province. “Bi Dao” will improve the quality of cities on both sides of the river or lake and lead to industry transformations and upgrades, which will promote economic and social development and improve the level of ecological civilization.

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