

# Research on Ecological River Channel Governance Measures

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**Abstract:** With the acceleration of urbanization, ecological problems in rivers are becoming increasingly prominent. Traditional river management methods often focus on flood control, drainage, and other basic functions, while neglecting the ecological functions of rivers. This paper aims to explore the principles, methods, and impacts of ecological river management on the ecological environment, in order to provide theoretical support and practical guidance for river ecological management.

**Keywords:** ecological river, management measures, environmental protection, sustainable development

## Introduction

As an important component of the natural environment, rivers not only bear basic functions such as hydrological cycle and material transport but also serve as crucial carriers of biodiversity. However, in recent years, due to human activities, the ecological environment of rivers has been severely damaged, with increasing problems such as water pollution and loss of biodiversity. Therefore, studying ecological river management measures is of great significance for restoring the ecological functions of rivers and protecting biodiversity.

## 1. Principles of Ecological River Management

### 1.1 Ecological Priority Principle

The principle of ecological priority emphasizes that in the planning, design, and implementation of river management measures, ecological considerations should always come first to ensure the full functionality

of river ecosystems. Ecological priority means minimizing disturbances and damages to riverine ecosystems during the management process. Traditional river management methods such as hard revetments and channelization often achieve flood control and drainage goals but severely disrupt river ecology, reducing the self-purification capacity of rivers and leading to issues like water pollution and loss of biodiversity. Therefore, the ecological priority principle requires a shift in management philosophy towards eco-friendly measures. For instance, adopting eco-friendly techniques like vegetative revetments instead of traditional hard revetments, using methods like vegetation restoration and biofilm technology to restore damaged river ecosystems, and rational utilization of rainwater and recycled water to supplement ecological water needs. These measures not only protect and restore riverine ecosystems but also enhance self-purification capacity,<sup>[1]</sup> reduce water pollution, improve



water quality, provide better habitat for organisms, and enhance biodiversity. Additionally, ecological river management can improve urban ecological environments, enhance landscape quality, and provide residents with more livable living environments.

### 1.2 Systematic Principle

Rivers are not isolated entities but complex ecological systems closely interconnected with natural and social environments. In this system, various elements such as water flow, soil, vegetation, microorganisms, and animals are interdependent and interact, maintaining the ecological balance of rivers. Therefore, in river management, it is essential to adopt systematic approaches. The systematic principle requires comprehensive understanding and evaluation of riverine ecological conditions. This includes aspects such as hydrological characteristics, water quality, biodiversity, and riparian vegetation. Only with a thorough understanding of riverine ecosystems can we develop practical management plans. Furthermore, the systematic principle emphasizes the comprehensiveness and coordination of management measures. Various techniques like ecological restoration, water purification, and vegetation restoration need to be comprehensively applied to achieve overall improvement of riverine ecosystems. These measures should be coordinated to avoid conflicts or counteractions. Finally,<sup>[2]</sup>the systematic principle also requires attention to the long-term effectiveness and sustainability of management efforts. Restoring and improving riverine ecosystems is a long-term process, so management measures must focus on long-term effects to ensure the sustainable stability of river ecosystems.

### 1.3 Sustainability Principle

The sustainability principle emphasizes that ecological river management should not only meet current needs but also consider future development and utilization. This means that management measures need to be forward-looking and long-term rather than just addressing immediate issues. To achieve sustainability, management measures should be based on a deep understanding and respect for riverine ecosystems. Rivers are natural ecological systems with self-repair and self-balancing capabilities. Therefore, management measures should minimize disturbances to natural river

processes and instead guide and enhance natural river functions to achieve management goals. Additionally, the sustainability principle requires rational utilization and conservation of resources during the management process. This includes fair water allocation, efficient land use, and biodiversity conservation. Through scientific planning and rational layout, efficient resource utilization can be achieved, avoiding waste and destruction. Moreover, the sustainability principle emphasizes the economic feasibility and social acceptability of management measures. Management measures should consider economic costs and social impacts while meeting ecological needs to ensure smooth implementation and continuous progress of management efforts.

## 2. Ecological River Management Methods

### 2.1 Ecological Slope Protection Technology

Ecological slope protection technology is an important component of ecological river management. It plays a significant role in restoring the ecological functions of rivers and enhancing their self-purification capacity. Ecological slope protection technology is a new approach to riverbank protection that avoids traditional hard methods such as concrete and stones, instead opting for more ecologically friendly methods like vegetation slope protection and ecological brick slope protection. These new materials not only provide stability and durability but also create essential habitat for riverine ecosystems. Vegetation slope protection is a common form of ecological slope protection technology. By planting suitable vegetation on riverbank slopes, it can effectively prevent soil erosion and provide habitat and food sources for organisms. The roots of vegetation also stabilize the soil and enhance slope stability. It's essential to prioritize biodiversity in vegetation selection to avoid ecological risks from single-species dominance. Ecological brick slope protection is another form of ecological slope protection technology. Ecological bricks, with their porous structure, provide habitat space for organisms and promote the self-purification capacity of water bodies. Implementing ecological slope protection technology not only enhances the ecological functions of rivers and improves water quality but also effectively enhances the surrounding ecological environment. The application of vegetation and ecological brick

materials provides a favorable habitat for organisms, promoting biodiversity recovery. Moreover, ecological slope protection technology can reduce water pollution effectively, improve water quality, and provide better water resources for nearby residents.

### 2.2 Ecological Restoration Technology

Ecological restoration technology is a comprehensive environmental management approach aimed at restoring damaged river ecosystems through methods like vegetation restoration and biofilm technology. Vegetation restoration is a core aspect of ecological restoration technology. By planting aquatic and wetland plants suitable for local conditions, it can prevent soil erosion, provide habitat, and absorb nutrients in water, reducing the risk of eutrophication while providing food and habitat for aquatic organisms. Biofilm technology,<sup>[3]</sup> a rapidly developing method, involves the installation of biofilms in rivers to absorb and degrade pollutants such as organic matter and heavy metals, thereby purifying the water. Microbial communities on biofilms degrade complex organic matter into simpler inorganic substances, providing usable nutrients for other organisms in the river.

### 2.3 Ecological Water Supplement Technology

Ensuring an adequate and stable water supply for rivers is crucial for maintaining their ecological health. Traditional water supplementation methods often rely on groundwater or surface water, but with water resources becoming increasingly scarce, these methods are insufficient for modern river management needs. Ecological water supplement technology, as a new water replenishment strategy, is gaining widespread attention. It aims to use rainwater, recycled water, and other unconventional water sources to supplement ecological water use, thereby maintaining the health and stability of river ecosystems. Rainwater collection and utilization are essential components of ecological water supplement technology. In urban areas, a large amount of rainwater is directly discharged into rivers through drainage systems, wasting valuable water resources and potentially causing pollution. Establishing rainwater collection systems such as green roofs and rain gardens can effectively collect and purify rainwater for river water supplementation, reducing the risk of urban flood disasters and providing stable ecological water for rivers. Recycled water utilization is another important

ecological water supplement method. Recycled water, treated wastewater from sewage treatment plants, can be further treated to meet the quality standards for ecological water supplement. Using recycled water for river water supplementation not only conserves fresh water resources but also reduces environmental pollution from direct sewage discharge. Implementing ecological water supplement technology requires comprehensive consideration of factors such as water source, water quality, and water quantity to ensure the stability and sustainability of water supplementation. Additionally, it's essential to establish a comprehensive monitoring and management system to monitor and manage the water supplementation process in real-time, ensuring that the water supplementation effect meets expectations.

## 3. The Impact of Ecological River Management

Ecological river management has brought far-reaching positive impacts to modern cities, demonstrating its value and significance across multiple dimensions. Firstly, it has led to improvements in water quality, which is one of the most tangible and important outcomes of ecological river management. Through scientific management measures, the self-purification capacity of water bodies has been significantly enhanced, effectively reducing the concentration of pollutants in the water and improving water quality noticeably. This provides surrounding residents with a healthier and safer aquatic environment. Secondly, ecological river management plays an important role in biodiversity conservation. The implementation of management measures has provided more suitable habitats for organisms, promoting the protection and restoration of biodiversity. In the rivers after management, various aquatic plants, fish, birds, and other organisms thrive, collectively forming a richer and more colorful ecosystem. This not only increases the biodiversity of cities but also provides residents with more opportunities to get close to nature. Lastly, the enhancement of urban landscapes cannot be overlooked. Through vegetation restoration and landscape construction, the managed rivers have added more green spaces to the cities, improving the quality of urban landscapes. Facilities such as green belts and waterfront platforms along the rivers not only beautify the urban environment but also provide residents with

recreational areas. People can take walks, fish, and enjoy the scenery here, experiencing intimate contact with nature.<sup>[4]</sup>

#### 4. Case Study: Ecological River Management Practice in a City

In a certain city, a major river has suffered from deteriorating water quality and severe damage to the ecosystem due to accelerated urbanization, increased industrial emissions, and ineffective management in recent years. To address this situation, the local government decided to implement an ecological river management project.

##### 4.1 Objectives

(1) Improve river water quality to meet national standards. (2) Restore the river's ecosystem and enhance biodiversity. (3) Enhance the river's natural purification capacity to achieve sustainable development.

##### 4.2 Management Measures

###### 4.2.1. Water Quality Purification

Construct artificial wetlands to utilize the purifying effects of plants and microorganisms to reduce pollutant levels in the water. Install aeration equipment to increase oxygen content in the water and enhance its self-purification capacity.

###### 4.2.2. Ecological Restoration

Rebuild riverbank vegetation by planting native plants to establish stable ecological communities. Place eco-bricks and stones in the riverbed to provide habitat for aquatic organisms. Introduce fish, shellfish, and other aquatic animals to enrich the aquatic food chain.

###### 4.2.3. River Channel Reconstruction

Partially widen and deepen the river channel to increase flow velocity and prevent sedimentation. Design a meandering river course to enhance flow diversity and facilitate habitat for organisms.

###### 4.2.4. Rainwater Management

Construct rain gardens and infiltration ponds to collect and treat urban stormwater runoff, reducing pollutants entering the river. Build flood retention areas upstream to mitigate the impact of floods on the river's ecosystem.

###### 4.2.5. Regulation and Promotion

Strengthen river management to prohibit illegal

discharge and dumping of garbage. Conduct public education and awareness campaigns to enhance environmental consciousness and citizen participation.

##### 4.3 Implementation Effect

After several years of implementation, significant improvements have been observed in the river's water quality, meeting national standards. The river's ecosystem has gradually recovered, with noticeable increases in biodiversity. Lush riverbank vegetation and diverse aquatic animal species have returned. Meanwhile, the river's natural purification capacity has been enhanced, achieving sustainable development in ecological, economic, and social aspects.

#### Conclusion

Ecological river management is a crucial means of restoring and protecting river ecosystems. By adhering to principles such as ecological priority, systematicity, and sustainability, and employing methods like ecological slope protection, ecological restoration, and ecological water supplementation, significant improvements can be made in river ecology, biodiversity protection, and urban landscape enhancement. In the future, with the growing prevalence of ecological conservation concepts and continuous technological advancements, ecological river management will play an even more vital role in the field of river governance.

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