Original Research Article

Ecological Management Model and Ecological Restoration Technology of Small and Medium-sized Rivers

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Abstract: At present, the management of small and medium-sized rivers in China has achieved initial results, and further improvement of river ecological environment has also been made. In the long-term process of carrying out the ecological management of small and medium-sized rivers, the concept of ecological water-saving has been integrated into the management projects of small and medium-sized rivers, and different types of ecological management models of small and medium-sized rivers corresponding ecological restoration technology system have been gradually formed. Based on the current implementation status of ecological restoration measures in the management of small and medium-sized rivers in China, this paper analyzed the mode and application technology of ecological management of small and medium-sized rivers, and provided references for the development of ecological management work of small and medium-sized rivers in the new era.

Keywords: Small and medium-sized rivers; Ecological management model; Ecological restoration technology

1. Introduction

China is a country with a relatively developed water system, with a large number of small and medium-sized rivers. As the increasing human activities, the ecological environment of many small and medium-sized rivers has been seriously damaged. In the past few decades, the development of small and medium-sized river resources in China has been very severe, and many rivers experiencing depletion. China has issued a series of management plans for small and medium-sized rivers, but implementation has encountered many difficulties, and the shortcomings of traditional management methods are becoming increasingly prominent. In the critical period of China's economic and social development, how to scientifically carry out the ecological quality of small and medium-sized rivers is an important issue that should be urgently solved by governments at all levels.

2. Current situation of ecological restoration of small and medium-sized rivers in China

2.1. Lack of systematic management

Currently, according to the overall situation quo of small and medium-sized rivers in China, it is found that the management method is single, inefficient and the technical level is generally relatively backward. At present, most of the quality work of small and medium-sized rivers in China adopts similar methods, but only simple restoration has been carried out without systematic management system. Due to a lack of pertinence, the ecological restoration effect is not satisfactory. Especially in the southeast coast of China, rainstorm, typhoons and continuous rainfall occur frequently, which puts forward higher requirements for the ecological carrying capacity of small and medium-sized rivers. If there is no scientific and reasonable quality method, the ecological function of rivers will decline, resulting in various adverse problems of small and medium-sized rivers.

2.2. Interruption of natural rivers

Some management projects will build dams to control and store flood water. Firstly, the construction of dams has caused disruptions, and dynamic rivers have become stagnant reservoirs, which not only caused serious damage to the ecological patterns of downstream watersheds, but also caused a large number of endangered species to die and migrate in downstream water bodies. The migration of other species will change the species composition of other regions, thereby affecting the ecological pattern of other regions. Secondly, the construction of dams can also cause lateral interception of rivers. The construction of dams can play a controlling role to a certain extent, but the construction of dams will also change the lateral shape of the river, thereby changing the lateral flow structure of the river.

3. Ecological management model of small and medium-sized rivers

3.1. River cross section management

The scientific restoration of river flats and riverbeds plays an important role in improving the stability of vegetation in the watershed. Firstly, the height of river' flood is determined according to the factors such as the average annual discharge and the average water depth. When the slope of the river is relatively large, the buried depth of the flat should be limited to 1.2-1.5 meters. In the river section design, compound section can be selected. Under general conditions, the height of the second order embankment of the section must be controlled within 2.5 meters, when the second section embankment is higher than 2.5 meters, the third order embankment of the section should be constructed. Secondly, it is necessary to design the width of the riverbank reasonably, so that the riverbank can meet a certain flood control capacity and make the river layout more scientific, so that the minimum width of the river can reach a certain level. Under general conditions, if the riverbank is located in the urban area, the width of the riverbank area should be controlled within a range of 1-3 meters. If there are many houses near the river and the comprehensive cutting method cannot be used, the rectangular or trapezoidal sections can be selected. In this case, the depth of the section must be ensured to be greater than 2.5 meters, and safety protection devices must be installed on the shore to ensure the safety of surrounding residents. If the river flows through a city, then more consideration must be given to the function in the planning of the river to maximize its effectiveness. For example, when the ratio of width to depth of a river is less than 1, it will give people a feeling of being narrow and crowded; Therefore, it is necessary to effectively implement various plans in the process of river section management to ensure the scientificity and rationality of the planning results.

3.2. River profile management

In order to ensure the biodiversity of rivers, it is necessary to rationally design rivers in the planning of river sections, so that the width of the river section is maintained between 1% and 3%, and the rationality of the river section is ensured. When the longitudinal ratio exceeds 3%, the stepped deep pool structure can be selected, and the combination of fish passage and step drop method can obtain good longitudinal effect, both of which can make the river section design more reasonable, and also enhance the ecological stability of the river. When the longitudinal ratio is 1%-3%, using artificial auxiliary measures or using stepped deep pools can achieve better results. In the planning process, it is necessary to ensure the stability of the river profile, and fully consider the connectivity of the river, as well as the architecture that affects the function of the river, so as to ensure the efficient implementation of the renovation project.

4. Ecological restoration technology of small and medium-sized rivers

4.1. River habitat restoration technology

River habitat generally refers to natural forms such as river bed, riverbanks and coastal zones. River habitat are the foundation for rational biological survival and reproduction of organisms, and is also an important factor to maintain the health of river ecosystem. In the restoration of river habitat, river ecological filling method, ecological riverbed construction method, deep pool and shallow beach construction method and biological habitat construction method can be adopted.

4.2. Ecological revetment technology

Ecological bank protection technology is the organic integration of plants or vegetation with civil engineering to achieve the purpose of biological conservation, creating a good ecological environment, and maintaining riverbank slopes. River management mainly adopts three forms: natural bank protection, semi-natural bank protection, and compound natural bank protection. The main technical measures include plant revetment, geotechnical compound plant base revetment, green concrete revetment, gabion revetment, mechanized rockfill revetment, ecological slurry stone retaining wall revetment, porous precast concrete block revetment and self-buried retaining wall revetment.

4.3. Bioremediation technology

Bioremediation refers to the process of absorbing, transforming, removing or degrading pollutants in the environment through microorganisms to achieve a certain degree or completely restore their original state. At present, the relevant biological remediation technology mainly rely on microbial remediation technology, which refers to the introduction of microorganisms that existed in nature or can transform target pollutants into harmless substances within a certain period of time, and introduce them into the microbial ecosystem, so as to improve water quality. For example, in the ecological restoration of a river, aquatic plants (including emergent plants, underwater plants, phytoplankton, etc.) are mainly used to adsorb pollutants in the water, thereby achieving effective control of pollutants in the water body. By regulating the interrelationships between the consumers of different levels such as zooplankton, benthic animals and fish and the polluted object, the transfer of the consumers of the polluted object to the polluted objects can be restored or promoted. In the water environment, microorganisms decompose, absorb and degrade pollutants through growth, reproduction and other processes, so as to achieve the purpose of controlling pollutants.

4.4. Chemical remediation technology

Chemical remediation technology refers to the use of various chemical methods to “degrade” and “recombine” organic substances in polluted or damaged water bodies of rivers, in order to achieve the purpose of reducing or removing pollutants in water bodies.

4.4.1. Chemical algae removal measures

Chemical algae removal technology refers to the addition of various chemical substances or drugs to rivers, so as to achieve the purpose of algae removal. Chemical algae removal technology has the advantages of simple operation, easy implementation and low labor costs. However, in practical applications, there is a risk of secondary pollution to river and lake wetland ecosystems, and it needs to be carefully selected. Compared with artificial algal removal methods, chemical methods are more suitable for situations where there is a lack of

manpower and cost, and the algal area is large.

4.4.2. Chemical phosphorus removal measures

Chemical phosphorus removal technology refers to the addition of phosphorus removal agents, iron salts, etc. to the rivers and lakeside water environment to promote the precipitation of phosphorus in the water, thereby achieving the management of eutrophication in the river and lakeside water environment. In practical applications, phosphorus removal technology also poses secondary pollution to river and lake shorelines, and caution must be exercised in practical applications.

5. Conclusion

To sum up, in order to effectively manage small and medium-sized rivers, it is necessary to formulate comprehensive remediation plans and choose scientific restoration methods based on the ecological characteristics of rivers, so as to improve the ecological environment of the river, ensure the biodiversity of small and medium-sized rivers, enhance the flood control capacity of the basin, and avoid the occurrence of floods within the basin. Therefore, when comprehensively regulating small and medium-sized rivers, multiple methods should be adopted to achieve better results, while also reflecting the idea of harmonious development between humans and nature.

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