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# Importance of Comprehensive Ecological Restoration of Mountains, Rivers, Forests, Farmland, Lakes and Grass: A Case Study of the Shichuan River

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**Abstract** With China's economic development and population growth, China's ecological environment continues to deteriorate. The comprehensive ecosystem restoration of the Shichuan River aims to build an ecosystem containing "mountains, rivers, forests, farmland, lakes and grass" by determining scientific and reasonable thickness of foreign soil, pollution restoration, ecological reconstruction, safeguard measures, etc. It brings new vitality to local ecological environment remodeling and economic development.

**Key words** Mountains, rivers, forests, farmland, lakes and grass, Ecological restoration, Shichuan River

## 1 Introduction

With the rapid growth of China's economy, increasing population, social activities and other factors have caused adverse effects on facilities and the ecological environment around a city, and eventually led to serious ecosystem degradation in some regions of China. In view of the existing ecological degradation areas, China has successively organized major ecological protection and environmental construction projects, which have played a significant role in the improvement of forest and grass vegetation and forest coverage<sup>[1-3]</sup>. However, due to the lack of continuity, systematism, and comprehensiveness between different construction projects, there are phenomena of disordered control direction and incomplete functions in later restoration and control period. The local effects of these control plans are better, but the overall effect of control is more weak, and the all-round service functions of ecosystems have not been restored and improved in fact. In recent years, the overall ecological restoration system of mountains, rivers, forests, farmland, lakes, and grass has been proposed, which can effectively improve the limitations of individual policies and trade-offs and let local environment achieve the harmonious development of humanities and landscapes.

The comprehensive restoration of ecosystems has been fully recognized in the extensive practice of ecological protection warfare. The comprehensive restoration of ecosystems is to rationally use systematical engineering and combine with local cultural land-

scape to improve ecological problems in environmental degradation areas<sup>[4]</sup>. It is necessary to maintain the harmonious symbiosis of natural resources and ecological environment as well as pollution control plans and ecological protection in the area, and form a sustainable long-term development goal. In this paper, the initial pollution situation, ecological control and restoration of the Shichuan River and the ecological and economic benefits generated locally are analyzed, which can further promote and apply the overall restoration of ecosystems to improve the environmental problems of soils pollution and degradation.

## 2 Current basic situation of the Shichuan River

The Shichuan River (108°57' – 109°26' E, 34°42' – 35°06' N) is located in Fuping County, Shaanxi Province, and is a typical gully area in Loess Plateau. The Shichuan River, a tributary of the Weihe River, originates from the northern mountains in Jiaoping and Yaoqu Town, Yaozhou District, Tongchuan City, Shaanxi Province. The river flows from northwest to southeast, and mainly flows through Wangyi District and Yaozhou District of Tongchuan City. It flows to Fuping County, Weinan City and then to Yanliang District and Lintong District of Xi'an City, finally merging into the Weihe River at Jiaokou Town of Lintong District. The land area of the entire Shichuan River basin is about 1 233 km<sup>2</sup>. The river is about 48 km long and 35 km wide at most<sup>[5]</sup>. Due to the expansion of land area, some river channels have been buried or covered and lost functions. Various problems have caused fragile ecological environment and serious pollution in the river basin, and it is urgent to improve environmental fragility through river basin control<sup>[6]</sup>. Among them, the garbage problem in the Shichuan River Basin in Fuping City is the main problem. Most of these garbage are inorganic components and are non-combustible and non-corrosive

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waste. This requires a lot of transportation and landfill work to deal with and digest these wastes. At the same time, it also needs to increase efforts to realize its recycling and management classification, so as to facilitate the separate disposal of hazardous wastes, which can not only continuously improve the realization of "harmlessness, reduction, and recycling", but also play a certain role in economic and social benefits and will play an important role in improving the environmental quality of Fuping City and creating an ecological livable Fuping.

### 3 Main restoration techniques

**3.1 Determining the scientific and reasonable thickness of foreign soil** Soil is the foundation of plant growth. The thickness of soil layer determines the state of soil productivity and directly affects the growth of plants. Similarly, the stability of soil structure is also the focus of engineering construction. In addition, the thickness of covering soil also determines the cost of the project. When the thickness increases or decreases by a few centimeters, and the engineering volume and cost input cannot be underestimated. Under the premise of ensuring the normal growth of plants and the stable foundation structure of construction land, reducing project cost and determining reasonable thickness of foreign soil is one of the innovation points of this project.

**3.2 Pollution restoration** In the project area, the organic reconstruction of soil is used to clean up garbage and reasonably determine the thickness of topsoil stripping. In the locally polluted area, excavation and deep burial measures are taken. The compacted thickness of each layer of foreign soil should not exceed 25 cm. Foreign soil is used to compact surface soil, and measures such as planting trees and shrubs and laying turf immediately are taken to further improve soil, thereby meeting the requirements of implementation of landscape greening, municipal roads and other projects for soil.

For the treatment of pollution sources, there are mainly soil pollution and water pollution. Soil pollution is mainly treated in different places. According to local characteristics, there are a lot of domestic garbage and contaminated soil on the river bed. According to different soil textures, it is classified, and then different measures are taken. Domestic garbage is treated in a centralized manner and transported to a landfill for disposal. Miscellaneous soil is treated in situ, namely being used to compact the riverbed. Some rubbish soil containing humus is used as a filling material for landscape along the banks. For the treatment of polluted water quality, due to serious water eutrophication, the river's own purification function is mainly considered. Besides, it is necessary to strengthen the protection of water sources, and do a good job in river dredging and barrier removal projects. A large number of aquatic plants should be planted on both sides of the river.

**3.3 Ecological reconstruction** When the river channel con-

struction is completed, in order to achieve the purpose of ecologicalization, the idea of organic reconstruction needs to be taken into account in the design process. In the course of river design, in order to consider the survival of creatures and fish in the river, the flow velocity of the river is reduced due to the design of the water blocking project. At the same time, there is a decrease in the oxygen content of the water. Therefore, in the process of designing the water blocking project, a rolling dam is finally used as the water blocking project. There are two main considerations: firstly, the rolling dam can divert the incoming water upstream to achieve the effect of aeration, thereby increasing the oxygen content in the water; secondly, due to its many types of materials, rubber can be used as the material of the rolling dam, which reduces the engineering cost on the one hand and has little impact on the environment on the other hand. At the same time, a fountain is designed in the design process after the needs of both landscape and ecology are fully considered. On the one hand, it can greatly improve regional landscape level; on the other hand, it also increases the oxygen content in the water, provides the necessary guarantee for the survival of water creatures and fish to achieve the goal of harmonious coexistence. In the process of landscape design, the principle of harmonious coexistence between man and land is also considered, and the organic reconstruction of the soil is carried out. First of all, in the bank slope protection project on both banks, ecological slope protection is adopted, and slope protection plants are planted, and no engineering slope protection measures in the project are adopted.

**3.4 Safeguard precautions** The Shichuan River basin in Fuping is dry and lacks water all year round. There are construction waste and domestic waste everywhere in the river channel, and the water is foul. Due to excessive sand mining in the river channel, the river bed sinks severely and becomes uneven, which has caused extreme damage to local ecology and huge losses to society and people's lives and property, and severely restricted the sustainable development of regional economy and society. In order to speed up the construction progress of the project and complete the watershed control as soon as possible, low temperature will have an adverse impact on the pouring quality of concrete in winter construction, antifreeze is added to concrete, and "indoor" conditions are created for the maintenance of on-site concrete. That is, a temperature shed is set up immediately after pouring to cover the construction site and then minimize the negative impact of low temperature on concrete.

## 4 Significance of restoration and control of ecosystems in the Shichuan River

In the past, all kinds of construction garbage and domestic garbage were distributed everywhere in the river channel, and the sewage flowed crosswise. The implementation of the comprehen-

sive renovation project of the Shichuan River (urban section) makes the river water clear and the both banks green, and it becomes a good place for residents to relax. A cultural and commercial street—"Baihuaxigu" food street is being built along the the south bank, while Sijiyanguang Hotel is under construction along the north bank. High-end nursing homes and senior apartments equipped with top three hospitals are planned and under construction. The scenery along the river is beautiful, and it is close to Languang Middle School. Real estate developers have invested in the construction and development along the coast, which has brought along the increase of coastal house prices by about 200–600 yuan/m<sup>2</sup>. The beautiful riverside landscape zone, which is equipped with elegant and unique leisure places and music fountain light show performances, attracts the arrival of people from Xi'an, Tongchuan, Yanliang and other areas around Fuping County, which stimulates regional economy and increases the income of local people.

After the implementation of the comprehensive renovation project of the Shichuan River (urban section), the right bank and Binhe Road on the left bank reach the standard of flood happening every 50 years in the Shichuan River; the river park on the left bank reaches the standard of flood happening every 20 years. Based on comprehensive ecological control measures, river pollution should be controlled to expand waterfront space and strengthen air circulation; ecological revetment design, ecological design of river bottom vertical section, and design of green corridors adopt a new model of water resources utilization that coordinates "open source-purification-utilization-emission-regeneration" with opening up new ways. Water resources are not damaged, and can enter the recycling system well through the purification and regeneration of sewage. The reuse of reclaimed water refers to the recycling after advanced treatment, namely turning waste water into treasure, which can not only reduce the intake of fresh water, but also alleviate the crisis of urban domestic and industrial water, and open up a reliable new water source for the sustainable use of regional water resources. The implementation of this project has improved the water environment of the river basin and made the river become a beautiful river with safety, ecology and landscape. Therefore, this project is a comprehensive ecological project integrating sightseeing, tourism, vacation, leisure and entertainment. After the project is completed, it promotes the harmonious development of local humanities and landscape, and achieves the consistent development of mountains, rivers, forests, farmland, lakes, and grass.

## 5 Outlook

Guided by mountains, rivers, forests, farmland, lakes, and grass, the whole ecosystem is restored. The ecological river channel is a complete ecosystem with extremely rich biological populations, including plants, animals and microorganisms. In the ecological river system, various biological populations communicate information and exchange materials and energy through complex food chains, thereby maintaining the dynamic balance of biological populations in the system. Seen from the relationship between the ecological river channel and the outside, river ecosystems and terrestrial ecosystems exchange information, energy, and materials through interactions such as land-based rainwater runoff, erosion of river banks by water, and pollution runoff, so as to ensure the coordination and common development with surrounding ecosystems. Through the implementation of the comprehensive remediation project of the Shichuan River basin to control river pollution, expand waterfront space, and strengthen air circulation, the scene of the past river water pollution, scattered garbage, and waste water is changed, and the water environment of the river basin is improved to form a safe, ecological and beautiful river channel, which plays an important role in enhancing local overall image and taste. In addition, watershed control can reduce the isolated state of "island-like" habitats, improve the ability of the region to resist natural disasters, and form a public open space, which has important strategic significance for local development.

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