

Sustainable Development of Wetlands in China - A Case Study of Weifang Bailang River Wetland

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ABSTRACT

The sustainable development of wetlands is a key link in promoting ecological construction. However, the current protection model focuses on restoration while neglecting the importance of the prevention phase. Taking Weifang Bailang River Wetland as an example, this paper reveals the problems such as water pollution and declining biodiversity through field surveys and analysis of water quality monitoring data, and proposes solutions such as intelligent management. With economic development and technological innovation, China is playing an increasingly important role in global issues. Nevertheless, China's understanding of wetland protection is limited to restoration, which has led to a series of problems. These problems have adversely affected biodiversity, the development of urban ecosystems, and water conservation, such as a sharp decline in biodiversity and severe water pollution. To solve the above problems, this study adopts field survey methods and observation methods, and proposes corresponding solutions for each problem. Therefore, this paper aims to study issues related to promoting the sustainable development of wetlands. It is expected that these solutions can promote economic and social development, drive the sustainable development of wetland ecology, and provide a reference for the sustainable development of similar urban wetlands.

KEYWORDS

Ecology; Wetlands; Sustainable development; Prevention

1 Introduction

1.1 Research background

Wetlands, known as "the kidney of the earth", play irreplaceable roles in regulating climate, purifying water quality, and maintaining biodiversity, and are crucial to global ecological balance. As issues such as the reduction of global wetland areas become increasingly prominent, they have attracted widespread attention from the international community. At present, the situation of wetland protection in China is severe. The state attaches great importance to wetland protection and has issued a series of relevant policies and regulations to strengthen wetland protection and management, with the purpose of enhancing wetland protection and restoration, promoting ecological civilization construction, and achieving the goal of building a beautiful China. Against the background of global wetland degradation, urban wetlands in China are also facing severe challenges. For example, the ecological functions of Weifang Bailang River Wetland have declined due to urban expansion. Bailang River Wetland, located in Weifang, Shandong Province, is an important part of Weifang's urban ecosystem. However, with urban expansion and economic development, Bailang River is facing the contradiction between development and protection. After a series of ecological problems such as wetland area shrinkage and water pollution emerged, the Weifang government and citizens realized the importance of Bailang River Wetland for the city's own development, hoping to achieve the sustainable development of local economy and society through scientific planning and management.

1.2 Research significance

The sustainable development of Bailang River Wetland has multi-dimensional values. Ecologically, protecting biodiversity and studying its sustainable development are conducive to protecting local species resources, maintaining ecological balance, and creating a stable living environment for many organisms. Studying Bailang River Wetland can better exert ecological functions such as purifying water quality, regulating climate, and flood control and storage, improve the ecological environment quality of Weifang, and reduce the impact of natural disasters. Economically, the rational development of ecological tourism resources in Bailang River Wetland can promote the development of tourism, attract tourists, drive the development of related industries, boost local economic growth, and realize the transformation of ecological resources into economic value. Socially, it can promote social harmony. Creating a beautiful ecological environment in Bailang River Wetland can provide a space for residents' leisure and entertainment, enrich people's spiritual and cultural life, improve residents' quality of life, and promote social harmony and stability.

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1.3 Literature review

Regarding the sustainable development of wetlands, domestic studies have explored strategies and plans for balancing wetland ecological environment and rational development. Faced with the threats to wetlands from urbanization and agricultural development, the state has issued relevant laws and policies to provide legal guarantees for promoting the sustainable development of wetlands. In 2022, China began to implement the Wetland Protection Law of the People's Republic of China, which clarified the hierarchical management system for wetlands and strictly controlled behaviors such as occupying wetlands ^[1]. However, as of June 2024, only 63% of provincial supporting regulations have been completed, indicating that there are still certain limitations in the implementation of central policies at the local level. In addition, the CPC Shandong Provincial Committee and Shandong Provincial People's Government issued the Shandong Provincial Yellow River Basin Ecological Protection and High-Quality Development Plan in 2022 and issued a notice requiring all cities and departments to implement it earnestly in combination with actual conditions ^[2]. The introduction of these policies means that China's wetland protection has entered a new stage of high-quality development.

2 Argumentative analysis

2.1 Current situation of bailang river wetland park

In 2018, the Weifang municipal government issued the Measures for the Protection and Management of Wetlands in Weifang City on its official website to strengthen wetland protection, maintain wetland ecological functions and biodiversity, and promote the sustainable use of wetland resources ^[3]. To make the recreational functions of the wetland more in line with people's needs, it has solicited opinions from the public over the years. In 2025, it issued the Draft for Comments on the Revision of Measures for the Protection of Wetlands in Weifang City to promote the sustainable use of wetland resources, strengthen ecological protection, and maintain wetland ecological functions and biodiversity ^[4]. To earnestly implement Xi Jinping Thought on Ecological Civilization and General Secretary Xi Jinping's instructions on the river and lake chief system, and innovate and improve the standards of the river and lake chief system, the Three-Year Action Plan for Creating Beautiful and Happy Rivers and Lakes in the Whole Region of Weifang City was formulated to promote ecological balance and ensure the sustainable development of wetlands ^[5]. In addition, to implement clean rivers and maintain environmental hygiene in the basin, it has repeatedly called on the public to visit in a civilized manner, and issued the Notice of Weifang River Chief Office on the Comprehensive Implementation of Professional Whole-Domain Cleaning and Management of Rivers and Lakes to dredge waterways and clean the environment in the basin ^[6]. In 2008, Zhu Wei and Chen Lei, scholars from Shanghai, formulated the sewage interception and treatment project plan for Bailang River in Weifang. Based on the actual situation of the wetland, the plan formulated a reasonable treatment scheme, which effectively improved the water quality of Bailang River, making the water body of Bailang River meet the national Class V water standard for landscape environmental use and become a beautiful landscape in Weifang. However, this plan is too outdated, and the current treatment plan needs to be re-formulated to achieve the sound development of the wetland ^[7].

In recent years, with economic development and accelerated urbanization, the entertainment needs of Weifang residents in the wetland park have increased significantly. The management department has built multiple viewing platforms and footpaths for tourists and residents to enjoy (as shown in Figure 1). In addition, there are characteristic facilities or experiences such as sightseeing vehicles and lake tours, and a small amusement park has been built, bringing considerable income to the wetland. Especially during holidays, the number of visitors to the wetland increases significantly. However, the large number of visitors has caused a serious burden on the wetland. Some visitors tend to have uncivilized behaviors during visits, which damage the environment and increase the burden of cleaning work. Despite multiple warnings, such behaviors still occur.

The wetland is covered with a large number of vegetation (as shown in Figure 2). There are 220 species of wetland plants belonging to 47 families in the planned area, including 145 species of dicotyledons belonging to 37 families and 75 species of monocotyledons belonging to 10 families. Among them, *Glycine soja* is a national third-class protected plant, and *Populus tomentosa*, *Salix*, *Nelumbo nucifera*, *Robinia pseudoacacia*, *Amorpha fruticosa*, *Fraxinus chinensis*, and *Spartina anglica* are introduced and cultivated plants. In addition, a total of 61 species of terrestrial wild animals have been monitored in Shandong Bailang River National Wetland Park, including 2 species of mammals (*Lepus tolai* and *Erinaceus amurensis*), 56 species of birds (including *Ciconia boyciana*, *Anas zonorhyncha*, and *Platalea leucorodia*), 3 species of amphibians (*Bufo gargarizans*, *Bufo raddei*, and *Pelophylax plancyi*), and no reptiles have been monitored. Through monitoring of birds in different seasons, 26 species belonging to 14 families and 10 orders with a population of 633 individuals were monitored during the autumn migration season; 19 species belonging to 7 families and 6 orders with a population of 1451 individuals were monitored during the wintering season, among which *Fulica atra* was the largest population in the wintering season; 39 species belonging to 23 families and 12 orders with a population of 1272

individuals were monitored during the spring migration season. There are 6 species of national key protected birds, including 2 species of first-class key protected birds (*Aythya baeri* and *Ciconia boyciana*) and 4 species of second-class key protected birds (*Mergellus albellus*, *Anser albifrons*, *Platalea leucorodia*, and *Elanus caeruleus*)^[8]. However, due to unreasonable management and human factors, the number of animals and plants has decreased, resulting in a sharp decline in biodiversity in the wetland system.



Figure 1



Figure 2

2.2 Problems existing in bailang river wetland

Due to surrounding agricultural activities and factory wastewater discharge, some substances in the water exceed the standard. For example, at Liutong Bridge of Bailang River, due to single water supply and problems in river management, excessive standards have occurred. In addition, at the North Outer Ring Bridge of Bailang River, frequent heavy rains and high temperatures in summer have led to the massive reproduction of aquatic animals and plants, thus affecting the water quality of the river. Many urban areas have problems of substandard water quality, and the actual index is far from the target index, indicating that the river water quality problem is relatively serious^[9].

Counties/Districts	Water Quality Index	Water Quality Index from Jan.		Water Quality Index from Jan. to	Year - on - year Improve-
	Target	to Nov. 2024	Up to Standard?	Nov. 2023	ment Rate
Changle County	4.5	4.11	Yes	3.94	-4.31%
Changyi City	4.4	4.61	No	4.49	-2.67%
Linqu County	4.5	4.77	No	4.1	-16.30%
Anqiu City	4.9	5.04	No	5.11	1.37%
Xiashan District	4.6	5.08	No	4.71	-7.86%
Kuiwen District	4.8	5.29	No	4.95	-6.87%
Fangzi District	4.8	5.3	No	5.26	-0.76%
Zhucheng City	5	5.61	No	5.58	-0.54%
Qingzhou City	5.25	5.94	No	5.81	-2.24%
Hanting District	5.7	6.02	No	6.47	6.96%
Weicheng District	5.6	6.24	No	6.41	2.65%
Economic Zone	5.6	6.24	No	6.41	2.65%
Shouguang City	5.67	6.89	No	6.62	-4.08%
Gaomi City	6.45	7.68	No	6.86	-12.00%

The river flows through 3 counties and districts, namely Changle, Weicheng, and Hanting, and enters Laizhou Bay at Yangzi Town, Hanting, with a length of 127 kilometers and a drainage area of 1237 square kilometers. The wide coverage of the basin has led to unclear management among various regions. For example, the regulatory responsibility for the boundary section between Kuiwen District and Hanting District is vague, and illegal sand mining and illegal fishing occur frequently. The unclear jurisdiction scope of some river sections has affected the ecological environment and river safety of these sections.

Weifang City is located in the north temperate monsoon region, facing the sea and backed by the land. Affected by the Eurasian continent and the Pacific Ocean, the continentality is over 50%, belonging to the warm temperate monsoon semi-humid continental climate. Its climate characteristics are: cold winter and hot summer, distinct four seasons; windy and less rainy in spring, with changeable cold and warm in early spring and frequent late spring cold, and rapid warming in late spring; hot and rainy in summer with high temperature and humidity; clear and crisp in autumn, with drought in late autumn; dry and cold in winter with frequent cold winds. The average annual temperature is 12.3°C, with the lowest temperature of -21.0°C and the highest temperature of 40.5°C in previous years. Therefore, Weifang is prone to extreme weather, especially extreme rainstorms in summer, which easily lead to waterlogging in the river and a large amount of sewage flowing into the core area of the wetland. In addition, the river in the basin is prone to flow interruption or

drought. For example, in 2024, the number of days with flow interruption reached 138 days (only 45 days in 2018), and the water storage capacity of the wetland decreased by 40%. This phenomenon is likely to lead to the shrinkage of the wetland area and have a great impact on the wetland ecosystem^[10].

3 Solutions

The government should formulate relevant policies and measures, and introduce high-level talents in computer or geographic information technology. Develop new monitoring systems for scientific detection, aiming at efficiency and accuracy, to observe various indicators in the wetland in real time. Adopt intelligent management measures, such as whole-basin digital supervision, build a "river-land-sky" integrated monitoring network, and implement three-dimensional management, which is more comprehensive and integrated. Use cutting-edge and precise technological means such as AI to analyze the basin, and locate the most polluted areas such as excessive fertilizer use through data analysis. Train or introduce high-level talents in environmental engineering, focusing on solving water pollution and biodiversity issues. Through water quality improvement projects, accurately intercept pollutants, and introduce aquatic plants or microorganisms with water purification functions to purify water quality and improve the problem of excessive substances in the river. Introduce advanced animals to improve the food chain, regulate various biological communities, thereby promoting ecological balance and enhancing biodiversity in the basin. Relevant departments should formulate incentive policies. For example, residents in the basin who correctly classify garbage can exchange points at corresponding locations, and these points can be exchanged for reasonable rewards such as water fees. Government departments and social organizations can launch volunteer activities, such as bird watching and exploring the number of plants in the wetland, to enhance the public's sense of participation in wetland protection. The development of such activities can help cultivate a sense of social responsibility. The persons in charge and institutions related to the wetland should improve the tourist routes again. Multiple routes can disperse the crowd, thereby reducing the pressure on some areas of the wetland and enabling the ecology in the wetland to develop in a sound cycle.

4 Conclusion

The sustainable development of Bailang River Wetland should take ecological carrying capacity as the bottom line, and achieve the balance between protection and utilization through the dual drive of "technology + system". Wetlands are an indispensable part of the urban system. Urban wetlands have many functions, such as water conservation, flood reduction and storage, improving local climate, and maintaining biodiversity. However, with the continuous development of urbanization, more and more urban wetlands are under certain threats, and ecological problems are becoming increasingly serious. Therefore, the protection of urban wetlands needs to be put on the agenda. The construction of urban wetland parks is an excellent measure to balance the protection and rational utilization of urban wetlands. Through literature review and field observation, it is concluded that promoting the sustainable development of wetlands needs to combine theoretical support from ecology, economics, and policy science. Develop the economy while ensuring the sound development of the ecological environment. Give priority to people's suggestions and ideas to rationally develop and utilize wetland resources to promote mutually beneficial economic and ecological win-win results. In the future, combined with the carbon sink trading mechanism, various governance schemes can be explored.

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