



# Analysis of the Effect of Ecological Wetland Construction on Dianchi Lake's Nitrogen and Phosphorus Removal and its Innovative Research under the Information Management Mode

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**Abstract.** As the sixth largest freshwater lake in China, Dianchi Lake has long been plagued by eutrophication caused by nitrogen and phosphorus pollution. In recent years, the construction of ecological wetlands and innovation in information management models have played a significant role in the management of Dianchi Lake. This paper takes Dianchi Lake as an example to analyze the effect of ecological wetland construction on the removal of nitrogen and phosphorus in water, and discusses how information and management model innovation can improve the efficiency and quality of management. Through comprehensive research, this paper reveals the interactive effects of ecological wetland construction and information management on the management of Dianchi Lake, providing scientific evidence and practical references for the management of eutrophication in lakes.

**Keywords:** Dianchi Lake, Ecological Wetland, Nitrogen and Phosphorus Removal, Information Management.

## 1 Introduction

Dianchi Lake, with a drainage area of 2,920 square kilometers and a total volume of 1.56 billion cubic meters, is an important plateau lake in China. Its eutrophication problem has always been a difficult point in water environment management. Due to long-term pollution input, Dianchi Lake once became a lower class V water body with severe eutrophication<sup>[1]</sup>. In recent years, with the advancement of ecological wetland construction and a series of management measures, the water quality of Dianchi Lake has been significantly improved. As an ecological restoration technology, ecological wetlands can effectively remove nitrogen and phosphorus in water through plant absorption, microbial degradation and other mechanisms. At the same time, the application of information technology and management model innovation in the management of Dianchi Lake has played an important role in improving the efficiency and quality of water area management<sup>[2]</sup>. This paper aims to analyze the effect of Dianchi ecological wetlands on the removal of nitrogen and phosphorus in water, and discuss the appli-

cation of information and management model innovation in the management of Dianchi Lake<sup>[3]</sup>.

## 2 Construction of Dianchi Ecological Wetlands and the Removal Effect of Nitrogen and Phosphorus

### 2.1 Current Status of Ecological Wetland Construction

The construction of Dianchi ecological wetlands is an important part of the water environment management of Dianchi Lake. In recent years, Kunming City has vigorously promoted the construction of Dianchi wetlands, and has built a 62,900-acre Dianchi Lake Ecological Belt mainly composed of lake wetlands, forming a 200-meter-wide, 81% vegetation coverage lake closed ecological belt. For example, the No. 1 Wetland of Caohai (Gaoyao Wetland) can purify 33.55 million cubic meters of water every year, and the water quality of the effluent reaches Class IV<sup>[4]</sup>.

In addition, the Dianchi Basin has also promoted the rectification of 35 rivers flowing into the lake through "one river, one policy", and regularly carried out the "three clear" actions to further reduce the pollution load.

### 2.2 Analysis of Nitrogen and Phosphorus Removal Effects

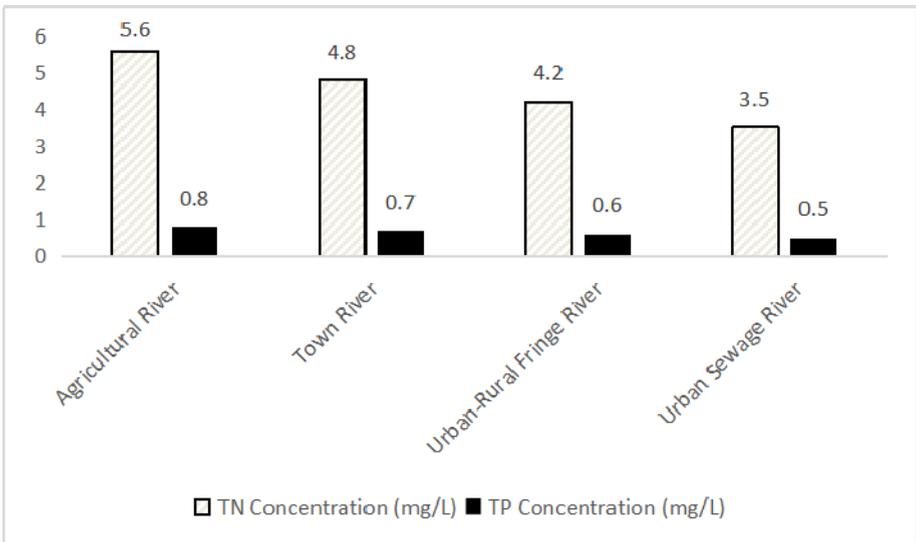
**(1) Pollution Characteristics of Nitrogen and Phosphorus in Rivers Flowing into the Lake:** Studies have shown that the pollution characteristics of nitrogen and phosphorus in rivers flowing into Dianchi Lake are significant. The monitoring data in the summer of 2014 showed that the concentrations of total nitrogen (TN) and total phosphorus (TP) in the rivers flowing into the lake increased from upstream to downstream, indicating that nitrogen and phosphorus were continuously enriched along the rivers. Among them, the TN and TP concentrations in agricultural river were the highest, while those in urban sewage rivers were relatively low. Through data comparison, it was found that the degree of nitrogen and phosphorus pollution in the rivers flowing into Dianchi Lake was different<sup>[5]</sup>. The rivers flowing through agricultural planting areas had serious TN and TP pollution, with TN concentration as high as 5.6mg/L. The water quality of Panlong River, which flows through the main urban area of Kunming, was relatively good, with TN concentration of 3.5mg/L and TP concentration of 0.5mg/L. The main reason was the obvious dilution effect of the water in the river by the Niulan River water diversion project. The average concentrations of TN and TP in river water were in the order of agricultural rivers > town rivers > urban-rural fringe rivers > urban sewage rivers. For other data, As the Table 1 and Figure 1.

**(2) Removal Effect of Ecological Wetlands:** The removal effect of nitrogen and phosphorus in Dianchi Lake is significant. Studies have shown that ecological wetlands can effectively reduce the concentration of nitrogen and phosphorus in water through plant absorption, microbial degradation and other mechanisms. The Dianchi ecological wetlands have significantly improved the treatment efficiency of low-pollution water through the optimization and configuration of aquatic vegetation and the technology of

three-dimensional floating beds<sup>[5]</sup>. For example, the design unit of Baofeng Peninsula Wetland introduced that the wetland has restored 12 plant communities with local characteristics in Yunnan, including 101 plant species, such as the original submergent plant community.

**Table 1.** Distribution characteristics of nitrogen and phosphorus concentrations in rivers flowing into Dianchi Lake<sup>[6-7]</sup>

River Type	TN Concentration (mg/L)	TP Concentration (mg/L)
Agricultural River (Dahe)	5.6	0.8
Town River (Chaihe)	4.8	0.7
Urban-Rural Fringe River (Baoxiang River)	4.2	0.6
Urban Sewage River (Panlong River)	3.5	0.5



**Fig. 1.** Distribution characteristics of nitrogen and phosphorus concentrations in rivers flowing into Dianchi Lake

Dianchi Lake and the original sea cabbage plant community, to create a "hydrophyte-herbaceous-terrestrial" composite ecological belt, which effectively reduced the pollution load of the lake. In addition, the upstream of Xinghai Peninsula Wetland is the No. 7 and No. 8 water quality purification plants in Kunming. After the treated effluent flows into the wetland, it is further purified through the cobblestone, dawn redwood, reed marshes, grassland and other layers in the wetland before flowing into Dianchi Lake, and its water quality can be improved from Class V to Class IV. According to the Kunming Dianchi Lake Administration, in 2023, the lake wetlands in the Dianchi Lake Basin absorbed a total of 1,324 tons of total nitrogen and 74 tons of total phosphorus in

the water. In addition, by optimizing the configuration of wetland plants and management measures, the purification ability of the wetlands was further improved, and the important role of restoring the ecosystem, conserving water and soil, and purifying water quality was played.

The following is the improvement of water quality in Dianchi Lake in the past six years, including the changes in the concentration of total nitrogen and total phosphorus, and the amount of total nitrogen and total phosphorus absorbed by the wetland system (among them, the data for 2025 is predicted data). For other data, As the Table 2.

**Table 2.** Changes in Nitrogen and Phosphorus Content in Dianchi Lake Water and the Amount of Total Nitrogen and Total Phosphorus Absorbed by Wetlands in the Past Six Years<sup>[8-9]</sup>

Year	Total Nitrogen Concentration (mg/L)	Total Phosphorus Concentration (mg/L)	Total Nitrogen Absorbed by Wetlands (tons)	Total Phosphorus Absorbed by Wetlands (tons)
2020	1.8	0.15	1200	60
2021	1.6	0.12	1250	65
2022	1.4	0.10	1300	70
2023	1.3	0.09	1324	74
2024	1.2	0.08	1350	78
2025	1.1	0.07	1380	80

### 3 Innovation in Information and Management Models

#### 3.1 Application of Information Management Technology

With the development of information technology, intelligent means have gradually been introduced into the management of Dianchi Lake. Through the Internet of Things technology, the nitrogen and phosphorus concentrations, dissolved oxygen, pH value and other indicators of the water in the wetland can be monitored in real time, which can timely adjust the operating parameters of the wetland and improve the removal efficiency of nitrogen and phosphorus. For example, by using satellite remote sensing and drone technology, the ecological wetlands in the Dianchi Lake Basin can be monitored on a large scale, and pollution sources and ecological degradation areas can be detected in a timely manner.

#### 3.2 Management Model Innovation

The Dianchi Lake Basin has established a "four-level river chief five-level governance" system, and through scientific scheduling and precise management, the management efficiency of rivers and wetlands has been effectively improved. In addition, the Dianchi Lake Basin has also implemented the "one river, one policy" rectification plan, and formulated personalized governance measures for different rivers according to their pollution characteristics. This innovation in management model has not only

improved the governance effect, but also provided valuable experience for the management of other lakes.

## **4 Comprehensive Research in the Engineering Field**

### **4.1 Synergistic Effect of Engineering Measures and Ecological Wetlands**

The management of Dianchi Lake relies not only on the natural purification function of ecological wetlands, but also on a variety of engineering measures. For example, the Dianchi Lake Basin has implemented the construction of sewage interception pipes and the rectification project of rivers flowing into the lake, which has effectively reduced the input of external source pollution. At the same time, through the application of ecological floating bed technology and wetland function transformation, the nitrogen and phosphorus removal ability of wetlands has been further improved.

### **4.2 Application of Information Technology in the Engineering Field**

Information technology has played an important role in the engineering management of Dianchi Lake. For example, by establishing the construction specifications of Dianchi Lake wetlands and the information management platform, the construction of wetlands has been standardized and scientific. In addition, by using drone and satellite remote sensing technology, the Dianchi Lake Basin is monitored on a large scale, providing precise data support for the implementation of engineering projects.

## **5 Practice and Case Analysis**

### **5.1 Case One: Information Management of Water Quality Purification Plants**

There are 29 urban water quality purification plants in the Dianchi Lake Basin, with a designed daily treatment capacity of 2.52 million cubic meters. Through scientific scheduling, in 2024, the load reduction of water quality purification plants was increased by 28.1%, 15.8% and 18.3% respectively compared with 2023 in terms of chemical oxygen demand, total phosphorus and total nitrogen. These water quality purification plants have achieved efficient operation and large-scale reduction of pollutants through information management.

### **5.2 Case Two: Information Management of River Rectification**

The Dianchi Lake Basin has promoted the rectification of 35 rivers flowing into the lake through "one river, one policy", and regularly carried out the "three clear" actions, completing the dredging of 92 river sections, tributaries and direct lake inlet ditches with a total length of about 84.55 kilometers<sup>[10]</sup>. Through information management, the scientific and precise management of river rectification has been realized, and the water quality of rivers has been effectively improved.

## 6 Conclusion

The construction of ecological wetlands in Dianchi Lake has achieved significant results in the removal of nitrogen and phosphorus in water, providing an effective way for the management of eutrophication in lakes. Combined with the innovation of information and management models, the operation efficiency and governance quality of ecological wetlands can be further improved. Through comprehensive research in the engineering field, this paper reveals the promoting effect of information and management model innovation on the construction of ecological wetlands, and provides scientific basis for the management of eutrophication in lakes. In the future, we should continue to strengthen the construction and management of ecological wetlands, further explore the governance model of lake eutrophication, and provide references for the management of other lakes.

## Acknowledgment

**Project source:** Scientific Research Fund of Yunnan Provincial Department of Education project "Construction of Ecological Wetland to solve" effect analysis of nitrogen and phosphorus pollution in water-take Dianchi Lake as an example  
No. 2024J1186

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