Discussion on ecological system management of urban reclaimed water environment-a case study of Xihua Park in Kunming

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Abstract. Compared with tap water, reclaimed water in urban water environment is more likely to lead to water eutrophication. According to the local water pollution status and the types of pollutants, the physical, chemical and biological ecological methods should be organically combined in the water environment treatment, and a variety of suitable aquatic plants should be selected for reasonable allocation, so as to achieve complementary advantages, pay attention to maintenance and management, and establish a long-term maintenance and management system. In order to realize the sustainable ornamental, efficient purification and low-cost maintenance of urban water ecological landscape, it is necessary to build the plant community of urban water ecological environment and strengthen the bio ecological measures.

1. Introduction
Urban reclaimed water environment mainly includes lakes, rivers, water bodies of various parks, wetlands and waterscape of residential areas. With the rapid development of urban construction, urban water environment is increasing. A large amount of reclaimed water after sewage treatment is used in some places such as inland lakes, rivers or landscape, which accelerates the deterioration of water quality and eutrophication, and seriously affects the local living environment and quality of life. In recent years, many big cities have adopted various methods to reconstruct and repair the water ecological environment, and achieved certain results.

At present, water environment treatment technologies at home and abroad can be divided into physical, chemical and biological ecological methods. Physical methods include aeration and reoxygenation, sediment dredging and water diversion. Chemical methods mainly include enhanced flocculation, chemical oxidation and chemical precipitation [1]. Physical and chemical methods are generally not affected by climate conditions, and the treatment effect is obvious and stable. However, they often treat the symptoms but not the root cause, and the treatment cost is high. At the same time, they are easy to cause secondary pollution to the environment, so they are difficult to be used for a long time. Bio ecological method is not only an effective measure to restore the natural color of water environment, but also an important means for long-term and stable improvement of water environment quality. It uses the metabolic activities of cultivated plants or cultivated and inoculated microorganisms to transfer, transform and degrade pollutants in water body, improve water quality, build a water ecosystem with complete trophic structure, and fundamentally restore the ecological environment. Rehydration environment and ecosystem health[2]. Here I take Xihua Park in Kunming...
City as an example to discuss the measures of water environment treatment.

2. Reclaimed water environment in Xihua Park

Xihua park has 8666 square meters of water. The water source is treated reclaimed water. In 2012, Xihua Park carried out the water quality control work of rainwater collection project, built a dam, and divided the pond into 4 parts according to the terrain, including 4 ponds in the front garden and 4 lotus ponds in the back garden, with a total of 5 ponds. It looks like a water folding landscape. The reclaimed water after sewage treatment is introduced as the water source and discharged into the pond through the composite ecological filtration technology. That is to build a multi-media, multi structure "sandwich" vertical filtration device in the pond. The reclaimed water from the sewage treatment plant first goes through the filter, and then filters layer by layer to flow into other pond waters of the park. Sewage through here, through layers of purification, from turbid to clear, coupled with the water environment in recent years, has achieved remarkable results, has become a park benchmark. As shown in Figure 1:

![Figure 1 water environment treatment effect of Xihua Park](image)

3. Water environment control methods of Xihua Park

Compared with tap water, reclaimed water is more likely to lead to eutrophication. The key to control eutrophication is to build a complete aquatic ecosystem[3]. The reclaimed water environment treatment project of Kunming Xihua Park mainly includes two parts: water environment ecosystem restoration and ecosystem maintenance.

3.1 Water environment ecosystem restoration

The water body is the main landscape of the park, and also the main irrigation water source for the green space in the park. During the dry season from October to June of the next year, the green space in the park needs to pump water to the pond for irrigation more than three times a week, each time about 200 m³. The main water source of the pond is the tail water (reclaimed water) of Kunming No.1 sewage treatment plant, and the water quality monitoring conforms to the national standard.

Xihua Park improves the food chain of water ecosystem through water purification, algae feeding insects, microorganisms and Macrobenthos, installs oxygen generation facilities, replenishes water oxygen, and constructs a water environment ecosystem with complete structure and perfect function, so as to make the water have better anti pollution ability and self purification ability [4]; control the growth of blue-green algae wantonly, reduce water eutrophication, and promote water conservation Create a natural landscape water body with clear water, clean air, beautiful scenery and fish swimming[5].

3.2 Water environment ecosystem maintenance

Water maintenance is an important work for water quality and ecosystem to maintain health[6]. In addition to daily water quality cleaning, Xihua Park, according to the water quality, can regulate the growth of aquatic plants at any time, optimize the structure and quantity of aquatic plants and aquatic animals, add oxygen to the water body, supplement microbial bacteria timely, and keep the water
ecological stability and balance; ensure the water transparency is higher than 1.5m in sunny days and 1 m in cloudy days; the water body has no obvious odor and heterocolor, and it has a transparent appearance for a long time. The results showed that the area of blue and green algae was less than 1% of the water body and 10% of the water surface. After four years of water environment treatment in 2017-2020, the effect is obvious, as shown in Figure 2:
3.2.1 Maintenance and management of aquatic plants. Xihua park water reflects that submerged plants are Vallisneria, growing well, covering the bottom of the water body; emergent plants are Iridaceae, about 30 varieties, and lotus; floating plants are water lilies, growing well. Vallisneria can absorb nitrogen, phosphorus and other minerals in reclaimed water, and release oxygen to avoid deterioration of water quality. Form a good aquatic plant landscape. The maintenance and management of aquatic plants in the park are divided into daily and regular two ways [7].

(1) Daily maintenance and management of aquatic plants: pruning emergent plants, cleaning up pollutants attached to submerged plants, removing weeds (including Hydrilla verticillata), cleaning water surface (salvaging white garbage, fallen leaves, etc.), pest control, garbage cleaning, etc.

(2) Regular maintenance and management of aquatic plants: prune the height of submerged plants (Vallisneria) in the water body in winter, spring, summer and autumn every year to ensure the normal growth of submerged plants; organize the staff to clean and plant the residual leaves and underground rhizomes of lotus planted in the water body from January to February every year; organize the staff to harvest, clean, remove impurities and plant all emergent plants twice a year. As shown in Figure 3
3.2.2 Improve the supervision and management system. In order to better play the role of functional departments, Xihua Park samples and tests the water quality in the water environment every quarter, establishes a long-term management system and operation mechanism for the maintenance unit, formulates a water body assessment and standard rectification system, and plays a key role in the supervision and management of water environment governance. The water samples were sent to the third party testing organization for testing. The determination methods were ammonium molybdate spectrophotometry (GB11893-89), Nessler's reagent spectrophotometry (HJ), 535-2009, potassium permanganate index (GB11892-89) and iodometry GB7489-1987). The water quality test data from 2017 to 2020 are shown in Figure 4.

![Figure 4](image_url)

Figure 4 Monitoring data of reclaimed water environment in each pool after water ecological restoration in Xihua park from 2017 to 2020

It can be seen from figure 4 that after the treatment of the reclaimed water environment in Xihua Park, the total phosphorus and total nitrogen in each pool are significantly lower than the water quality standard IV in the national surface water environmental standard; the degree of organic pollution is low; the dissolved oxygen in the water body shows an increasing trend, and the overall water environment maintains a good ecosystem.

4. Discussion on water environment treatment

After years of exploration, Kunming Xihua Park, in addition to the traditional physical and chemical methods such as harvesting, regular salvage, precipitation filtration and sub planting, can remove the target pollutants (suspended matter, dissolved phosphorus and nitrogen, etc.) in water, and improve the water transparency; the plant purification method is also adopted to form an underwater forest system dominated by bitter grass, and the organic pollutants and heavy pollutants are heavy by aquatic plants. The water quality is purified by metal degradation. The total phosphorus, ammonia nitrogen, potassium permanganate and dissolved oxygen content in water meet the corresponding requirements, and constitute a relatively complete and stable ecosystem.

The treatment of urban water environment itself is a dynamic, systematic and complex process.
According to the actual situation of polluted water, physical and chemical treatment should be reasonably applied to strengthen biological ecological measures. Based on the experience of Xihua Park in Kunming City, the water environment treatment mainly includes the selection of suitable reasonable allocation of various aquatic plants to achieve complementary advantages; according to the local environmental conditions, regular maintenance and reasonable supervision, the construction of plant cultivation community of urban water ecological environment to form efficient purification technology of water ecological environment; the optimization of maintenance and management mode to realize the sustainable development of water landscape Ornamental, efficient purification, low-cost maintenance, to achieve long-term sustainable water environment restoration, to achieve the best landscape effect.

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