Current Status and Challenges of the Ecological Environment of Wuliangsuhai Basin in China

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Abstract  Lake ecological security refers to maintaining the integrity and ecological health of the lake ecosystem under the influence of human activities, providing humans with stable ecological service functions, and preventing ecological catastrophes. In the lake ecosystem, lakes are the main body, and their water ecological health is the basis of system security. Therefore, the ecological safety and health of lakes are investigated, and the multi-faceted evaluation system of lake ecological safety is established, which can provide decision-making basis for lake management and pollution control. It is of great significance for the sustainable management of lake ecosystem and the rational utilization of resources to coordinate the environmental, social and economic benefits of relevant departments. Wuliangsuhai Lake is the largest natural wetland in the same latitude area in the world, and the eighth largest freshwater lake in China. It is the most typical shallow-water grass-algae lake in the arid area of Inner Mongolia. It is an important water conservation, storage, and water transfer site in the upper and middle reaches of the Yellow River. It is also a large grass-algae lake with biological diversity and ecological function, which is extremely rare in desert and semi-desert areas in the world. This article briefly introduces the main ecological and environmental problems and their causes in the Wuliangsuhai Basin.

1. Introduction
In the past few years, China’s Inner Mongolia Autonomous Region and Bayannaer City have attached great importance to the life management of the Wuliangsuhai Basin, invested a lot of manpower, material and financial resources, and implemented a large number of ecological environmental protection and restoration projects. The construction of ecological environment protection in the river basin has achieved some results. Since the 1990s, with the rapid advancement of the industrialization and urbanization of Bayannaer City, the urban domestic sewage and industrial wastewater discharged into Wuliangsuhai Lake has increased year by year(Du et al. 2011)[1]. The discharge of up to 55 million tons of sewage every year has caused damage to Wuliangsuhai Lake. Serious pollution. Wuliangsuhai Lake has weakened water cycle capacity, increased salt, nitrogen, and phosphorus concentrations, increased eutrophication, and gradually degraded ecological functions, seriously affecting the water ecological security of the Yellow River(Du et al. 2014)[2]. In 2008, the pollution of Wuliangsuhai Lake reached its worst period. Since 2009, Bayannaer City has actively promoted pollution source treatment and implemented the Wuliangsuhai ecological protection and restoration project(Feng et al. 2006)[3]. So far, the water quality of Wuliangsuhai Lake has gradually improved; the number of birds has increased; the ecological functions of the lake have been gradually restored, and pollution control has achieved initial results. The water supply is 200-300 million m$^3$.
every year; 54 waterways with a total area of 119 km are excavated to reduce the stagnant water area. The pollution in the Wuliangsuhai Lake District has been reduced, and the water quality has improved. According to water quality monitoring data, in 2015, the water quality of Wuliangsuhai Lake has historically changed from being inferior to Grade V to the overall Grade V(Li et al. 2015[4], Hu et al. 2017)[5]. The number of bird populations in Wuliangsuhai Lake has recovered significantly. Each year, about 1 million wild birds live in the wetlands, and the number of mute swans has grown from more than 200 to nearly 1,000 now. In the ecological pattern of Yellow River Basin and the northern desert belt in China, the structure and function of the Wuliangsuhai Basin ecosystem have been seriously damaged. It is the most urgent key area for remediation and restoration. The main problems are as follows.

2.Ulan Buhe desertification has intensified, affecting regional ecological security
Although some achievements have been made in the management of the Ulan Buh Desert, the ecological fragility of the desert area makes the task of consolidating the results arduous. At present, the sandy land ecosystem is mainly shrub and grass type. In some areas that have been governed, the vegetation is still in the recovery stage, and the stability is poor. If the protection and utilization are not proper, the land desertification is very easy to deteriorate(Liu et al. 2014)[7]. In the past five years, the newly reclaimed land area in the desert area is nearly 333km². With the original land, the development area of the desert area has reached 867km². The task of sand prevention and control is still arduous[6].

3.Environmental problems in the mine are prominent, and soil erosion is serious
There are three mountain ranges in the Wuliangsuhai Basin around Wulateqianqi County: Wula Mountain, Baiyun Changhe Mountain and Zhaertai Mountain. Wula Mountain faces the Yellow River in the south and Wuliangsuhai Lake in the west. It is about 90 km long from east to west and 20 km wide from north to south. It is the west extension of Daqing Mountain, with very typical biodiversity, and an important barrier for ecological security in Inner Mongolia(Mao et al. 2021)[10]. The Baiyun Changhe Mountain in the north is about 90km from east to west, and the Zhaertai Mountain is about 150 km from east to west. The Wula Mountain, Baiyun Changhe Mountain and Zhaertai Mountain are rich in mineral resources. Mining activities have gradually risen since the 1960s and 1970s. Due to long-term emphasis on development and over protection, mining development takes up and destroys a lot of land, causing serious damage to mountains and the ecological environment. Open pits and piles of waste gravel are all over, and the original topography and landscape are destroyed, resulting in ground collapse and collapse, landslides and other hidden dangers of geological disasters. The solid waste and waste water dust generated by mining activities have a serious impact on the environment(Qu et al. 2009)[11]. Land occupation and destruction have also led to vegetation destruction, grassland desertification, degradation of surface conservation, serious soil erosion, and biodiversity are also affected. This leads to frequent flash flood disasters. The annual flood of about 50 million m³ is accompanied by a large amount of sediment and pollutants washed into and deposited in the Wuliangsuhai Lake, causing pollution of the lake and increasing pollution year by year(Shi et al. 2021)[12].

4.The degradation of Alabeng grassland has worsened, resulting in a reduction in the function of ecological barriers
The Alabeng grassland is an important part of the Urad grassland. Grassland degradation is the biggest problem in the current grassland ecosystem. Due to frequent droughts and pests, and early overgrazing, grassland degradation has accelerated and even grassland desertification has been accelerated. The diversity of plants in the grassland has shown a significant downward trend, and the pasture species that make up the community have been reduced from more than 20 to about 10(Shi et al. 2020)[13]. High-quality population plants are gradually declining or even being replaced, and summer rain-type pastures are increasing. In terms of the composition of grassland plant species, the companion species
and invasive species in the community are increasing, and the main population is gradually weakened or replaced by invasive species or companion species in stages. The number of plant species in the community has drastically decreased; the stability has decreased; the ecological function of the grassland has degraded; the grassland has gradually become desertified, and the soil erosion has been serious. This has led to the decline of the water conservation area and the lake pollutant barrier function of the Alabeng grassland, resulting in the reduction of the ecological barrier function. The water quality of Wuliangsuhai has deteriorated (Shi et al. 2019)[14].

5. The water quality of the Wuliangsuhai Basin is poor and the water ecological security is seriously threatened. In recent years, with the continuous advancement of the comprehensive management of Wuliangsuhai Lake, the overall water quality has shown a trend of getting better year by year. According to the monitoring data of four indicators of Wuliangsuhai Lake from 2013 to 2017, the overall water quality of Wuliangsuhai Lake (annual average concentration) has reached Class V (total nitrogen is not included in the water quality category evaluation)(Sun et al. 2006)[15].

Figure 1 Comparison chart of annual average concentration of COD (Chemical Oxygen Demand) and class V standard
Figure 2 Comparison chart of annual average concentration of ammonia & nitrogen and class V standard

Figure 3 Comparison chart of annual average concentration of total phosphorus and class V standard
Figure 4 Comparison chart of annual average concentration of total nitrogen and class V standard

6.Conclusions
In summary, Bayannaoer City has implemented a large number of ecological environmental protection and restoration projects. The ecological management of the Wuliangsuhai Basin has achieved initial results, but the structure and function of the ecosystem are still seriously damaged and degraded. The main manifestations are the shrinkage of lakes, the water quality has not yet reached the standard, soil salinization, serious pollution of farmland and towns and villages, serious damage to mountains and forests, increased soil erosion, grassland degradation and other ecological and environmental problems. In terms of environmental management, there are still problems such as fragmentation, insufficient coordination of work, scattered deployment of governance projects, imperfect systems and mechanisms, and shortage of governance funds. The ecological environment governance and restoration work still lacks systemicity and integrity. In view of the special geographical location and important ecological functions of the Wuliangsuhai Basin, if the ecological environment in the basin cannot be further systematically treated, it will pose a serious threat to the water ecological security of the middle and lower reaches of the Yellow River and the ecological security of northern China.

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