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GUARDIANS OF THE RESERVOIR: EVALUATING STRATEGIES FOR WATER SOURCE PROTECTION IN HEPU

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Abstract: Reservoirs serve as vital sources for drinking water, irrigation, and various other functions essential to communities. However, the rampant use of fertilizers, pesticides, and other agricultural practices has led to substantial non-point source pollution in the surrounding farmlands. Moreover, the lack of comprehensive planning and construction of facilities, such as sewage networks, around the reservoir area exacerbates this issue. The presence of pollution risks in the water's ecological environment further compounds the problem, with shoreline protection plans requiring refinement. This predicament is not unique, as many regions in China grapple with varying degrees of reservoir-related environmental pollution. Recognizing that reservoir water source preservation and water quality enhancement directly impact the well-being of society, this study delves into crucial measures for water source protection and quality amelioration.

Keywords: Reservoir, Water Source Protection, Water Quality Improvement, Ecological Civilization, Environmental Pollution Prevention

1. Introduction

The reservoir is generally responsible for drinking water, irrigation and other functions, but because of agricultural production of fertilizers, pesticides, etc., a large number of farmland non-point source pollution to the soil ; the domestic sewage of residents around the reservoir area, the breeding points around the reservoir area, rain and sewage interception and other pipe network supporting facilities have not been planned and constructed as a whole ; there are still pollution risks in the water ecological environment, and the shoreline protection plan is not perfect [1-6]. As a result, there are environmental pollution problems with different degrees of reservoirs in many parts of China. Reservoir water source protection and water quality improvement are ecological civilization projects related to people's livelihood [7]. Therefore, it is of great significance to discuss the measures of water source protection and water quality improvement.

2. Basic situation of water source of Hepu Reservoir

The project management scope of Hepu Reservoir involves Pubei County of Qinzhou City, Bobai County of Yulin City, and one county and three districts of Beihai City. It is mainly composed of Xiaojiang Reservoir, Wangshengjiang Reservoir, Qingshuijiang Reservoir and Lake and Sea Canal and other major hub projects. Among them, Xiaojiang Reservoir and Wangshengjiang Reservoir are crossadministrative regional water conservancy projects of Hepu Reservoir. Xiaojiang Reservoir is a large Itype reservoir in Guangxi Zhuang Autonomous Region. The rainwater harvesting area is about 919.8 km2, and the total storage capacity is 1.025 billion m3. The water surface of the reservoir area is

half of Bobai County in Yulin City and half of Pubei County in Qinzhou City. Wangshengjiang Reservoir is a water conveyance corridor project connecting Xiaojiang Reservoir to the lake and sea canal. The rainwater collection area is 133 km2, and the total storage capacity is 150 million m3. The water surface of the reservoir area is composed of Bobai County of Yulin City, Pubei County of Qinzhou City and Hepu County of Beihai City. Xiaojiang Reservoir and Wangshengjiang Reservoir are the main water supply projects of Hepu Reservoir, which are responsible for the irrigation of 520,000 mu farmland downstream, Tieshangang Industrial Park, Beihai City and surrounding towns.

3. Water source protection and water quality status of Hepu Reservoir

3.1 Scientific management of water resources across administrative regions of Hepu Reservoir according to law and regulations

In order to protect and improve the water quality of Hepu Reservoir, prevent the decline of water resources quality of the reservoir, and promote the coordinated development of regional economy and environment, according to the relevant laws and regulations such as the ' Water Law of the People's Republic of China ' and the ' Implementation Measures of Guangxi Zhuang Autonomous Region ', the planning of fishery, water resources protection and water supply belongs to professional planning. The professional planning of river basins across districts and cities should be compiled by the relevant departments of the people's government of the autonomous region.

The three counties of Bobai, Pubei and Hepu County have a unified consensus, and work together to jointly manage the working mechanism. The cross-administrative waters of the reservoir will have a unified fishery and optimize the water resources allocation in the cross-administrative waters of the reservoir area. As the tap water source project for daily life of residents in Beihai urban area, Xiaojiang and Wangshengjiang reservoirs have high requirements for water quality safety standards. The orderly development and utilization of water resources in the reservoir area according to law, the development of fishery or the use of ecological fishery to purify water quality require the local government and relevant departments to work together, plan as a whole and supervise together. Through the combination of measures to strengthen the protection of water quality, to ensure that the water quality reaches the national surface water environmental quality standard III above, which further puts forward the requirements for the protection of water quality in Hepu Reservoir.

Water quality protection of Hepuyin Reservoir. Adhering to the principle of " two-pronged approach and tackling both the symptoms and the root causes, " we should not only solve the problem from the source, accelerate the cleaning and renovation of the sewage outlets into the reservoir, minimize the discharge of sewage into the reservoir, but also rely on the power of science and technology to promote the improvement of water quality. At the same time, we should not relax our vigilance. For the problem that some indicators are not up to standard at some time, effective measures should be taken to ensure that the water quality of the water source continues to reach the standard.

3.2 Solidly promote the management and protection of water resources, provide effective protection

In order to effectively strengthen the protection of drinking water sources, Beihai Environmental Protection Bureau launched the isolation and protection project of the first-level protection area of

drinking water sources in Hepu and Beihai reservoirs. The boundary of the water source protection area was set up with clear geographical landmarks, and the land around the water source area was all green, and the vegetation coverage rate was significantly improved. At the same time, the Hepu Reservoir Engineering Management Bureau has implemented a series of water source protection measures, and actively organizes "World Water Day" and "China Water Week" activities every year. The management bureau and the second-level units are the center points. During the activity, the water laws and regulations are disseminated to the surrounding village committees and crowded areas by hanging banners and distributing leaflets. Timely organize personnel to salvage and harmlessly treat the garbage and floating objects on the water surface of the reservoir area and the main canal. In the past three years, a total of 9211 people have been dispatched, 302 dead pigs and 1600 bags of livestock have been harmlessly treated, 900 nets have been cleaned up, 186 nets have been fenced, and 188 tons of water surface garbage have been salvaged and cleaned up, effectively ensuring the safety of water quality. Due to the effective improvement of water environment and water ecology, the 4 km section of Hongbeicheng Village Committee in Shikang Town and the 3.5 km section of Qingshan Village Committee in Lianzhou Town have been included in the list of beautiful and happy rivers and lakes in Guangxi. In 2022, according to the requirements of the use and management of water conservancy development funds and the subsidy and incentive funds of the river chief system in the autonomous region, combined with the task of beautiful and happy river and lake construction indicators, we will fill in the short board of technical management with practical actions. A total of 12 monitoring equipment were set up in 11 places along the lake and sea canal, which filled the gap in intelligent management technology along the lake and sea canal, and fundamentally improved the information management level of our bureau.

3.3 Continue to promote the reservoir ' four chaos ' problem clean-up and renovation to provide protection for the water source

In August 2020, the Political and Legal Committee of the Party Committee of the Autonomous Region listed the rectification of the "four chaos" problem in the reservoir area of Hepu Reservoir (involving Bobai, Pubei and Hepu County) as the key area of annual social security and the prominent problem of public security. In order to further strengthen regional cooperation, the three counties and one reservoir jointly compiled and implemented the ' joint implementation of the ' four chaos ' remediation work plan for the Hepu reservoir area '. Joint Hepu County People 's Government and relevant departments and units to form a special rectification working group to promote the first and second rounds of " four chaos " clean-up and rectification of the Wangsheng River system in Hepu Reservoir (Beihai municipal district). In March 2021, it took the lead in completing the centralized rectification of 438 " four chaos " problems in Beihai municipal district of Hepu Reservoir, and all of them passed the municipal verification in that year. A total of 4895 people were dispatched, about 1072 vehicles for hooking and transporting soil, 16 ships, about 500,000 cubic meters of earthwork were cleaned, and about 4,000 acres of water surface area of the reservoir were restored. In November 2022, Pubei, Bobai County People's Government, County River Chief Office and law enforcement departments jointly carried out the clean-up and remediation of illegal aquaculture cages in Xiaojiang Reservoir. A total of

120 personnel were dispatched, and 15 ships and assault boats were dispatched. At the beginning of December, a total of 90 breeding cages (about 2688 boxes of cages) in Xiaojiang Reservoir (Pubei County) have all passed the acceptance number of Qinzhou River Chief Office. In 2022, the "four chaos" problem in the reservoir area of Hepu Reservoir (Hepu, Pubei, Bobai County) passed the verification at the autonomous region level. The overall rectification and control work and its effectiveness have been fully affirmed by the Political and Legal Committee of the Party Committee of the autonomous region and the River Chief Office of the autonomous region, as shown in Figure 1.

Figure 1: Cleaning illegal cages in Pubei Reservoir

3.4 Present situation of water quality safety management

3.4.1 Water quality categories

According to the relevant provisions of the ' Guangxi Reservoir Drinking Water Source Pollution Prevention and Control Regulations ', the reservoir drinking water source protection area is protected by classification. The Hepu Reservoir Project Management Bureau cooperates with local governments to strictly implement relevant regulations in protected areas at all levels, which effectively protects the water quality of the reservoir water source. Over the years, the surface water quality monitoring results have shown that the water quality of the Ganghepu Reservoir has been maintained above the Class III standard all the year round, and has reached the drinking water Class I and II standards in individual months, which is in line with the standards of the ' Surface Water Environmental Quality Standard ' (GB3838-2002) and the ' Sanitary Standard for Drinking Water ' (GB5749-1985).

3.4.2 Water quality safety monitoring

In order to maintain the safety of water quality, the Hepu Reservoir Engineering Management Bureau and the North Sea Water Environment Monitoring Center jointly set up water quality automatic monitoring equipment in Hepu Reservoir to monitor the water quality of the reservoir in real time. At the same time, the North Seawater Environmental Monitoring Center conducts water quality testing

of Hepu Reservoir once a month. The water quality monitoring instrument is installed in the key inlet estuary, and the video monitoring is set up at the key points of the reservoir. The monitoring considers the dumping of garbage and floating garbage on the water surface. At the same time, the long-range UAV is also used to check the interval along the reservoir area.

3.5 Emergency management of sudden water pollution incidents in reservoirs

Hepu Reservoir has a large area and a wide cross-region. Its geographical location is complex and adjacent to the main traffic arteries and rural roads. The sudden accidents of road transportation of hazardous chemicals have caused water pollution of dangerous goods. At the same time, the water quality of the reservoir is reduced every year due to coastal storms. In order to improve the ability to respond to sudden water pollution incidents in Hepu Reservoir and minimize the consequences of water pollution, the Hepu Reservoir Engineering Management Bureau has formulated the " Comprehensive Emergency Plan for Sudden Water Pollution Incidents in Hepu Reservoir, " " Emergency Disposal Plan for Sudden Water Pollution Incidents in Hepu Reservoir " and " Special Plan for Sudden Water Pollution Incidents in Hepu Reservoir, " and has been revised and improved. At present, the departments involved in water source protection have established a linkage mechanism for water source security and implemented information resource sharing. In addition, the staff is arranged to participate in the emergency training and exercise of reservoir water source environmental protection organized by Beihai Environmental Protection Bureau every year. At the same time, all the staff of the reservoir are organized to carry out sand table exercises and comprehensive exercises, so as to be able to carry out effective emergency and rescue in the event of emergencies.

4. Analysis of the causes of water quality decline in Hepu Reservoir Reservoir pollution is the root cause of water quality decline. The pollution of Hepu Reservoir is analyzed below.

(1) Pollution of sewage from production enterprises

Enterprise sewage is an important source of water pollution, which is characterized by large amount, wide surface, complex composition, high toxicity and difficult to purify [8]. There are a large number of low-tech and polluting enterprises around the reservoir and the confluence rivers. Papermaking, brick making, kaolin, feed factory food processing and other polluting plants, a large amount of wastewater will be illegally discharged directly to the reservoir area or confluence rivers without any treatment, and ultimately greatly reduce the water quality of the reservoir.

(2) Pollution of domestic sewage and domestic waste

A large amount of domestic sewage is produced in the living process of the people in the surrounding towns and villages in the adjacent reservoir area. The domestic sewage contains or breeds organic matter such as pathogenic bacteria and insect eggs, and also contains a large amount of N and P fertilizer elements, which will lead to a large number of algae and other aquatic animals in the reservoir area. At the same time, it also produces a large amount of domestic waste. If it is not treated in time or sanitation work lags behind, when it rains heavily, these wastes will enter the reservoir with the flood, causing waste to float on the surface of the reservoir. The precipitation of pollutants in the water becomes water source pollution. The construction of construction projects around the reservoir area

will produce a lot of construction waste, which will pollute the water source of the reservoir and reduce the water quality.

The operation of the farmhouse near the reservoir also causes kitchen pollutants such as oil pollution, kitchen spoiled leftovers, and the discharge of cleaning supplies, which becomes pollution.

(3) Pollution of breeding industry

Pig farms, cattle farms, chicken and duck breeding sites, cages around the reservoir, feed and excreta from farms (sites) flow into the water, resulting in an increase in nitrogen and phosphorus, contaminating the water quality of the reservoir. In particular, when a large number of deaths occur due to large-scale epidemics in farming, large dead birds and dead pigs are often directly dropped into the reservoir, which has serious consequences. In the past five years, more than 500 dead pigs and more than 2,000 bags of livestock have been harmlessly treated in the reservoir to effectively avoid further water pollution.

(4) Agricultural production pollution

Farmers around the reservoir use pesticides, chemical fertilizers, agricultural waste, etc., which cause water pollution in the agricultural production process. The ways of polluting the reservoir by undegraded pesticides, chemical fertilizers, agricultural waste, etc.are as follows : 1. Produce sewage directly into the reservoir ; 2, the first pollution of soil, rainfall process, by the rain into the reservoir ; the influence of precipitation, the fertilizer and pesticide in the surrounding and upstream of the reservoir area will directly enter the reservoir with the inflow of rainwater, the water quality will be polluted, and the pesticide content will increase.

(5) Soil erosion pollution

The surrounding area of the Hepu Reservoir is mostly yellow clay and sandy land. It has experienced large explosive rain. Affected by surface runoff, rainwater will bring fine particles of soil into the reservoir water, resulting in increased impurities in the reservoir. The color of the water becomes red and yellow and polluted. At the same time, sugarcane and eucalyptus are planted around the reservoir area, in which sugarcane planting will be fertilized and fertilized with certain toxic fertilizers to prevent pests; eucalyptus has a high trunk and developed roots, and the planting income cycle is short, but the transpiration is large, which is easy to cause land desertification, which is not conducive to water conservation and purification. The continuous erosion of vegetation on both sides of the waters is likely to lead to ecological imbalance in the region, further floods and droughts, surface runoff, long-term exogenous pollution input, resulting in eutrophication of some reservoir water bodies, and even intermittent outbreaks of algal blooms, affecting reservoir water quality [9].

5. Measures for water source protection and water quality improvement of Hepu Reservoir

(1) All local departments attach great importance to the protection and utilization of water resources, and face up to the gap between our protection and utilization of water

Water is the source of life, the key to production, and the basis for all survival. The problem of water is the most important livelihood issue and the most basic production material issue. We must cherish water with awe, protect water, save water, and do a good job in the protection and utilization of water

resources. To strengthen the propaganda of water law, around the protection of drinking water sources, carry out the ' Internet + rule of law propaganda ' action, increase the propaganda of new platform propaganda methods such as Weibo, WeChat, and clients, and combine with traditional propaganda methods, and constantly improve the reservoir area. The masses around the reservoir area widely participate in the activities of ' protecting water sources and preventing water pollution ', develop the concept of ' loving water and protecting water ', and vigorously strengthen the protection of water sources in Hepu Reservoir.

(2) The water quality protection work of Hepu Reservoir should be done well.

Adhering to the principles of " two-pronged approach, treating both symptoms and root causes " and " controlling exogenous sources first and then treating endogenous sources " for reservoir water quality improvement, we should not only solve the problem from the source, speed up the cleaning and renovation of the sewage outlets in the reservoir, and minimize the discharge of sewage into the reservoir, but also rely on the power of science and technology to promote the improvement of water quality.

(3) To guide the enterprise pollution-free production

We will resolutely close down enterprises with low technology, high energy consumption and high pollution, implement the system of one-vote veto on the environment, and not approve production licenses without environmental evaluation. Heavy penalties for illegal sewage discharge, wastewater without any treatment will be directly discharged. Actively guide enterprises to introduce technology for pollution-free production or less pollution production, production sewage compulsory treatment to meet emission standards. It is necessary to speed up the construction of production sewage treatment facilities and pipe network supporting facilities, and continuously improve the efficiency of sewage treatment and the rate of discharge compliance.

(4) Cross-administrative regional ' Qing Si Luan ' collaborative governance

We resolutely promoted the collaborative governance of the "four chaos " of Hepu Reservoir across administrative regions and strengthened regional cooperation. The three counties and one reservoir jointly prepared and implemented the "joint implementation of the ' four chaos ' remediation work program " in the Hepu Reservoir area. Joint Hepu County People 's Government and relevant departments and units to form a special rectification working group to promote the first and second rounds of " four chaos " clean-up and rectification work of Hepu Reservoir (Beihai municipal district) Wangsheng River system. In March 2021, it took the lead in completing the centralized rectification of 438 ' four chaos ' problems in Beihai municipal district of Hepu Reservoir, and all of them passed the municipal verification in that year. A total of 4895 people were dispatched, about 1072 vehicles for hooking and transporting soil, 16 ships, about 500,000 cubic meters of earthwork were cleaned, and about 4,000 acres of water surface area of the reservoir were restored. In November 2022, Pubei County, Bobai County People's Government, County River Chief Office and law enforcement departments jointly carried out the clean-up and remediation work of illegal aquaculture cages in Xiaojiang Reservoir. A total of 120 personnel were dispatched, and 15 ships and assault boats were dispatched. At the beginning of December, a total of 90 breeding cages (about 2688 boxes of cages) in

Xiaojiang Reservoir (Pubei County) have all passed the acceptance number of Qinzhou River Chief Office. We regularly or irregularly carry out collaborative law enforcement inspections every year, do regular inspections and key inspections around the reservoir area, actively carry out special inspections of water administration law enforcement, inspect the incoming rivers, the left and right banks of the reservoir, and the water surface of the reservoir, and promptly investigate and deal with illegal sand mining, abandoned slag, sewage and other behaviors within the scope of reservoir management, and conduct a thorough investigation and investigation of the sewage situation in the upstream and surrounding towns of the reservoir. At the same time, toxic and harmful substances are strictly prohibited from entering the drinking water source protection area, and the problems of direct discharge of livestock and poultry breeding sewage and agricultural pesticide pollution are treated in time to minimize the pollution of breeding and planting. Timely eliminate all kinds of illegal activities around the reservoir area in the bud, for drinking water.

(5) Strengthen soil and water conservation, and continuously improve the protection of ecological environment

In view of the environmental characteristics of the surrounding and upstream areas of Hepu Reservoir, the soil and water conservation policy of " prevention first, comprehensive planning, local conditions, and benefit-oriented " is actively implemented, and methods such as planting trees, planting grass, and returning farmland to forests are adopted to greatly improve the vegetation coverage rate, so as to achieve water conservation, prevent soil erosion, and improve the self-healing and self-regulating functions of the ecosystem. At the same time, we should guide farmers to develop ecological agriculture and organic agriculture, encourage the use of organic fertilizers and green manure, rationally use chemical fertilizers and pesticides, and control agricultural non-point source pollution.

According to the characteristics of pollution sources in Hepu Reservoir, the surface flow wetland is constructed at the entrance, and the ecological floating island and submerged plant system are arranged in the water area with poor hydrodynamic conditions. The surface flow wetland, ecological floating island and submerged plant system are used to intercept the non-point source pollution of land and adsorb the nutrients of water body, so as to achieve the purpose of ensuring and improving water quality [10].

It is very important to strengthen water quality monitoring and ensure the water quality safety of water sources. As the drinking water source of Beihai City, the water quality safety of Hepu Reservoir is very important. Therefore, we should conscientiously implement the notice of the Ministry of Water Resources on strengthening the quality management of water quality monitoring. At the same time, while regularly monitoring the water quality of the reservoir, we should analyze the monitoring results and put forward measures and requirements. The townships in the reservoir area coordinate the establishment of a water pollution information communication platform, and establish a water source protection contact system [11]

6. Summary

The reservoir plays a very important role in the residents ' life and the development of industry and agriculture in the counties and cities to which it belongs. The pollution of the reservoir will lead to

different degrees of impact on the operation of the reservoir, which is not in line with the requirements of the sustainable development of the reservoir. This paper analyzes the various reasons for the pollution of Hepu Reservoir, and puts forward the principles of attaching great importance to the protection and utilization of water resources, " two-pronged approach, tackling both the symptoms and the root causes, " " controlling exogenous sources first, and then treating endogenous sources " to improve water quality, guiding enterprises to non-polluting production, collaborative governance, strengthening soil and water conservation, and continuously improving the protection of ecological environment. Measures and methods for reservoir water source protection and water quality improvement.

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