

Ecological Environment Management and Sustainable Development Strategy of "One Lake and Four Rivers" in Hunan Province

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Abstract: *With the rapid development of urbanization and industrialization, the serious ecological environment pollution caused by the "one lake and four rivers" in Hunan Province has not been fundamentally solved, and the water ecological environment is facing serious challenges. The article adopts a qualitative research method to analyze the difficulties faced by the ecological environment governance of "one lake and four rivers" in Hunan Province, such as uncoordinated governance entities, weakened regional governance capabilities, limited governance system effectiveness, weak foundation of basin water ecological environment warning system, and insufficient supervision of water ecological environment governance; propose countermeasures to promote the governance of aquatic environment from the perspectives of building a collaborative governance mechanism for water ecological environment, improving the governance system for water ecological environment, guiding multiple entities to participate in water ecological environment governance, implementing ecological compensation for river basins, promoting the construction of functional zones for water ecological environment, and strengthening the supervision of water ecological environment governance.*

Keywords: *one lake and four rivers, ecological environment, sustainable development*

1. Introduction

In order to implement the development direction of the Yangtze River Economic Belt of "jointly focusing on major protection and not engaging in major development", with improving the quality of the water environment as the core, water and land coordination, river lake linkage, both root and root causes treatment, and construction and management are carried out simultaneously, strengthening source control, systematically promoting water pollution prevention and control, water ecological restoration, water resource management, and flood control capabilities, and building an ecological water network with clean water, smooth rivers, and green banks, laying a solid foundation for building a prosperous, beautiful, and happy new Hunan. The ecological environment security of Hunan Province's "one lake and four rivers" should clarify the key tasks of water ecological environment governance, deeply implement water ecological protection and water pollution prevention and control actions, incorporate ecological flow supply into the regional water resource planning system, strictly set production, living, and ecological space development and control boundaries, and implement ecological red line management for key water ecological environment functional areas and major river sections, ensure the quantity and quality of water resources within a safe range, and promote regional water ecological environment governance [1]. Most of the existing research has focused on water environmental pollution or water ecosystem protection, with less emphasis on water ecological environment governance strategies. This study is based on the transformation of the ecological environment governance goals of "one lake and four rivers" in Hunan Province. By analyzing the ecological environment status of "one lake and four rivers" in Hunan Province, the difficulties faced in water ecological environment governance are identified, and corresponding countermeasures are proposed to address the practical problems in water ecological environment governance.

2. The realistic dilemma of the ecological environment governance of "one lake and four rivers" in Hunan Province

2.1 Incoordination of ecological environment governance entities

The governance of water ecological environment involves multiple functional departments such as water conservancy, ecological environment, natural resources, agriculture, fisheries, forestry and grass, urban construction, etc. Objectively, there is a phenomenon of repeated management by multiple institutions, lacking a unified coordination mechanism, and it is difficult to form a regional water ecological environment governance system. The water ecological environment governance system of the "one lake and four rivers" watershed in Hunan Province is not fully perfect, and the watershed management agencies and relevant regional departments implement segmented management [2]. The governance boundaries of the watershed and administrative regions can't be effectively overlapped. The ecological function zoning based on administrative regions has led to prominent contradictions in the upstream and downstream areas of the watershed and cross provincial boundaries. Multiple relevant departments jointly undertake the tasks of ecological protection and environmental pollution control in the watershed, but the responsibilities and authorities of each department are not clear and their respective policies are implemented, lacking overall planning and comprehensive management. Some watersheds have not yet implemented overall layout and scientific regulation, making it difficult to communicate and collaborate closely between upstream and downstream regions, and can't effectively resolve conflicts among stakeholders in water ecological environment governance within the watershed [3].

The problem of low cooperation among various administrative departments in the management of watershed water ecological environment has led to a situation of multiple management in watershed ecological environment management [4]. For example, the collection and management of pollution discharge fees and emissions trading in river basins are carried out by the ecological environment department, the utilization and development of water resources in river basins are managed by the water conservancy department, and the collection and management of mineral resource compensation fees and land resource occupation compensation fees are collected and managed by the natural resources department. This multi management not only hinders the centralized management of river basin water ecological environment, but also hinders the improvement of fund utilization efficiency. As the main body of water ecological environment governance, enterprises lack external incentives, and the governance costs cannot be internalized, making it difficult to enhance the enthusiasm of enterprises to participate in water ecological environment governance [5]. Although the upstream and downstream regions of the watershed adopt corresponding governance measures based on their respective resource environment and socio-economic conditions, the effectiveness of this decentralized water ecological environment governance is limited. Some regions excessively rely on administrative means to carry out water ecological environment governance, neglecting economic management methods, and cannot promote the formation of a community of responsibility and interests in upstream and downstream regions.

2.2 Weakening of regional ecological environment governance capacity

The top-level design and overall planning layout of regional water ecological environment governance are missing, and the linkage and coordination ability is weakened. The investment in water ecological protection and restoration in the four regions is insufficient, and the measures for water ecological protection and restoration in existing plans have not been implemented. The planning plan has not been refined, and no special action plan for water ecological protection and restoration has been formulated.

The formulation of regional water ecological environment governance goals has not been integrated with the evaluation of the benefits of improving water ecological environment quality and the evaluation of the performance of ecological environment governance in upstream and downstream areas of the basin [6]. With the tightening of resource constraints, the difficulty of large-scale resource development under the extensive economic growth model has increased, and the marginal benefits of investment have decreased, making it impossible to maintain the pattern of sustained expansion of investment scale in the long term. The infrastructure for water ecological environment governance in Hunan Province's "one lake and four rivers" is weak, the investment in governance equipment is insufficient, and the progress of governance engineering construction is slow. Some areas' infrastructure can't meet the actual needs of water ecological environment governance [7]. Despite

increasing investment in the construction of water-saving facilities for production and living, the leakage rate of urban and rural pipeline networks has not significantly decreased. The production processes and key links in some industrial industries have severe water consumption, and the water consumption for industrial added value of 10000 yuan remains relatively high. The centralized sewage treatment rate in Hunan Province has been increasing year by year, but in some rural townships, it is difficult to carry out centralized sewage treatment due to the serious lag in infrastructure construction. Due to the lack of supporting sewage treatment facilities, some industrial parks have become concentrated areas for water environmental pollution discharge.

2.3 Limited effectiveness of ecological environment governance system

The construction of water ecological environment governance system lags behind and is difficult to effectively implement. Some existing laws and regulations in China and the water ecological environment to governance related, but the formulation departments and focus of these laws and regulations are different, making it difficult to implement and the relevant measures cannot be implemented in place [8]. Although the "river chief system" and "lake chief system" have begun to be fully implemented, a benign operating system has not yet been formed, and social awareness and acceptance urgently need to be improved. The investment of water ecological environment governance entities is seriously insufficient, and a comprehensive water ecological protection responsibility system has not yet been formed throughout the entire basin. There is no established standards and rules for water ecological environment governance, and there is a lack of guidance and institutional constraints in water ecological protection and restoration practices.

At present, the ecological compensation for the "one lake and four rivers" watershed in Hunan Province is mainly through government financial transfer payments, supplemented by market-oriented compensation methods [9]. Most regions are exploring and practicing market-oriented compensation. If the main body of ecological compensation in the watershed is single, the compensation responsibilities and rights are unclear, and the cost and benefit distribution of ecological services in the watershed are uneven, relying on the government compensation model for a long time will lead to a lack of stability in the implementation of ecological compensation in the watershed. The adoption of uniform standards for ecological compensation in river basins can easily lead to insufficient or excessive compensation for the object. The implementation of the ecological compensation system in river basins is not strong, and the efficiency of using compensation funds is relatively low. The investment and financing channels for ecological compensation are single, the compensation period is long and short, and the scope of compensation implementation is small. The level of ecological compensation investment in the four regions is relatively low, with a few regions receiving partial compensation funds from international agency grants, loans, and funded projects.

2.4 Weak foundation of watershed water ecological environment warning system

The ecological environment warning system for "one lake and four rivers" in Hunan Province is not sound, and there is a lack of regular monitoring and effectiveness evaluation for the impact of most implemented projects on the water ecological environment. The water ecological environment governance based on the watershed as a unit has not been given enough attention, and there is a lack of overall governance layout at the watershed scale. The current water ecological environment management only focuses on the centralized management of river water bodies, with insufficient emphasis on the protection and restoration of water ecosystem functions and aquatic habitats, and a lack of effective ecological protection and restoration measures. There is no integration of ecological protection and restoration with the management of ecological water consumption and water environment quality objectives. The warning and emergency mechanisms for water ecological environmental risks in the watershed are not perfect. Non key functional areas in the watershed are usually areas with high water ecological environmental risks, and it is difficult to cover these areas with existing watershed management capabilities. They do not yet have the ability to respond to sudden water ecological environmental risks in the entire watershed.

The emergency warning system for water ecological environment in key river basins is incomplete, and an effective risk warning platform has not been established yet. The monitoring methods for watershed water ecological environment are outdated, and the emergency response capacity is low, which cannot adapt to the situation of watershed water ecological environment governance. Some enterprises have not been able to effectively curb the problem of excessive pollution discharge in a timely manner. The layout of industrial parks along the Yangtze River is dense, and there are many

chemical production enterprises, especially in the upstream and midstream regions that undertake the potential transfer of polluting industries from downstream regions, increasing the risk of water environmental pollution.

2.5 Insufficient supervision of ecological environment governance

The responsibility for the management of water ecological environment in river basins is unclear, involving regions acting independently. Insufficient supervision in the implementation of watershed planning, lack of effective management methods, and inadequate regulatory responsibilities. The existing regulatory and law enforcement systems can't meet the actual needs of water ecological environment governance in the new situation, and to a certain extent, they still face challenges such as lower illegal costs and higher law enforcement costs, unable to publicly disclose water ecological safety information in real time, making it difficult to implement public supervision. The social participation mechanism is not sound, and the public's enthusiasm for participating in water ecological environment governance is not high. The investment in water ecological environment governance in the "one lake and four rivers" region of Hunan Province is higher than the compensation for ecological environment protection, which leads to the inability to exert the incentive effect of ecological compensation in the basin and guide the upstream areas of the basin to actively carry out ecological environment construction. The formulation of ecological compensation standards for river basins is disconnected from the arrangement of compensation implementation guarantee systems, and the operability of ecological compensation methods for river basins is weak. The four regions lack full supervision and performance evaluation in the practice of ecological compensation in river basins.

3. Sustainable development strategy of "one lake and four rivers" in Hunan Province

In response to the practical problem of ecological environment governance in Hunan Province's "one lake and four rivers", it is necessary to take stakeholders such as the government, enterprises, communities, and the public as the main body, carry out comprehensive water ecological environment governance, promote diversified investment from the whole society, and fully play the role of government leadership, market regulation, and participation from the whole society. Taking into account the endowment of water resources, market conditions, and ecological security, we will use administrative, technological, and economic means to improve the efficiency of ecological water use, strengthen the prevention and control of water environmental pollution, and enhance the modernization level of the water ecological environment governance system and governance capacity.

3.1 Building a collaborative governance mechanism for ecological environment

Hunan Province will improve its water ecological environment governance mechanism, break the fragmented management model, optimize the allocation of responsibilities among relevant departments, clarify their respective division of labor, promote departmental coordination and linkage, improve the joint law enforcement system for river and lake ecological environment governance between water affairs departments and relevant departments, compact the responsibilities of river and lake leaders, and fully leverage the role of river and lake leaders at all levels. Hunan Province has established the basic goal of "maintaining the health of rivers and lakes, promoting harmony between people and water", and has coordinated the protection of water ecology, flood control, hydropower generation, etc., correctly handling the relationship between water ecological water use and pollution prevention between upstream and downstream regions, rivers and lakes, and achieving a balance of regional rights and interests, as well as between collective and individual rights and interests.

Hunan Province effectively guarantees regional ecological water consumption and strictly controls the discharge of major water pollutants. Hunan Province improves water ecological functions and water environmental quality, effectively reducing the damage caused by excessive development and construction to the water ecosystem. Hunan Province has formulated a plan for controlling the discharge of wastewater pollutants in river basins, and implemented pollution reduction measures for key control units in river basins based on water environmental capacity and requirements for limiting the discharge of pollutants into rivers. Clarify the control scope of the upstream and downstream areas of the watershed, and develop a comprehensive management plan for water ecological protection and water environmental pollution prevention that combines the watershed with the region[10]. Hunan Province has optimized its industrial and product structure, adopted clean production processes, strictly prohibited the construction or expansion of heavily polluting industries, and stopped all production

activities near drinking water sources. For watershed development projects; we must implement a water-saving and emission reduction system, strictly control the increase of pollution sources, and prevent the degradation of the watershed ecosystem. Agriculture should prioritize low wastewater pollution load and high water and soil resource utilization rate as the main criteria for industry selection, and prevent and control agricultural non-point source pollution in river basins from the source; Industry has a significant impact on water resources and the water environment, so the proportion should not be too high. We should leverage the advantages of natural resources in the basin, choose green production enterprises, and support projects with low water consumption and pollution; the energy consumption and pollution load of the service industry are relatively small, and priority choices can be made based on regional factor endowments.

3.2 Improving the ecological environment governance system

Hunan Province continues to deepen the institutional arrangements for water ecological protection, restoration, and prevention and control of water environmental pollution, establish the functional positioning of watershed ecological space, effectively protect ecological land such as water sources, wetlands, and forests, improve the supply of watershed ecological products, and meet economic and social needs. Hunan Province reduces the consumption of natural resources, reduces the intensity of basin resource development, and ensures a continuous decrease in the discharge of water pollutants from production and daily life. Adhere to the ecological protection red line of the watershed, and clearly include drinking water source protection areas, wetland protection core areas, etc. within the ecological protection red line area of the watershed. Hunan Province strictly implements the management system of ecological protection red line areas, increases the protection of water sources, and prohibits the establishment of direct drainage outlets in the main stream of drinking water functional areas, effectively ensuring the safety of drinking water quality. Hunan Province has improved the environmental access system for river basin industries, and all industrial zones must achieve wastewater discharge standards. It is strictly prohibited to transfer outdated production capacity from downstream areas to upstream areas, and promote green transformation of regional industries. Hunan Province has achieved parallel development of river basin resources and ecological protection, and it is prohibited to blindly duplicate construction of similar projects. Pay attention to the collaboration between the upstream and downstream areas of the watershed, as well as the left and right bank areas, and strengthen water quality management in the buffer zone of the boundary. Strictly implement water pollutant discharge control standards, and resolutely refuse approval for construction projects that do not meet the requirements of clean production or do not meet the standards. Hunan Province will punish and rectify areas that have failed to achieve the goal of controlling the total amount of wastewater discharge and have not met the water quality standards of functional areas. Strengthen the standardized construction of industrial parks, and prohibit enterprises that cannot meet the emission standards from entering the park.

3.3 Guiding multiple subjects to participate in ecological environment governance

The government, enterprises, and the public need to jointly participate in water ecological environment governance, strengthen cooperation between government departments in the upstream and downstream regions of the river basin, improve the regional consultation system, sign multi-party agreements, clarify the specific tasks of all parties in water ecological environment governance, jointly bear the comprehensive costs of ecological protection and environmental governance in the river basin, strictly monitor the inlet and outlet of each administrative region, and ensure that the water supply and quality meet the standards. Increase investment in water ecological protection and water environmental pollution prevention and control, and promote the construction of urban and rural sewage pipelines. Strengthen the protection and restoration of watershed water ecosystems, improve water resource utilization efficiency, reduce water environmental pollution load, and minimize ecological environment damage to the greatest extent. For enterprises that adopt measures for ecological protection and environmental governance in river basins, tax exemptions and preferential loans can be implemented; Local governments that have achieved significant results in water environment governance can provide rewards and subsidies; Disciplinary punishment must be imposed on those who damage the ecological environment of the watershed. The development and utilization of watershed resources and those who suffer damage should at least bear the cost of water ecological environment governance, ensuring that the cost of water ecological environment damage is not lower than the cost of governance. Increase funding and policy support to cultivate a trading market for watershed ecological environment services. Carry out innovative practices in water ecological environment governance and promote the

marketization of water ecological environment governance services. While promoting the purchase of ecological and environmental protection services by the government, attention should be paid to the cooperation between government investment and social capital, and third parties should be encouraged to undertake the task of water ecological and environmental governance.

3.4 Implement ecological compensation for river basins

Clarify the responsibilities and authorities for ecological compensation in the upstream and downstream areas of the watershed based on the water quantity and quality requirements. If the water ecological protection and water environment governance in the upstream area meet the established requirements and can provide water sources that meet the water quantity and quality standards for the downstream area, then the downstream beneficiary area must provide ecological compensation for the upstream protection area. On the contrary, if the upstream region cannot provide qualified water sources as required, it will require the upstream region to bear corresponding responsibilities. At the same time, on the basis of increasing government financial transfer payments and special fund subsidies in the upstream and downstream regions of the basin, we advocate for market-oriented ecological compensation and establish a basin ecological compensation service platform.

Reasonably determine the scope of ecological compensation in the watershed. When the scope of ecological compensation is small, the number of ecological service providers is limited, and the beneficiary group of the watershed is clear, direct transactions can be made through the connection between the compensation subject and object. For situations where the watershed spans multiple regions and the scope of ecological compensation is large, public payment can be used to increase the proportion of ecological compensation in regional fiscal taxation. The government authorities in the upstream areas of the river basin should allocate the compensation funds obtained to the victims and protectors based on the degree of ecological damage and the weight of ecological protection contributions. At the same time, indirect compensation can also be implemented for the upstream areas of the river basin through methods such as tax reduction, policy incentives, and project support. The competent department of the watershed should assess the implementation progress of ecological compensation projects based on the standards for improving water quality and ensuring water quantity in the watershed, and analyze the changes in profits and losses before and after the implementation of ecological compensation policies in the upstream and downstream areas of the watershed.

3.5 Strengthen the regulation of ecological environment governance

Strengthen the dynamic monitoring of water quantity and water quality in key areas such as water ecological environment functional zones, boundary buffer zones, river discharge outlets, and drinking water sources, and carry out cross boundary water quality assessment and ecological water consumption dynamic supervision. Using satellite remote sensing, big data, and the Internet of Things to track and monitor the ecological flow of rivers and lakes, setting up water environment monitoring sections, and implementing unified supervision of water pollutants, water pollution sources, and water environment media. We will strengthen routine monitoring, fixed-point monitoring and real-time monitoring of the water ecological environment, and improve the coverage of water volume and water quality monitoring in the ecological functional areas of important rivers and lakes, the main rivers and the provincial boundaries of primary tributaries. Strengthen capacity building in monitoring, early warning, and emergency response of water ecological environment governance, improve the level of water ecological environment governance and supervision, form a complementary monitoring network between river basins, regions, and industries, and achieve monitoring information sharing.

4. Conclusion

In recent years, Hunan has deeply promoted the protection and governance of the "'one lake and four rivers"' system, making Hunan's contribution to protecting the mother river of the Yangtze River. In 2021, the excellent water quality rate of 147 national examination sections in Hunan Province reached 97.3%, an increase of 9 percentage points compared to 2017, ranking fourth in the country; Yongzhou, Zhangjiajie, and Huaihua cities have ranked among the top 30 in terms of surface water environmental quality in prefecture level cities nationwide, with a total quantity ranking among the top three in the country. In 2020 and 2021, the national and provincial examination sections of the Hunan section of the Yangtze River main stream and the four water main streams of Xiangzi, Yuan, and Li have all reached or exceeded Class II for two consecutive years. The total phosphorus concentration in

Dongting Lake will decrease by 13.7% in 2021 compared with that in 2017, especially in the west Dongting Lake, which will reach the Class III standard; from 2021 to 2022, there will be 404000 wintering waterbirds in Dongting Lake, and the number of winter migratory birds will break the historical record.

As a major agricultural province, populous province, and hometown of non-ferrous metals, Hunan must highlight precise, scientific, and legal pollution control, continue to deepen the protection and governance of the "one lake and four rivers" system, in order to demonstrate new responsibilities and achievements.

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