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The Current Situation and Development Strategies of China's River Chief System

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Abstract

The river chief system is a unique river management model in China It greatly reversed the long-term trend of ecological environment deterioration and provided Chinese cases and practices of ecological environment governance As an important ecological security barrier in the upper reaches of the Yangtze River and the most important water conservation area in the Chengdu Plain, Dujiangyan City has played an extremely important role in China's food security, economic development and social stability. Protect the water environment, manage water resources, and activate the water economy. In this study, one-on-one interviews were conducted with relevant personnel of Sichuan Dujiangyan Water Conservancy Development Center. The interview mainly aims to understand the implementation of the "river chief system" collaborative governance, the effectiveness of the evaluation system, the current operation status of the river chief office, the degree of digital technology application, the advantages and disadvantages of the existing river chief system, and suggestions for optimizing the river chief system work in the future. This study proposes several suggestions for the development of the river chief system, including increasing the proportion of voluntary policy tools, adopting different coordination strategies to promote work, highlighting the driving role of technological innovation and industrial upgrading, establishing effective incentive policies, increasing publicity efforts, and implementing digital river management.

Keywords: River Chief System, Water Management, River Pollution Control, Implementation Strategy

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1. Introduction

Water pollution is one of the most pressing environmental issues faced by countries around the world. The United Nations world water development report 2015 pointed out that two-thirds of the global population will face water scarcity by 2025. The deterioration of water environment not only affects the realization of sustainable development, but may also threaten human survival. For this reason, countries around the world have adopted different methods to control water pollution. European countries have centralized management model to control water pollution, but this model cannot achieve maximum social benefits (Li & Lu, 2020). Countries such as the United States and Canada adopt a comprehensive decentralized management model, delegating environmental power to each state. Although this has improved the efficiency of environmental regulation, there has been a phenomenon where some states take advantage of other states' water pollution control and do not take action (Zhou et al., 2021).

The river chief system is a unique river management model in China. River chiefs are led by local leaders, whose responsibilities include water resource protection, water pollution prevention and control, water environment improvement, water ecological restoration, and law enforcement supervision. The organizational form is a river chief system that runs through multiple levels such as provinces, cities, counties, and townships (Shi, 2024). In 2003, Changxing County in Huzhou City, Zhejiang Province took the lead in establishing the river chief system. In 2016, China issued the "Opinions on the Overall Implementation of the River Chief System". This marks the comprehensive implementation of the river chief system in China (Zhou et al., 2024). In 2017, Law of the People's Republic of China on Prevention and Control of Water Pollution first included the river chief system. At present, a four-level river chief system at the provincial, municipal, county, and township levels has been established nationwide, and the river chief system has achieved cross regional development. For example, in June 2019, Wujiang in Jiangsu, Tongxiang in Zhejiang, and Nanxun in Zhejiang jointly established the United River System. In September 2020, Wujiang in Jiangsu, Jiashan in Zhejiang, and Qingpu in Shanghai released and implemented the "Special Plan for Joint Protection of Key Cross border Water Bodies in the Yangtze River Delta Ecological Green Integration Development Demonstration Zone". The three regions implement a joint river chief system, including joint river patrols, joint cleaning, joint monitoring, joint law enforcement, and joint governance.

"Opinions on the Overall Implementation of the River Chief System" clearly states that according to the attributes of each watershed unit, different levels of government leaders are designated as corresponding river chiefs at all levels. In terms of cross departmental collaboration, the responsibility for water control will be delegated to river chiefs at all levels, who will take the lead in coordinating and resolving conflicts and contradictions between departments. In terms of cross regional cooperation, the higher-level river chief can be requested to provide administrative coordination. In terms of cross level governance, hierarchical control over the watershed can be achieved through vertical leadership responsibility chains and strengthened assessment and accountability. The river chief system involves various roles and tasks such as river chiefs, river chief offices, relevant administrative departments, and the general public. It is both an innovative work system and a complex work system. The river chief system has explored a new mode of water resource system governance in China, which greatly reverses the long-term trend of ecological environment deterioration, provides Chinese cases and practices of ecological environment governance, and is an original national governance innovation that demonstrates China's institutional advantages (Liu & Hu, 2023). Regarding the effectiveness of the river chief system, some studies have pointed out that it is limited to only increasing the concentration of dissolved oxygen in water. Secondly, the lag in the implementation effect of the river chief system policy and the inadequate implementation of the policy have led to the failure of the river chief system policy to improve water environment quality in the short term. In addition, although the river chief system can significantly reduce the degree of environmental pollution, it also has a short-term inhibitory effect on economic development (Ding & Sun, 2023). Therefore, the relevant strategies around the river chief system still need further improvement.

As an important ecological security barrier in the upper reaches of the Yangtze River and the most important water conservation area in the Chengdu Plain, Dujiangyan City spans the Minjiang River, Tuojiang River, and Jinjiang River basins. It is one of the "Three Heritage Cities" in the world with world natural heritage, world cultural heritage, and world irrigation project heritage. This also makes the development of Dujiangyan City always interweave with "water". China attaches great importance to Dujiangyan Irrigation Project Water Conservancy Project and continuously increases investment. After more than 70 years of hard work, Dujiangyan Irrigation Project irrigation area has reached the first in China (Zhou & Li, 2023). At the same time, Dujiangyan Irrigation Project Water Conservancy Project also plays a comprehensive role in urban water supply, flood control, ecological environment, power generation, tourism and other benefits. Dujiangyan City takes the river leader system as the cornerstone, coordinates the water ecology, water resources and water economy to serve the social development, and realizes the continuous improvement of the river bank appearance. Dujiangyan City has played an extremely important role in China's food security, economic development and social stability. Therefore, this study plans to conduct in-depth research around the current development status and problems of the river leader system in Dujiangyan Irrigation Project City, and put forward effective suggestions for the future river leader system to promote the development of water ecology, water resources, and water economy to serve the society.

2. Objectives

1. Deeply understand the current development status of the river chief system in Dujiangyan City, and dig out the main problems.
2. Propose effective strategies to improve the river chief system, in order to maximize its advantages and compensate for related shortcomings, ultimately promoting the sustainable development of water ecology, water resources, and water economy in serving society.

3. Literature Review

3.1 Current situation of river chief system in Dujiangyan Irrigation Project City

Dujiangyan City is located at the mountain exit of Minjiang River at the northwest edge of Chengdu Plain, with developed water system, including the main channel of Minjiang River mainstream, provincial channel, mountain stream channel, etc. In recent years, Dujiangyan City has taken the river system as a starting point,

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focused on water ecological control and water pollution prevention, promoted the continuous improvement of water quality in Dujiangyan Irrigation Project section of Minjiang River, Tuojiang River and Jinjiang River, and created a beautiful picture of harmony between people and water.

Dujiangyan City has set up municipal river leaders, town level river leaders, village level river superintendents, district river police officers, and river patrol team members to build a management system of "river superintendents + police chiefs + river guards" and jointly promote the comprehensive improvement of the river basin. "Since the overall implementation of the river director system in 2017, Dujiangyan Irrigation Project City has actively innovated the water eco-tourism inspection mode, and set up an eco-tourism inspection liaison office, becoming the first liaison office set up in the county level river director office in China, opening the curtain of coordinated promotion of the ecological environment management and protection of the" Minjiang River Water Source in the Yangtze River Basin ".

Dujiangyan City has continuously improved the informatization and intelligent management level of river courses and the performance level of river leaders, incorporated the river leader system management into target management, strengthened supervision, inspection, assessment and evaluation, improved the supervision and inspection mechanism, and engaged social supervisors to establish a joint acceptance inspection team to carry out inspection and evaluation. In addition, Dujiangyan City has continuously improved the system construction, formulated a series of documents such as the “Implementation Plan of Dujiangyan City for Comprehensive Water Ecological Treatment of Tuojiang River, Jinjiang River and Jinma River Basins”, “Work Plan of Dujiangyan City for Heavy Fist Water Control”, “Annual Key Work Points of Dujiangyan City's River Chief System Management”, and “Dujiangyan City Fully Implements the Action Plan for Primary River Chiefs to Perform Their Duties”, to provide institutional guarantee for water ecological management.

3.2 Main job responsibilities and achievements of the river chief

3.2.1 Protect the water environment and jointly draw a blueprint for safeguarding the ecology of rivers

1) Fulfill duties, fulfill responsibilities and take on responsibilities, and firmly guard the defense line of water ecological security

The river chiefs of Dujiangyan City are responsible for protecting and managing the rivers as the "guardian god" of the rivers. Following the principle of "County-level river chief in charge, town and village level river chief in charge of patrol", hundreds of river chiefs at the county, town and village levels will be dynamically optimized and set up. By 2023, nearly 300 problems will be discovered and solved during river patrols. Dujiangyan City Established a collaborative management and protection mechanism of "river patrolmen + river guards + folk river chiefs + community workers " to integrate civilian resources and leverage civilian power. More than More than 40000 community cadres, community workers, volunteers, the public, individual businessmen and other social forces work with the river chiefs to protect the water source of Dujiangyan City.

2) Neighborhood linkage forms a joint force to build a strong water environment safety barrier

Dujiangyan City has established and improved the linkage and coordination mechanism to realize the upstream and downstream linkage and the left and right banks co governance, so as to strengthen the water environment security barrier. Dujiangyan City and Aba Tibetan and Qiang Autonomous Prefecture jointly carried out emergency drills for ecological and environmental emergencies in Zipingpu Reservoir. Besides, Dujiangyan City signed a cooperation agreement on joint prevention, control and treatment to promote ecological management and protection of the river basin with the water management units of the irrigation area and the upstream and downstream districts and counties. On this basis, cross regional joint river patrols will be implemented. The comprehensive water quality index of Dujiangyan City has ranked first in Chengdu for a long time.

3) Linking ecological judicial forces to protect water environment security

Dujiangyan City has established a mechanism for linking administrative law enforcement and criminal justice in river management and protection, consisting of river chief, police chief, prosecutor, and judge. The procuratorate carries out ecotourism inspection in the mode of " Designated Resident Personnel + itinerant inspection". Through joint meetings, joint surveys, joint supervision, information sharing and other mechanisms, Dujiangyan City jointly promotes the implementation of watershed water ecological governance and protection of the river director system management, and contribute judicial power to the sustainable economic and social development of Dujiangyan City.

4) Protecting water sources and intercepting pollution to improve water quality and ecological environment

Dujiangyan City has accelerated the construction of projects such as the improvement of water supply and drainage systems and the enhancement of urban and rural drinking water safety. Dujiangyan City completed the survey, inspection, disease control, and partial reconstruction and repair of the municipal drainage network. The scale of domestic sewage treatment in the city has nearly doubled.

3.2.2 Manage water resources well and efficiently utilize them to benefit millions of people

1) Building a safe and beneficial urban and rural water supply system, taking multiple measures to conserve water sources

Dujiangyan City implemented the urban and rural drinking water safety improvement project, continuously improve the quality and efficiency of household waste disposal, implement precise strategies in different fields and industries, and maximize the benefits of every drop of water. Dujiangyan City has guaranteed irrigation area of more than ten million mu, providing all-round water services for the life, production and ecology of more than 28 million people. The water quality of Dujiangyan Irrigation Project section of Minjiang River basin continues to maintain Class II water quality, and the rate of reaching the standard of excellent water body is 100%. In 2023, the penetration rate of tap water in rural areas of Dujiangyan Irrigation Project City has been greatly improved.

2) Connect irrigation canal systems and build high standard farmland

Dujiangyan City implements accurate water resource allocation, effectively improving canal system irrigation assurance rate and effective utilization rate of farmland irrigation water (Chen, 2021). By improving irrigation surface, Dujiangyan Irrigation Project City has built a 10000 mu modern grain economy complex industrial park and completed the construction of 10000 mu high standard

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farmland, which presents the grand scene of irrigation area with prosperous agricultural industry.

3.2.3 Activate the water economy and inject new energy into the development of water conservancy

1) Developing smart water conservancy to achieve precise control of the 'smart brain'

Dujiangyan City vigorously develops smart water conservancy system (Cai & Xiang, 2022). It has built a whole basin intelligent supervision system, integrated and optimized the drinking water source supervision system, the whole basin monitoring system, and the IOT perception system. Dujiangyan City has established a comprehensive and multi-level water quality monitoring network system for the entire basin.

2) Inheriting the ancient weir civilization and creating a water culture "Tianfu International Reception Hall"

Dujiangyan City takes the river chief system as the starting point and links with the river leaders of Dujiangyan Irrigation Project Irrigation District to promote the construction of the water culture museum for inheriting the ancient weir civilization and leading the modern water conservancy. The annual Water Release Festival in Dujiangyan City has attracted many foreign envoys in China and media reporters to visit Dujiangyan Irrigation Project Scenic Area. Dujiangyan City has already possessed the name card of the international reception hall leading the water culture and civilization, which shows cross-border, cross language and cross cultural exchanges and integration (Hu, 2020)

3) Exploit tourism resources and build Dujiangyan Irrigation Project high-quality water conservancy scenic spot

Dujiangyan City helps to build Dujiangyan Irrigation Project high-quality water conservancy scenic spot with the river leader system. Relying on Dujiangyan Irrigation Project water conservancy project scenic resources, it gives full play to the role of river scenic spots in water conservation and ecological protection, and promotes the healthy and sustainable development of river scenic spots. The city develops tour guides in the scenic spot to become the "tour leader" of Dujiangyan Irrigation Project Water Conservancy Scenic Area, and promotes the world heritage and Dujiangyan Irrigation Project water culture to tourists around the world. In 2023, Dujiangyan City received over 28 million tourists.

3.3 Main assessment contents of the river chief system

The assessment of river systems in most regions of China is carried out centrally at the end of the year, including local self-assessment and on-site review. Some regions have also conducted quarterly and monthly assessments, and the results of quarterly or monthly assessments are included in the year-end assessment according to certain weights. The state explicitly requires that the assessment results of the river system should serve as an important basis for the comprehensive assessment and evaluation of local leaders and cadres. The main assessment contents of the river chief system can be summarized into four aspects: the progress of work organization, the performance of the river chief and relevant department, the completion of target tasks, and the health status of the river. The promotion of work organization and the performance of river chief duties reflect the process of river chief system work, while the completion of target tasks and the health status of the river reflect the effectiveness of river chief system work (Chen et al., 2022).

3.3.1 The progress of work organization

The promotion of work organization is mainly carried out by the deployment of the general river chief and the leadership of the river chief's office. The specific work and assessment content can be subdivided into the daily work of the general river chief's work deployment, organizational system construction, institutional system construction, supervision and inspection, assessment and evaluation, commendation and incentive, publicity and training, innovation demonstration, and guiding public participation, as well as the basic work of information construction and application, one river one file construction, one river one policy (Liang, 2025), shoreline planning, and river health evaluation.

3.3.2 The performance of river chief and relevant department

The assessment of river chiefs' performance is currently included in the assessment indicators for local governments, but most of the assessment indicators only involve work-related indicators such as river and lake patrols, meetings held, and problem rectification. There is a lack of detailed examination and verification of the key points and effectiveness of river chiefs' personal performance

3.3.3 The completion of target tasks

This section mainly evaluates and scores the completion rate of specific target tasks such as water resource protection, water area shoreline management and protection, water pollution prevention and control, water environment governance, water ecological restoration, law enforcement supervision, etc., as well as other target tasks such as water and drought disaster prevention, water conservancy project risk elimination and reinforcement, which are included in the national river chief system documents.

3.3.4 Health status of rivers

The evaluation of river health status should not only include the health status of rivers, but also the maintenance of river health. It is possible to evaluate the health status of specific rivers and assess the personal performance of river chiefs, as well as to reflect the effectiveness of the local government's river chief system by evaluating the overall health status of regional rivers. The current river health assessment conducted in most regions has not yet been integrated with the assessment work. We should strengthen the application of river health assessment in the performance evaluation of river chiefs and the effectiveness evaluation of local party committees and governments' river management work, and introduce public evaluation opinions. Specific indicators include water quality compliance, water quality improvement, comparison of upstream and downstream water quality, daily cleaning of embankment water surface, maintenance of coastal facilities, setting of river discharge outlets, treatment of illegal activities related to rivers, garbage cleaning, treatment of shoreline encroachment, compliance of sewage treatment plant discharge, and illegal discharge to urban drainage facilities.

In addition, guiding the public to evaluate the health status of rivers is of great significance (Zong, 2024). In public satisfaction surveys, emphasis should be placed on the evaluation of the health status and management of specific rivers or rivers in the region by the general public. Evaluation indicators that are easy to answer and reflect the effectiveness of river chiefs' duties and river management work should be designed, such as whether the water is clear, whether the color and odor are normal, whether there are floating objects on the water surface, whether there is garbage on the riverbank, and whether there is disorderly discharge of sewage.

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3.4 General problems with the river chief system

3.4.1 Insufficient assessment and incentive effects

Due to the low weight proportion of assessment scores in the river chief system, the results of the river chief system have weak binding force on the member units and counties of the river chief system, and have not played a true role in supervising and assessing. Local governments provide certain subsidies to grassroots river patrol officers based on their financial situation, but their income is still very low. The efforts and rewards of grassroots river patrol officers are not proportional, resulting in low work enthusiasm, initiative, and collaboration, and poor guarantee of work quality and effectiveness. In the future, it is urgent to use economic incentives to increase its enthusiasm for environmental protection.

3.4.2 The authority of the river chief system office is insufficient

The main responsibility of the River Chief System Office is to provide river services for river chiefs at all levels to patrol, inquire about, and manage rivers. At the same time, it coordinates and coordinates various river related departments to carry out river management and protection work. Its tasks are very heavy and require a permanent institution to ensure the operation of daily work. However, the fact that river chiefs at all levels are concurrently held by the top leaders of the units has led to problems such as insufficient professionalism and execution, posing a huge challenge to the operation of the river chief system (Gao, 2019). At the same time, the administrative level of the River Chief System Office is on par with other units involved in collaborative governance, so the power and coordination ability of the "River Chief Office" are limited, and its authority is insufficient, resulting in limited constraints on other departments.

3.4.3 Mismatch of responsibilities among participating departments

In the process of implementing collaborative governance in river basins, each participating department is under the leadership of both higher-level departments and river chiefs at all levels. When the two agree, they can form a working force to better promote collaborative governance; But when there is disagreement, lower level executors will be troubled by the different opinions of multiple leaders, which will affect the implementation of the river chief system. In addition, the work of the river chief system is a responsibility system, mainly involving departments such as water affairs, agriculture and rural areas, ecological environment protection, natural resources, transportation, and housing construction. During the implementation process, none of the departments are willing to take the lead, and the collaborative role of the departments has not been fully utilized (Yao et al., 2024).

3.4.4 The synergy and integration of technology empowerment have limitations

Technological empowerment is an effective means of carrying out collaborative river management work and is widely applied in practice. Among them, advanced technologies such as big data and cloud platforms can better promote information sharing and online coordination among departments and units. At present, the operation of these technological means has become a mainstream trend. However, there are still certain technological barriers to digital empowerment in river and lake management. For example, relying mainly on embedded sensors or manual sampling for water quality monitoring has not yet solved the problem of using satellite and unmanned aerial vehicle equipment to monitor and analyze water quality, making it difficult to achieve full coverage of cross-sectional water quality monitoring (Li & Zhou, 2023). Due to the significant reliance on public financial resources for the construction of digital infrastructure, the uneven distribution of financial resources across regions has also greatly contributed to the digital empowerment gap in local ecological governance. In addition, digital technology is difficult to overcome the dilemma of deep level collaborative governance. Due to departmental interests, professional barriers, and division of authority, the role of digital technology in organizational collaboration still largely remains at the level of task decomposition.

4. Methodology & Result

In order to deeply explore the implementation of the "river leader system" in Dujiangyan City, this study conducted a one-on-one interview with relevant personnel of Sichuan Dujiangyan Water Conservancy Development Center. The interview mainly aims to understand the implementation of the "river chief system" collaborative governance, the effectiveness of the evaluation system, the current operation status of the river chief office, the degree of digital technology application, the advantages and disadvantages of the existing river chief system, and suggestions for optimizing the "river chief system" work in the future, providing a practical basis for the analysis of the next problems and reasons.

4.1 What are the existing problems of river in Dujiangyan City? Why does Dujiangyan City need to implement the river leader system? What problems can River Chief System solve?

In the process of urban expansion and rapid economic development, rivers in Dujiangyan City are threatened by non-point source pollution, illegal sewage discharge, river occupation and sand mining damage, and cross regional and multi sectoral supervision is difficult to coordinate. By implementing the river chief system, the responsibility for river management can be delegated to party and government officials at all levels, and a regular inspection and law enforcement mechanism can be established to promptly curb illegal activities; Simultaneously promoting comprehensive measures such as water quality monitoring, sewage treatment, and shoreline ecological restoration, gradually improving the river environment and ecosystem. This will not only maintain the traditional functions of Dujiangyan Irrigation Project in flood control and irrigation, but also enhance its cultural tourism value and realize the sustainable development of economy, society and ecological environment.

4.2 For the implementation of "River Leader System" in Dujiangyan City

The "River Chief System" in Dujiangyan City is well carried out. The establishment of river chiefs at all levels is relatively complete and not entirely based on administrative divisions。

4.3 For the effect of river patrol at the basic level of Dujiangyan City

The effect of river patrol during flood season is better than that during dry season, but the effect of river patrol during dry season needs to be improved

4.4 For the cooperation of all departments in Dujiangyan City with the work related to the "River Chief System"

The cooperation among various departments is good, which has formed a relatively complete collaborative governance mechanism

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and reflects the concept of "ecological priority and green development".

4.5 For the public participation and publicity in Dujiangyan Irrigation Project's "River Chief System"

The level of public participation and publicity efforts need to be strengthened.

4.6 Is there a folk river leader system in Dujiangyan Irrigation Project? If so, what is the operation mechanism and current situation of the Dujiangyan Irrigation Project folk river leader system? What is the interaction and relationship between the folk river leader system and the official river leader system in Dujiangyan Irrigation Project?

In Dujiangyan City, the folk river leader system is mainly carried out by social organizations, community residents, etc. spontaneously or in collaboration with the government. Through voluntary river patrol, problem feedback and science popularization, it makes up for the shortcomings of the official river leader system in daily supervision and cross regional governance. Its operation usually relies on regular inspections and online and offline information sharing. If illegal pollution discharge or shoreline encroachment is found, it will promptly communicate with the official river chief or functional departments. The official river leader system has the advantages of administrative law enforcement and resource allocation, while the private river leader system plays the role of "social supervision" and "grass root sentry". Through normal communication and coordinated disposal, the two sides form complementary governance of the river environment and jointly promote the sustainable development of Dujiangyan Irrigation Project's water ecology.

4.7 Is the division of responsibilities of each unit or department in Dujiangyan City's "River Chief System" collaborative governance clear?

Dujiangyan City has effectively promoted the development of river and lake governance by clarifying the division of responsibilities, strengthening communication and coordination, and implementing regulatory measures in the "River Chief System". Through the "Regulations on the System of River and Lake Chiefs" and related documents, the responsibilities of river chiefs at all levels and relevant departments have been clarified. The responsibilities of grassroots river chiefs (township level river chiefs) mainly include: organizing and implementing daily inspections of responsible rivers and lakes, timely discovering and reporting problems; Coordinate and handle specific issues in river and lake management, supervise village level river chiefs and relevant units to implement governance tasks; Supervise the water quality, sewage outlets, and garbage cleaning of rivers and lakes within the jurisdiction to ensure a clean and tidy environment.

Dujiangyan City has taken a number of measures in water pollution control to ensure that supervision is in place: implement the "1000 village demonstration project" for rural domestic sewage treatment, and promote the treatment of black and odorous water bodies in rural areas; Strengthen the supervision of river discharge outlets, strictly control pollutant emissions, and ensure that water quality meets standards; Promote the application of the joint supervision and service information system for ship water pollutants, and strengthen pollution prevention and control at ports and terminals. The focus of the river and lake chief system work includes promoting the construction of ecological protection compensation mechanisms across provinces and cities. Strengthen rural water environment governance and enhance grassroots river and lake management and protection capabilities. Continuously consolidating the achievements of meeting water quality standards and promoting green development in the basin. Implement the "One River (Lake), One Policy" plan to solve prominent problems in rivers and lakes.

Dujiangyan City has established a relatively complete communication and coordination mechanism: regular scheduling meetings, information sharing platform and supervision and assessment mechanism. When communication is not smooth, the following measures are usually taken: (1) Strengthen coordination: the river chief system office or the superior river chief will take the lead in coordinating, clarifying the responsibilities of all parties, and promoting problem resolution. (2) Establish a linkage mechanism: Ensure smooth information flow and collaborative governance through cross regional and cross departmental joint prevention and control mechanisms. (3) Strengthen training: Provide training to grassroots river chiefs and related personnel to enhance their business skills and communication and coordination abilities.

4.8 For the specific requirements of Dujiangyan City's "River Chief System" collaborative governance

The coordination mechanism of units and departments at all levels is relatively complete, including vertical collaboration between superiors and subordinates, as well as horizontal collaboration between different departments at the same level.

4.9 What are the specific responsibilities and work communication modes of Sichuan Dujiangyan Water Conservancy Development Center and other water conservancy departments regarding the river leader system?

Sichuan Dujiangyan Water Conservancy Development Center is mainly responsible for the daily operation and maintenance and technical management of Dujiangyan Irrigation Project water conservancy project in the river director system, including irrigation area dispatching, flood control security, water quality monitoring and other specific work, and cooperate with the local government to implement the relevant measures of the river director system; The provincial water resources department at the higher level formulated policies and regulations on water resources management and river director system implementation from the macro level, coordinated cross regional water affairs planning, supervision and assessment, assigned tasks to Sichuan Dujiangyan Water Conservancy Development Center and provided technical, financial and administrative support; Subordinate water conservancy units (such as hydrometric stations at all levels, irrigation canal management offices, etc.) are responsible for front-line monitoring, maintenance and law enforcement assistance, and feed back the patrol and technical data to Sichuan Dujiangyan Water Conservancy Development Center and Sichuan Provincial Water Resources Department. The three parties form a working mode of linkage from top to bottom through regular working meetings, scheme approval, information exchange and joint law enforcement: the Provincial Water Resources Department is responsible for top-level design and comprehensive management, Sichuan Dujiangyan Water Conservancy Development Center is responsible for overall coordination and implementation, and subordinate units are responsible for grass-roots inspection and

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operation maintenance, so as to jointly promote the safe operation and ecological protection of river and irrigation area in Dujiangyan City.

4.10 For the main contents of the evaluation system for Dujiangyan City's "River Chief System"

The evaluation system of the "River Chief System" mainly focuses on the performance of river chiefs, the construction of institutional systems, and the effectiveness of river management and protection. The assessment methods include self-examination and self-evaluation, organizational assessment, third-party evaluation, etc. At the same time, the application of assessment results is strengthened to promote the implementation of the river chief system.

4.11 Do you think the current evaluation criteria of the 'river chief system' have a promoting effect on the implementation of work? Can we motivate the participants' enthusiasm? Is it fair and reasonable? Have rewards and punishments been fulfilled?

The current "river chief system" evaluation system has achieved certain results in promoting work implementation, mobilizing participants' enthusiasm, fairness and rationality, and rewarding and punishing. However, there are also some areas that need further optimization.

4.12 Do you think it is reasonable to establish the 'River Chief Office' in existing units/departments? What is the authority of its work?

At present, the river chief office is usually established in the water conservancy department or the ecological environment department, which has its rationality: (1) Professionalism and synergy: The water conservancy and ecological environment departments themselves have professional capabilities in water resource management and water pollution prevention, and can provide technical support for the office of the river chief. (2) Resource integration: By integrating existing departmental resources, duplicate construction is avoided and work efficiency is improved. (3) Cross departmental collaboration: The River Chief's Office can break down departmental barriers and coordinate multiple water related departments (such as water conservancy, environmental protection, agriculture, housing construction, etc.) to jointly promote river and lake governance.

However, this setup also has some limitations: (1) Limited power: As a coordinating agency, the power of the River Chief Office mainly comes from the authorization of the river chief, and it lacks independent law enforcement and decision-making power. (2) Level difference: In some places, the river chief's office has a lower level, which may affect its authority in cross regional and cross departmental coordination.

The authority of the River Chief Office in carrying out its work faces some challenges: (1) Departmental cooperation: In practical work, the River Chief Office needs to coordinate multiple departments, but these departments may have inconsistent cooperation during the execution process. (2) Limited resource allocation capability: The River Chief's Office may rely on the support of higher-level departments in resource allocation, and its own resources are limited.

There is indeed a problem of inconsistent rights and responsibilities in the actual work of the River Chief Office and related departments, mainly reflected in the following aspects: (1) Insufficient law enforcement power: The River Chief Office itself lacks independent law enforcement power and needs to rely on the law enforcement forces of water conservancy, environmental protection and other departments. (2) Separation of assessment and execution: The river chief's office is responsible for assessment, but the department responsible for specific tasks may not provide timely feedback on the assessment results or execute them properly. Difficulty in cross regional coordination: In cross regional river and lake governance, the coordination ability of the river chief's office may be limited by administrative divisions and departmental interests. (3) Cross departmental responsibilities: Different departments have overlapping responsibilities in water resource protection, water pollution prevention and control, which can easily lead to buck passing.

4.13 Do you think there are any corresponding problems in the implementation plan of collaborative water pollution control? If so, what are its specific manifestations?

There are indeed some problems in the implementation plan of collaborative water pollution control, which are mainly reflected in the following aspects:

1) **Institutional dilemma and insufficient departmental collaboration:** Water pollution control involves multiple administrative entities and departments, but there are functional divisions and goal differences between different departments, leading to institutional dilemmas in collaborative governance. For example, the cooperation strength between the Ministry of Ecology and Environment and other ministries is weak, and the number of joint publications is limited. In most cases, water pollution control policies are issued separately by the Ministry of Ecology and Environment. This departmentalization problem leads to insufficient synergy between policy tools, which affects governance efficiency.
2) **Cross regional coordination is difficult**: water pollution has mobility, and cross-border water pollution issues are particularly prominent. However, the division of administrative divisions makes it difficult for regional governments to coordinate the division of powers, resulting in insufficient effectiveness of collaborative governance mechanisms. For example, although the Yangtze River Delta region is gradually improving the cross-border water pollution joint prevention and control mechanism, it still faces problems such as high governance costs, unclear responsibility subjects, and imperfect emergency mechanisms. In addition, the authority of watershed management agencies is limited, making it difficult to coordinate the economic development and pollution control of various local governments.
3) **Imperfect information sharing mechanism**: Information asymmetry is an important factor restricting collaborative governance. In cross-border water pollution control, the lack of effective information communication mechanisms between upstream and downstream regions leads to resource waste and redundant construction. For example, the upstream region failed to promptly report the pollution situation to the downstream region, and the downstream region lacked supervision over the protection of water resources in the upstream, which affected the effectiveness of joint prevention and control.

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In addition, the information communication platform between the government and the public urgently needs to be improved, making it difficult for the public to implement effective supervision.

4) **Lack of synergy among policy tools:** Water pollution control policy tools mainly include regulatory, market-based, and voluntary tools, but in practice, the synergy between these tools is insufficient. For example, although regulatory policy tools have a strong impact on water pollution control, the role of market-based and voluntary tools has not been fully utilized, resulting in poor synergistic governance effects of policy tool combinations.

5) **Insufficient public participation and social supervision**: Collaborative governance requires the joint participation of the government, enterprises, social organizations, and the public, but the current mechanisms for public participation and social supervision are still incomplete. For example, in the water pollution control of S city in Heilongjiang province, although emphasis is placed on the collaboration between the government, enterprises, and social organizations, the channels and mechanisms for public participation still need to be further optimized.

6) **Inconsistent legislation and standards**: The lag in legislative work and inconsistent standards also constrain the effectiveness of collaborative governance. For example, there are differences in legislation and standards for water pollution control in different regions, which makes it difficult to form a unified action plan for cross regional governance.

4.14 How do you think about the application of digital technology in collaborative river management? What are the achievements of digitalization/artificial intelligence applications?

In recent years, significant progress has been made in the application of digital technology for collaborative river management, especially driven by cutting-edge technologies such as digital twin technology, artificial intelligence, and satellite remote sensing. The level of digitalization and intelligence in river management has improved.

4.15 What do you think are the benefits of the "River Chief System"? What are the shortcomings?

The river chief system has achieved significant results in clarifying the responsible parties, improving governance efficiency, and promoting public participation, but it also faces problems such as inadequate implementation of responsibilities, insufficient regulatory capacity, and low level of specialization

4.16 What suggestions do you have for effectively promoting and optimizing the future "River Chief System" work?

To effectively promote and optimize the future "river chief system" work, improvements can be made in the following aspects:

1) Strengthen the implementation of responsibilities and assessment mechanisms

Consolidate the responsibilities of river and lake chiefs: further clarify the responsibilities of river and lake chiefs at all levels, ensuring full coverage and no blind spots of the river and lake chief system.

Improve assessment and incentive mechanisms: Implement differentiated performance evaluation and assessment based on the actual situation of different rivers and lakes, and take the audit results and rectification of natural resource assets of leading cadres as important references.

Strengthen accountability mechanism: Hold river and lake chiefs accountable for their inadequate performance, ensuring that responsibilities are fully implemented.

2) Enhance public participation

Raise public awareness: Utilize various media forms such as essay contests, knowledge competitions, and cultural performances to strengthen the promotion of the river chief system and enhance public awareness and understanding of the river chief system.

Smooth participation channels: Establish and improve public participation platforms, clarify the requirements and procedures for public participation, and ensure effective communication between public opinions and decisions.

Innovative participation mode: Promote incentive mechanisms such as "ecological green coins" to encourage the public to actively participate in river and lake governance.

3) Improve collaborative governance mechanism

Strengthen departmental linkage: Improve the work pattern of Party committee leadership, government responsibility, water resources leadership, departmental linkage, and public participation, and establish a sound horizontal linkage mechanism.

Deepen the "River Chief+" model: promote mechanisms such as "River Chief + Prosecutor General" and "River Chief + Police Chief", and utilize the power of procuratorial and public security organs to crack down on illegal and irregular activities related to rivers and lakes.

Strengthen regional collaboration: Improve watershed coordination and regional collaboration mechanisms, promote joint governance of upstream and downstream, left and right banks, and main and tributary rivers.

4) Strengthen capacity building

Enhance the level of specialization: strengthen the capacity building of river chiefs' offices, enrich personnel strength, and improve the performance ability of grassroots river and lake chiefs.

Strengthen digital empowerment: promote the "river length + Internet" model, and use digital technology to improve the modern level of river and lake management.

Improve basic work: Accelerate the revision and legislative process of relevant laws and regulations, and provide solid legal protection for the river and lake chief system.

5) Optimize the setting and operation of the river chief's office

Upgrade the specifications of the river chief office: Regions with conditions can upgrade the setting specifications of the river chief office to enhance its overall coordination ability.

Improve the performance evaluation system: Establish a system for reporting and evaluating the performance of member units in the river chief's office, and regularly inspect and evaluate the implementation of work.

6) Promote the systematization of river and lake governance

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Adhere to systematic governance: Starting from the overall and systemic nature of rivers, promote the integrated protection and systematic governance of mountains, waters, forests, fields, lakes, grasses, and sands.

Strengthen ecological restoration: Increase investment in river and lake ecological restoration, enhance the diversity, stability, and sustainability of river and lake ecosystems.

7) Strengthen funding support

Build a diversified investment mechanism: Strengthen the financial support for the work related to the river and lake chief system, especially the financial support for the construction of happy rivers and lakes.

5. Discussion

The river chief system is a water resource system governance policy with distinct Chinese characteristics, which is different from the centralized governance model of the United States federal government and the decentralized governance approach of Europe. To address the relevant issues, the following measures can be taken to make up for them.

5.1 Increase the proportion of voluntary policy tools used. In the river chief governance system, different types of policy tools represent the three forces of government, market, and society, each with its own advantages and disadvantages. Among them, voluntary policy tools are ways to guide, promote, and educate individuals such as families, communities, and volunteer organizations to freely express themselves. At present, the use of voluntary policy tools under the river chief system is still relatively limited, and can only exert systematic governance effects in areas with less external pressure on the water resources system. The proportion of voluntary policy tools should be appropriately increased, and new media and other channels can be used to actively promote and educate, enhance public awareness of water management culture, regularly hold water management public welfare activities, expand diversified ways of participating in water management, encourage the development of action plans for "private river chiefs" to participate in local river chief systems, and affirm the public's decision-making power in water management (Du & Deng, 2024).

5.2 Adopt different coordination strategies to advance the work. The overall coordination strategies adopted by the river chief's office can be divided into four types: conventional coordination, relational coordination, leveraging coordination, and creating momentum coordination. Conventional coordination refers to the use of formal governance resources owned by the river chief's office to coordinate water related units, mainly including issuing supervision notices and convening joint meetings. Relationship based coordination refers to the use of informal governance resources owned by the river chief's office to coordinate water related units, mainly manifested in the use of interpersonal relationships for persuasion and cooperation. Borrowing coordination refers to the coordination of water related units by the river chief's office using formal governance resources owned by entities other than the deliberation and coordination body. This mainly includes two forms: leveraging the authority of the river chief and leveraging strong departments. Campaign oriented coordination refers to the coordination of water related units by the river chief's office using informal governance resources owned by entities other than the deliberation and coordination body, mainly manifested in the use of news media to create public opinion and influence organizational reputation. Starting from the complexity and urgency of river affairs, adopt corresponding coordination strategies to promote work (Lv & Zhao, 2024).

5.3 Support the development of water conservancy technology and highlight the driving role of technological innovation. Moderate scale of water conservancy engineering construction is necessary to improve the effectiveness of water resource system governance. It can establish a connection with national science and technology innovation policies, comply with the wave of vigorously developing science and technology in the country, provide innovation platforms and financial support for water conservancy talents (Fan et al., 2024), encourage the development of high clean, low pollution, and high-efficiency water conservancy technologies, gradually improve the water conservancy technology updates of existing water conservancy projects, and scientifically control the construction scale of water conservancy projects within an appropriate range. At the same time, technological progress and structural upgrading are important transmission paths for the river chief system to promote economic green transformation. Therefore, on the one hand, efforts should be made to promote the development of innovative technologies towards green and ecological directions, integrate resources, and adopt various measures to enhance regional green technology innovation capabilities. One is to strengthen policy support for green technology innovation, and create a favorable green innovation environment through policies such as innovation subsidies, tax reductions, and talent introduction; The second is to guide financial institutions such as securities and insurance to actively participate in green technology innovation and provide sufficient financial support for green technology innovation. On the other hand, we will focus on promoting the optimization and upgrading of industrial structure. One is to promote the development of traditional industries towards high-tech, low-energy intensive industries. The second is to actively cultivate clean industries and stimulate the vitality of emerging industries.

5.4 Establish effective incentive policies and strengthen the governance responsibility of officials. Incentive policies can have a positive impact on the effectiveness of the river chief system policy, that is, compared to official incentives aimed at economic growth, strengthening ecological accountability in official assessments can better enhance the environmental governance efficiency of the river chief system (Zhang et al., 2024). Further increase the proportion of environmental indicators in the performance evaluation of local officials, in order to enhance their attention to environmental governance in their jurisdiction and promote the institutionalization and normalization of

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environmental governance performance evaluation. Strengthen the continuing education level of current local officials to enhance their credibility in governance. In the selection and appointment of local officials, we actively explore and cultivate outstanding young cadres, build a high-quality and professional team of young cadres, improve the scientific decision-making ability of leading cadres, promote the ecological development of regional economy, and improve the quality of economic development.

5.5 **Intensify publicity efforts and broaden participation channels.** Provide multiple channels for public participation, empower and empower the public, fully leverage their supervisory role in river and lake environmental governance, lower the threshold for public participation, improve the level of public participation, and truly incorporate public participation into the environmental governance system. Intensify information disclosure efforts and enhance social collaboration capabilities (Chen et al., 2021). In combination with the historical scenic spots of Dujiangyan Irrigation Project Canal Head Hub, it needs to be further explored and enriched the water supply, food production, ecological environment improvement and other contents closely related to the life and production of the masses, take the form that is popular and acceptable to the masses, and increase publicity through the Internet, streaming media, short video and other ways to enhance Dujiangyan City's popularity and identity in the whole society.

5.6 **Realize digital river management, reshape and interact cross regional subject relationships.** The digital economy is fundamentally changing the way humans produce, live, and organize society, and digitization is profoundly changing river governance, which is the main content of building smart and happy rivers (Wang&Cao 2024). The digital river can use satellite remote sensing, artificial intelligence, edge computing, machine learning, webGIS UAV, etc. to realize the sky earth integration of river flu knowledge network, so as to achieve real-time monitoring, scientific perception, accurate prediction of rivers and their basins, build digital twin rivers and digital twin basins, and make information available, visible on the scene, command accessible, operation controllable, accurate and reliable. The digital river will also greatly enrich the river length information system and river governance level. By transcending administrative boundaries and geographical divisions, the cross-border joint river chief system digital management system should comprehensively cover water resources, water environment, water ecology, and other situations in the basin, achieving real-time sharing of information such as water level, water quality, hydrology, etc., and addressing river pollution problems in a targeted manner. In addition, through tools such as the joint river chief performance platform, online consultation platform, and information sharing platform, Xin has linked the disposal of automatic monitoring data and manual monitoring data, breaking the limitations of geographical scope, standardizing the performance process of joint river chiefs at all levels, and achieving the exchange of cross regional river water environment information. The positive impact of digital literacy on the implementation of river chief policies should be taken seriously, and relevant departments should carry out precise skill operation training, thinking training, etc., to comprehensively enhance the digital literacy of river chiefs (Pan et al., 2025).

6. Conclusion & Recommendation

The comprehensive implementation of the river chief system is an inherent requirement for implementing the concept of green development and promoting the construction of ecological civilization. It is an effective measure to solve China's complex water problems and maintain the healthy life of rivers and lakes. It is also an institutional innovation to improve the water governance system and ensure national water security (Gao & Chen, 2024). Administrative divisions have boundaries, but rivers have no boundaries. For cross regional rivers, where the upstream and downstream, as well as the left and right banks, share a clear stream, it is necessary to rely on the "river chief system" and "cross-border" cooperation to achieve common problems, common goals, synchronized work, and shared achievements. The work of the river chief system involves connecting multiple district level responsible units for rivers, reservoirs, and the district river chief office within the entire district. At the same time, it also has to undertake the supervision of towns and streets, as well as other administrative work. The workload is large and the requirements are high. If the river chief office is not a permanent institution, it is not convenient for external connection and work supervision and guidance. According to the establishment of the river chief system work organization by the Water Resources Bureau, a dedicated river chief system work organization should be set up, with corresponding staff, to enhance the work force of the river chief system. Further clarify the "four lists" of river chief system staff, responsibility list, work list, and river area list, and explore the standardization, normalization, and process management of river chief system. Explore the establishment of five major mechanisms, including cross regional regular communication, joint river patrols, information sharing, joint meetings, and joint law enforcement, to strengthen the coordination and linkage among cross regional river chiefs (Lang et al., 2022). The upstream of the river reservoir should strengthen the inspection of the river sections within their respective jurisdictions, investigate the discharge outlets, and enhance the interception and treatment of pollution. Strengthen upstream and downstream water quality monitoring and early warning, promote coordinated planning of cross regional river chief system, and improve the level of river governance and protection. Timely organize the mid-term evaluation of the "One River, One Strategy" and adjust the goals and tasks of river reservoir protection in a timely manner. Due to the large amount of assessment content and workload under the river chief system, in order to improve the efficiency of assessment work, the assessment work should be decomposed into daily tasks, and the power of information platforms and third-party organizations should be fully utilized to achieve the daily, information-based, and automated inspection and indicator scoring. Every year, the chief river officer publicly discloses the performance of his responsibilities and the effectiveness of river management and protection in his jurisdiction through media websites, and accepts social supervision and evaluation. Enhance the digital literacy of river chiefs, streamline and implement the hierarchical processing mechanism of digital platforms, and strengthen the effectiveness of public participation in digital platforms (Wang & Cao, 2025). This study only

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conducted in-depth research on Dujiangyan Irrigation Project area, and future research can expand the understanding of the development of river leader system in other relevant regions of China. At the same time, future research directions can further refine indicators for assessing the performance of river chiefs, emphasizing both process and results, highlighting river health indicators and river management indicators. Develop corresponding assessment indicators and scoring standards based on the different responsibilities and key points of river chiefs at different levels, in order to gain a deeper understanding of the difficulties faced by river chiefs and provide more detailed and targeted solutions.

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