Establishing Multi-support River Chief System (RCS) to Achieve Long-term Restoration and Management Effectiveness of Transboundary Rivers

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Abstract. Due to the lack of effective communication and coordination between regions, the problems of water pollution and water environment of transboundary rivers are prominent. The restoration and management of the transboundary rivers has been the focus and difficulty in China for a long time. As an innovative system of river and lake restoration and management in the new era, the River Chief System (RCS) has a unique role in achieving long-term restoration and management effectiveness of rivers and lakes in China. Focusing on the restoration and management of transboundary rivers, this article studied on the construction of multi-support RCS in order to achieve long-term restoration and management effectiveness of transboundary rivers in China. With a view to achieve a highly organic unification between the short-term goals of water pollution treatment and the long-term goals of water ecological protection for the domestic rivers in China, this paper can provide technical support for the restoration and management of the transboundary rivers with the help of RCS.

1. Introduction

With the rapid development of society and economy, there are many water environment problems in China, such as the shortage of water resources, serious water pollution and so on [1-2]. It has been a long-standing problem in China that the transboundary rivers are difficult to repair and manage. At present, the water quality of many transboundary rivers is inferior to Class V quality standard of surface water in China. Due to the lack of effective communication and coordination between regions, there are certain difficulties in the restoration and management for the transboundary rivers, which water environment and aquatic ecological problems are relatively prominent.

In the basin scale restoration of the transboundary river, there are some problems for the upstream and downstream, left and right banks, main and tributaries of boundary river, such as the disadvantages of block restoration, overlapping or vacancy of management, and the non-formation of multiple repair mechanisms, which easily lead to the slow progress of boundary river restoration, which is particularly outstanding in the modern perspective of water environment improvement in China.

It is the problems such as poor river systems, periodic black and stinky water quality, and difficulty in coordination that often lead to the difficulties in the Cooperative restoration of transboundary rivers [3].

Generally speaking, it is difficult to restore the boundary river, which is mainly manifested in the following aspects: First, the cost of water environment pollution control is too high. Second, the
progress of pollution control projects has been made, but the effect of water quality improvement is limited or even rebounded. Third, it is inferior to Class V water for the purpose of improving water quality, the goal is not long-term enough. Fourth, the asynchronous phenomenon of cross regional pollution control is common [4]. In addition, for the rivers across the administrative region, there are also limitations that the short-term goal of water pollution control is not in harmony with the long-term goal of water ecological protection. In practice, there are drawbacks that the work results brought about by the different administrative divisions of rivers are mutually impaired or partially gained, which leads to the loss of integrity [5].

The RCS is an innovative river and lake management system and mode with Chinese characteristics, which was first implemented by the local government of Wuxin and extended to the whole country of China [6]. Since the founding of RCS, China has had more than 10 years of practical experience. At present, RCS has made remarkable achievements in the implementation process of all provinces, municipalities and autonomous regions in China. The implementation of RCS is an important strategic measure involving many fields, institutions and groups, and it requires a large project jointly undertaken by the government, enterprises, society and individuals [7]. As an innovative system of river and lake management in the new era, RCS plays a unique role in realizing effective management and long-term restoration of transboundary rivers.

In order to overcome the limitations and disadvantages of transboundary river management and restoration, and at the same time, in order to realize the pertinence, long-term and sociality of RCS across administrative regions, it is necessary to study and build a multi-support system based on RCS, and to realize the goal of maintaining the healthy life and the sustainable function use of the transboundary rivers in combination with the long-term management.

This paper focused on the restoration and management of the transboundary rivers in China and studied on the construction of multi-support RCS in order to achieve long-term restoration and management effectiveness of transboundary rivers in China. With a view to achieve a highly organic unification between the short-term goals of water pollution treatment and the long-term goals of water ecological protection for the domestic rivers in China, this paper can provide technical support for the restoration and management of the transboundary rivers with the help of RCS.

2. Text

2.1. The Origin, Main Tasks and Main Problems of RCS

2.1.1. The Origin of RCS. In 2003, the RCS was taken the lead in implementing at Changxing County, Zhejiang Province in China. A blue algae outbreak occurred in a large area in Taihu Lake in China in May 2007. In order to fully implement the water environment management and restoration of the Taihu Lake, the Wuxi Municipal Party Committee and the Municipal Government incorporated the water quality test results of 79 river sections into the performance assessment to the main leaders of the party and government in each city (county) and district, and set up "river chiefs" for 64 main rivers in Wuxi City at the same time. Led by the main leaders of the municipal party committee, municipal government and relevant departments, the RCS was initially established to put all pollution control measures in place [3].

In June 2008, Jiangsu Province initially promoted RCS in the Taihu Lake basin. It was stipulate that each river was jointly served as the "river chiefs" by the main provincial and municipal leaders. The main person in charge of the party and government at all levels is the first person responsible for river management and protection. Under this mechanism, the river restoration and treatment effect is remarkable. For example, the Taige south canal, one of the main rivers inflowing into Taihu Lake, has been plagued by pollution problems for a long time. The water quality and water ecological environment of the river have been greatly restored after the river chiefs of Jiangsu Province and Yixing City supervised the pollution remediation and treatment on the spot. From 2011 to 2016, after the restoration and control under the RCS, the overall rate of compliance with the water quality of the 79 managed sections of the rivers basically maintained above 70% in Wuxi.
At the end of 2013, in order to solve the problem of water pollution, Zhejiang province realized the full coverage of RCS at the provincial, municipal, county and township four levels, and formed the RCS characterized by the provincial, municipal, county, township and village five levels linkage, with a total of more than 50 thousand River chiefs (Pan Tianming, 2014). In October 2018, the nation's first local standards for RCS work specification were issued in Shaoxing, Zhejiang Province [8].

In December 2016, the general office of the Central Committee of the Communist Party of China and the general office of the State Council issued “Opinions on the Comprehensive Implementation of RCS”, and issued a notice requesting that all regions and departments seriously implement it in accordance with actual conditions [9-10]. On New Year's Day in 2017, General Secretary Xi Jinping issued the decree of "Each river must have a 'chief'" in a New Year's message [11]. Up to now, the RCS has been gradually promoted in all provinces, cities and autonomous regions in China. At the press conference held in Beijing on the comprehensive establishment of RCS on July 17, 2018, E Jingping, the Minister of water resources, said that 31 provinces, autonomous regions and municipalities directly under the central government had established RCS across the country by the end of June 2018. A total of more than 300 thousand river chiefs were identified at the provincial, municipal, county and township four levels, and more than 760 thousand village level river chiefs in 29 provinces in China, opening up the "last mile" of RCS [12].

2.1.2. The Main Task of RCS. On December 2016, the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council issued the Opinions on Full Implementation of RCS [5]. Generally speaking, the main tasks of the RCS include the six aspects as following [13].

First, strengthen water resources protection, comprehensively implement the most stringent water resources management system, strictly observe the Three Red Lines of water resources development and utilization control, water efficiency control, and water function zone restrictions on pollution, strengthen the responsibility of local governments at all levels, and strictly assess and evaluate and supervise.

Second, strengthen the management and protection of the shorelines of rivers and lakes, strictly control the water ecological space and other aquatic spaces, and strictly prohibit the invasion of rivers and reclamation of lakes.

The third is to strengthen the prevention and control of water pollution, coordinate the pollution control on the water and on the shore, investigate the sources of pollution into rivers and lakes, and optimize the layout of sewage outlets into the river.

The fourth is to strengthen the water environment management, ensure the safety of drinking water sources, increase the control of black and odorous water bodies, and achieve a clean and beautiful river and lake environment with clean water and green shores.

Fifth, strengthen water ecological restoration, delineate rivers and lakes management scope, and strengthen system management of forests, lakes, and lakes in accordance with law; sixth, strengthen law enforcement and supervision, and crack down on illegal activities involving rivers and lakes.

Sixth, establish and improve laws and regulations and a daily supervision and inspection system, strengthen law enforcement and supervision, and severely crack down on river-related illegal acts.

2.1.3 The Main Problems of RCS. As an innovative system of river management in the new period, some problems will inevitably arise during the implementation of RCS. The main manifestations are: the responsibilities of the river chiefs are not clear, and there are no specific laws and regulations; the supervision, management, assessment and accountability mechanism of RCS is not complete enough, resulting in some river chiefs being unnamed, being in a formal way in actual work and unable to be implemented; The problems of unclear responsibilities, unclear authority, poor collaboration ability, and low work efficiency of various departments of RCS are often encountered in the work; lack of integrity, overall planning and coordination, and carry out control activities in isolation between
different provinces and regions, and one-sided emphasis on rivers restoration and lack of comprehensive repair concepts at the regional level.

Therefore, the current RCS, especially the RCS for the boundary rivers, should also conform to the current development trend of China's ecological civilization and continue to carry out reforms and innovations in the course of development.

2.2. The Current Status and Problems of Transboundary River Restoration and Management in China. The restoration and management problems of transboundary river have a long history in China. In river basin remediation, problems such as poor water systems, periodic black and stinky water, and difficulty in coordination often lead to cooperation in trouble [3]. This is particularly prominent from the perspective of China's governance modernization. At present, there are problems such as insufficient law enforcement basis, incomplete law enforcement system, lack of law enforcement information sharing mechanism, and inadequate supervision mechanism. As a result, it is difficult to implement RCS and it is impossible to achieve the long-term goals of river restoration. Therefore, the current RCS, especially the RCS for the boundary rivers, should also conform to the current development trend of China's ecological civilization, and continue to carry out reforms and innovations in the course of development.

There are indeed many difficulties in the restoration and management of transboundary rivers. One is that due to the different economic development levels of neighboring provinces and cities, there are often some places that are stricter and some places that are looser in environmental access. This often results in just driving out the pollutant discharge enterprise here, but in a flash, that pollutant discharge enterprise has taken root in the neighboring provinces. Therefore, it is very important to implement coordinated and joint actions in the restoration and management of transboundary rivers. Therefore, in order to achieve the standard of river water quality, the key to do well in transboundary river remediation is to take coordinated and joint action between the two places at the same time.

Taking Guangdong Province as an example, Guangdong Province is located in the southeast of China, with a dense network of rivers. The main rivers, such as the Pearl River, the Dongjiang River and the Jianjiang River, all flow through several cities and belong to the boundary river across administrative regions. Once the water quality of these boundary rivers is polluted, it will often affect the whole basin and cause disputes between the upstream and downstream. Therefore, the water resource pollution of boundary rivers has become a complex problem that can’t be ignored [14]. The observation of RCS shows that the problem of "lack of authority" of the responsibility mechanism in the coordination mechanism can be solved better through the cross administrative region coordination mechanism at the horizontal and vertical levels, which greatly improves the coordination efficiency of the RCS with obvious effect in the short term. However, the basic characteristics of the vertical coordination of the hierarchy system based on authority have not changed, and will face the challenges of capability dilemma, organizational logic dilemma and responsibility dilemma [15]. At present, the main problems existing in RCS of boundary river are mainly manifested in the poor operability of the legal provisions, the inadequate implementation of the pollution prevention and upstream and downstream reporting systems, the lack of final jurisdiction of administrative organs over related disputes (including transboundary disputes), and failure to implement the environmental function zoning of transboundary rivers[16].

In the process of implementing the river system, the short-term goal of water pollution control should be surpassed, and the basic concept of water ecological protection should be established. This has not only ethical value, but also legal system value [5]. Establishing the concept of water ecological protection in the implementation of RCS. For the boundary rivers, it is necessary to overcome the limitations of RCS design in non-inter-administrative rivers and overcome the mutual reduction or partial loss of the work results brought about by the division in practice. The overall shortcomings reflect the integrity and systemicity of ecological protection into the specific practice of the boundary river RCS, thereby unifying the short-term goals of water pollution control of the boundary river and
the long-term goals of water ecological protection, and realizing the healthy and sustainable operation of the boundary river.

In the future, in order to make better use of RCS to restore and manage the boundary river, some necessary related research needs to be done. Firstly, identify the main problems in the implementation of RCS, and combine the short-term and long-term goals of water environment restoration and management, and find out the mechanism and short-term and long-term effects of RCS to promote water remediation. Secondly, in the face of the shortcomings of segmented remediation of the upper and lower rivers, the left and right banks, trunk and tributaries, the management of overlapping and vacancies, the replacement of river chiefs, and so on, a multi-element support system based on the multi-disciplinary of hydrology, water resources, water environment and water law, with the core of Multi Linkage of Superior Resolutions is established. In addition, based on the systemic, complex, and long-term nature of water environment remediation, the research on the evolution path of RCS to a long-term mechanism for water environment restoration and management, it is necessary to carry out the research on the evolution path of long-term mechanism of water environment treatment of boundary river RCS, so as to realize the long-term restoration and treatment of the rivers.

2.3. Establishing RCS Multi-Support System for Improving the Restoration and Management Level of Boundary Rivers

Combining the difficulties and sticking points of domestic boundary river rehabilitation, and based on the water resources, water administration, and water law, our research group had built a multi-support system of RCS with the technical standard system, administrative management system and policy legal system as the core.

2.3.1. The Technical Standard System of RCS. The technical standard system of RCS mainly involves the technical means and standard specifications which support the steady implementation of RCS. Corresponding to the main tasks of RCS, it can be divided into such categories as water resource protection, water ecological restoration, water pollution prevention and control, river health and river engineering construction.

Among the system, the technical standard system of water resources protection is an important basis and technical support for the management and protection of river resources. The technical standard system of water pollution prevention and control can be used as a reference for river directors in the prevention and control of river water pollution. The technical standard system of water ecological restoration is the technical guarantee for the river chiefs to carry out the ecological restoration of boundary rivers. The technical standard for river engineering construction is the technical basis and criterion formulated for the planning, survey, construction, acceptance, operation management and maintenance of various rivers construction projects. Relying on the technical standard, the river chiefs can guide and control the quality of the safety implementation of the construction of the boundary river engineering.

2.3.2. The Administrative Management System of RCS. The administrative management system mainly involves the administrative and management systems that support the steady implementation of RCS. It is divided into the RCS administrative examination and approval mechanism, RCS administrative assessment mechanism, RCS supervision and management mechanism, the water area shoreline management mechanism and the river protection mechanism.

Among the system, the supervision and management mechanism of RCS is a necessary measure to strengthen the supervision and assessment of boundary river management. The supervision and management of RCS should realize the transparency of information, regularly report the implementation of RCS and the performance of river chiefs, establish a publicity system and accept social supervision.

The administrative assessment mechanism of RCS is the guarantee to improve the efficiency and effect of boundary river management and protection. According to the actual situation of boundary
River, it is necessary to carry out differential performance evaluation and assessment in the way of combining quarterly assessment and annual supervision, and include the assessment results in the comprehensive performance assessment of the river chiefs, where merit must be rewarded and penalty must be given.

2.3.3. The Policy and Legal System of RCS. The policy and legal system mainly involves the support of policies and regulations to ensure the steady implementation of RCS, which is divided into several categories including river management legal system, water environment protection legal system, water right system, ecological environment water use policy and law, water dispute handling mechanism and water related ecological compensation mechanism.

The legal system of river management is to clarify the main contents and norms of boundary river restoration and management at the legal level, that is, to provide legal basis, such as Regulations of the People's Republic of China on the Management of River Courses, which is an important means for effective control of boundary river remediation and management. According to the principle of One River and One Policy of RCS, the cross-border government can fully communicate with the actual situation of the boundary river, formulate management implementation rules on several aspects of the boundary river management, and strive for all-round management [17].

2.4. The Application of Multi-Support RCS: Taking the Restoration and Management of Guangfo Transboundary Rivers as an Example

There are many boundary rivers in Guangzhou and Foshan. The key rivers to be controlled mainly include Liuxihe River, Xinjie River, Daling River, Tianmei River, Baijing River, Shijing River, Huadi River, the Pearl River West Channel, etc. Among them, the water quality of the Pearl River West Channel and the Baiji River were maintained between Class IV and Class V, the Huadi River was Class V, and the water quality of the Conghua Taiping Section in the upper reaches of Liuxihe River was Class III, and the rest of more than 10 river sections, including the Shijing River, were still inferior to Category V [18].

In order to remediate the transboundary polluted rivers, Guangzhou and Foshan Environmental Protection Bureau jointly issued Guangzhou and Foshan Municipal People's Government Circular on Comprehensive Treatment of Guangfo Boundary Rivers(Draft for comments), and put forward specific treatment opinions on 16 rivers and adjacent rivers in the cross-border area of Guangzhou and Foshan in December 2014 [19]. According to the opinions, the two cities started to jointly restore the transboundary rivers adopting the territorial management model. The specific methods are mainly as follows.

First, Guangzhou and Foshan jointly adopted the strategy of systematic water restoration and management. The pollution control of GuangFo transboundary rivers should be carried out in five steps including synchronous planning, synchronous investment, synchronous construction, synchronous monitoring and synchronous accountability, so as to promote the overall planning and coordination of the upstream, downstream and left and right banks.

Second, in terms of establishing a long-term mechanism for river basin protection and governance, both Guangzhou and Foshan actively explored new models of unified river basin planning, synchronous management, and joint management and protection, jointly prepared transboundary water quality protection plans, and jointly organized cross-boundary river water pollution prevention and control, jointly carried out law enforcement of river basin environment with emphasis on water pollution prevention and drinking water sources protection.

Third, in terms of establishing monitoring and information sharing mechanisms, the two sides carried out simultaneous monitoring of water quality across transboundary rivers, mutual notification of water quality monitoring data of transboundary rivers, real-time grasp of trends in water quality changes, and early warning; established an information sharing system, and regularly exchanged feedback to ensure regional information flowed smoothly.
In addition, cross-border environmental emergencies were being established in terms of emergency linkage mechanism. The two sides strengthened regional water environment emergency cooperation, improved water pollution prevention and emergency response plans, and strengthened water environment quality early warning.

After four consecutive years of rehabilitation, the Guangfo transboundary rivers achieved significant results. According to the monitoring by the Provincial Environmental Protection Department in 2017, the comprehensive pollution index of the water quality of Liuxihe River, southwest Chong and Foshan watercourse in the Guangfo transboundary rivers decreased by 36.9%, 17.4% and 26.7%, respectively [20]. As of September 2019, the water quality of transboundary rivers in Guangfo had continued to improve. Among them, the water quality of the national and provincial control sections of Foshan City had reached the assessment requirements, the average value of Foshan watercourse and southwest chong had reached Class IV water quality standard, and the comprehensive pollution index of the watercourse at the section of provincial concern had decreased by 26.92% year-on-year; in the municipal control section, the water quality of 10 sections in 11 municipal control sections of southwest chong had improved in varying degrees year-on-year, and 3 sections in 8 municipal control sections of Foshan watercourse have reached the standard, 6 sections in 7 municipal control sections of Shuikou watercourse improved year on year [21].

3. Conclusion
The full implementation of RCS is the urgent need and the perfect embodiment of the idea of Ecological Priority and Green Development in this era. With the rapid economic and social development in China, the ecological environment of rivers in some areas has been seriously damaged. The state timely and comprehensively implements the RCS, which shows the importance of the management and protection of rivers. RCS is an innovative river restoration and management system and model with Chinese characteristics that was first implemented by the local government of Wuxi and spread to the whole country in China. Since the founding of RCS, China has had more than 10 years of practical experience. At present, RCS has made remarkable achievements in the process of implementation in all provinces, municipalities and autonomous regions.

The cooperative management of transboundary rivers has always been the focus and difficulty of river and lake protection. At present, there are many disadvantages in the boundary rivers, such as block remediation of upstream and downstream, left and right banks, trunk and tributaries, overlapping or vacancy of management, inadequate implementation of joint pollution prevention and upstream and downstream notification system, weak operability of legal provisions, lack of force in administrative mediation, etc.

Our research group researched and constructed a multi-support RCS for the transboundary river restoration and management from three aspects including technical standards, administrative management and policies and laws, and proposed a feasible implementation way for the effective operation of transboundary RCS and expected to realize the long-term effective restoration and management of the transboundary rivers.

Guangzhou and Foshan’s joint restoration and treatment of the Guangfo transboundary rivers was a successful example of the multi-support RCS in transboundary river recovery.

It is of great significance to research and construct the multi-support RCS for the transboundary rivers restoration and management. While achieving the goal of maintaining the healthy life of rivers across administrative regions, the goal of maintaining long-term sustainable use of transboundary rivers ecological functions is also obtained.

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