

Chinese scheme to resolve the current complicated water issues: River chief system (RCS)

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Abstract. The problems of water pollution, structure-related water scarcity and water squander have long been impeding the sustainable development of China. In China, various departments including environment protection, water conservancy, housing construction and agriculture are more or less engaged in river control, bringing tremendous difficulties by the distinct and overlapping of responsibilities among departments. Aiming to solve the current complicated water issues, Chinese government has to make a breakthrough in the top design of river managements. Chinese government firstly appointed local government officials as river chiefs in 2007 to address a blue algae outbreak on Taihu Lake in Jiangsu province. In the past decade, the River Chief System has rapidly converted from an emergent policy up to the nation will, which seemed a complete surprise. However, the popularization of the system really made sense by fitting from the root of the traditional Chinese politics and current national conditions. This viewpoint paper provides a brief introduction about the origination, advantages as well as the prospects of River Chief System, which could be effective in solving the current Chinese complicated water issues and provide new insights for other developing countries in river management system design.

1. Origin of RCS: Emergent function-oriented system facing water issues

For the overall development of China, it is very important to manage rivers. River water resources management has become a humongous task due to following reasons: climate change, regional development, and population explosion. To tackle problems of river management, many international conferences have been conducted by multi-national organizations [1]. In various countries and provinces, concerted efforts have been made to address the following objective: to establish integrated river management systems suitable for national conditions. According to the World Wide Fund for Nature, an integrated river basin management system must be developed to deal with complex issues. The system must conduct following tasks: coordinate the process of conservation, management, and development of water, land, and related resources across sectors within a given river basin [2]. In order to quickly understand problems associated with river water management, Japan has developed the River Information Management System. With this innovative system, scientists can easily monitor all rivers across Japan [3]. In France, river water management systems are regulated and monitored by the Ministry of Environment, Ministry of Finance, and Ministry of Agriculture. Two major parliamentary decisions, namely, decentralization of governmental obligations and powers were taken



by local equivalents of the Ministry of Environment. The “Second Water Law” was implemented to ensure appropriate and efficient management of rivers in France.

Regional water shortage and water scarcity (It is caused by structural patterns of drought.) are the problems that primarily impede sustainable development in China. Based on international standards, water stress is defined as 1000 cubic meters of usable water per person per year. However, an average northern Chinese person has access to less than one-fifth of aforementioned amount. Water problems are worsening due to increased pollution, improper water usage, and water squandering. Due to rapid urbanization in recent decades, Chinese government has to now grapple several issues of water safety. These issues are as follows: deterioration of aquatic ecosystem, damage of water environment, and malodorous waters. These issues have been intertwined with old and new challenges associated with river water management. In general, rivers and lakes are the places where these complicated issues arise in China. Most lakes have been overused and over exploited for various commercial and domestic purposes. These lakes have already reached their limits of affordability in terms of aquatic resources and environments. Table 1 presents Environmental Quality Standard for Surface water in P.R.C (GB 3838-2002). Rivers account for 235 thousand kilometers in China. In these rivers, water quality is generally Grade IV and V. Water quality is worse than Grade V in some rivers. These rivers accounted for 9.9%, 4.2%, and 11.7%, respectively in 2015 [4]. Owing to deteriorated water quality, limited water resources, and inadequate regulations, serious social problems have occurred in China. Moreover, these problems have led to more severe and complicated water challenges, which are much tougher than in any other part of the world.

Table 1. Major environmental quality standard for surface water in P.R.C (GB 3838-2002) (unit: mg/L).

No.	Parameter	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
1	DO	7.5	6	5	3	2
2	COD	Below 15	15	20	30	40
3	BOD ₅	Below 3	3	4	6	10
4	NH ₄ -N	Below 0.15	0.5	1.0	1.5	2.0
5	TP	Below 0.02	0.1	0.2	0.3	0.4
6	TN	Below 0.2	0.5	1.0	1.5	2.0
7	Cu	Below 0.01	1.0	1.0	1.0	1.0
8	Zn	Below 0.05	1.0	1.0	2.0	2.0
9	F ⁻	Below 1.0	1.0	1.0	1.5	1.5

Class 1 mainly includes source water and national nature reserves.

Class 2 mainly includes primary sanitary zone concentrated with domestic drinking water supplies.

Class 3 mainly includes secondary sanitary zone concentrated with domestic drinking water supplies.

Class 4 mainly includes normal industrial water supply zones and water areas recreated for indirect contact with human body.

Class 5 mainly includes normal agricultural water supply zones.

In China, following departments are associated with river water management: environment protection, water conservancy, housing construction, transportation, finance, and agriculture. All these departments are more or less engaged in river control, leading to tremendous difficulties in the coordination of departments. This is because all responsibilities are not distinctly divided among all departments. In fact, overlapping of responsibilities is quite common and so these departments have to perform coordination on daily basis. Since a very long period of time, several major problems have been associated with water environment managements in China. Firstly, not a specific legal responsibility defines overall water management. Secondly, the involved departments fail to cooperate and coordinate in a proper way, leading to low efficiency. Thirdly, various tasks have to be carried out at a slow pace as most departments grapple with lack of funding. In order to solve complicated water issues, Chinese government has to make concerted efforts in improving river management systems.

The earliest exploration was carried out in the city of Wuxi near Taihu Lake in east China. In the early summer of 2007, there was a dramatic increase in temperature. This led to an outbreak of various blue algae in lakes and rivers, thereby severely threatening drinking water sources. Figure 1 illustrates that excess algae resulted in an obvious increase in total nitrogen (TN) and $\text{NH}_4\text{-N}$ in lakes. At the same time, dissolved oxygen (DO) decreased sharply in lake water. Since excess algae had accumulated and decayed in lake water, the safety of drinking water had declined sharply. The self-recovery of water qualities lasted around two weeks since May 27th, 2007. To grapple with water crisis, Wuxi government attempted to nominate the head officials in charge of Chinese Communist Party (CCP) and government as the river chiefs of 64 rivers. To determine performance appraisal of head officers in Wuxi province, Chinese government considered water quality results of 79 river cross-sections. All pollution control methods were swiftly implemented by top officials of CCP. Owing to innovative water policy, there were rapid and effective improvements in water quality. In major rivers of Wuxi province, the quality standards of water increased from 53.2% to 71.1% within one year. In Wuxi province, water quality rate increased from 7.1% in 2007 to 44.4% in 2015. In the 12 major river cross-sections of Wuxi province, water quality met all the requisite standards in 2011. Water quality of drinking water sources was 100% in 2012.

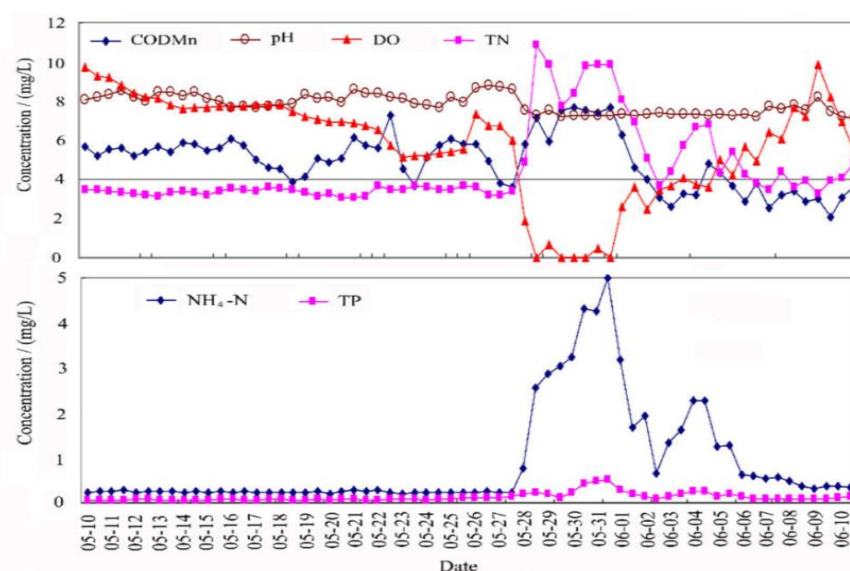


Figure 1. The alteration in qualities of water collected by the automatic monitoring station in Gonghu Drinking Water Plant in May and June, 2007.

2. Implementation of RCS: necessary requirement for ecological civilization

Summarizing the experience since 2008, Jiangsu authorities have been popularizing river chief system (RCS) in entire province. Moreover, Suzhou and Huai'an are the cities in which RCS was implemented in 2008 and 2009, respectively. Consequently, water quality improved tremendously in both the cities within a short period of time. Among the 86 monitored sections in Suzhou, standard water quality was achieved in 72 sections in 2008. Compared to previous year, an increase of 16.3% was reported in 2008 due to RCS. River dredging practices have been carried out on 313 rivers in Huai'an province in 2009. Re-management practices have also been conducted on 1829 ponds in 392 villages of Huai'an province. Furthermore, RCS has been implemented on 727 major rivers and 1212 channel segments in Jiangsu province till date. This system has tremendously improved water quality and aquatic system in rivers and ponds. To deal with various water bodies, Local government has also set up quality targets; these targets are used to measure the efficacy of RCS (table 2). Following the example of Jiangsu, RCS has also been implemented in prominent cities (Beijing and Tianjin) and

provinces (Zhejiang and Anhui). To implement RCS, management mode of the system was imported in these places. These places are always under strict supervision of Chinese government. Water bodies receive massive protection against detrimental factors, so water quality standards are definitely higher in these places.

Table 2. Water quality targets in ‘The views in fully implementing River Chief System in Jiangsu Province’ in 2020.

Water Type	Water quality targets	
Drinking water sources (daily water supply higher than 10000 tons)	standard-reaching	rate
	≥98%	
Key water functional areas	standard-reaching	rate
	82%	
Water quality in river cross sections superior than Grade III	70.2%	
Water quality worse than Grade V and black colored water with offensive odor	Basically eliminated	

The General Office of the CCP Central Committee and the State Council released the document ‘The process of implementing River Chief System: A systematic overview’ in December of 2016. In the document, government authorities clearly stated these objectives: protection of water resources, pollution control, improvement in environmental conditions, and restoration of ecology in China [5]. Within the last decade, RCS has rapidly evolved from an emergent policy into a national strategy, which seemed to be a complete surprise to many environmental scientists. This system became very popular as it blended the ethos of traditional Chinese politics with prevalent social conditions. This system could be regarded as an innovative strategy that solves complicated water issues prevalent in China. By closely adhering to water pollution control plan, river management systems can achieve high efficiency. These systems decompose goals and hierarchically transfer targets laid down in the “water pollution control plan.” Evaluation and assessments were undertaken strictly, and chiefs were punished for not meeting their goals. Since RCS could effectively tackle current challenges of Chinese watershed managements, it was very effective in overcoming collaborative problems of different departments, local government, and various political parties: these governmental bodies were finally able to provide superior water management services.

3. Functions of RCS: superiority over conventional management systems

Since ancient times, many official departments and parties are involved in river management in China. However, the power of these official departments varied among different dynasties. Since ancient times, river officers have shouldered a plethora of responsibilities, including flood prevention, irrigation, water transport, and prevention of water pollution. Currently, river chiefs have successfully implemented RCS in China. These officers primarily have following responsibilities: protection of aquatic resources, prevention and control of water pollution, ecological restoration, shoreline management and protection, management of water environment, and monitoring of law enforcement. Figure 2 summarizes common methods, techniques, and activities used to achieve these tasks. In order to meet the serious water issues in China, the public governance system did a laudable job of successfully implementing RCS in various water bodies of China.



Figure 2. Outline of the methods, techniques, and activities used to achieve tasks of RCS.

Firstly, the system breaks through the bottleneck of water management systems. With this system, government authorities successfully solved the problem of poor coordination and overlapping responsibilities of different government departments, which dealt with water management in China. In other words, management loopholes were clearly identified and eliminated by RCS. By appointing CCP or government heads as river chiefs, multi-procedures were jointly coordinated and integrated. Thus, water management personnel now had clear goals to achieve in China. Secondly, current legal and supervisory systems inevitably have many limitations: executive law enforcement was insufficient in different areas; details of regulation were non-specific; and law enforcement was difficult in China. In contrast, this system effectively solved aforementioned problems and administrative law enforcement was observed in various river basins. Thirdly, river chiefs implemented rigid check-up systems to tackle complicated water issues. Moreover, they were evaluated by very strict standards of assessment; water resource management and water pollution control were main responsibilities of these officers. Interestingly, RCS acted as a pair of invisible hands. Therefore, these river chiefs could not escape their responsibilities.

4. Upgraded RCS: more tasks and intensified functions

Jiangsu Province has always been at the forefront in the implementation and upgradation of RCS, because this system was invented at this place. In March 2017, Jiangsu Province approved the policy entitled 'The views of fully implementing RCS in whole province'. In this policy, government authorities are keen to implement 'Upgraded RCS' within the province. The document describes how multi-step river architecture can be established to encompass the province, city, county, and village. The main aim of upgraded RCS system was to cover more than 100 thousand rivers, lakes, and reservoirs beyond the village-level. In addition, 'Make contacts with river chiefs' system has been established: river chiefs of different hierarchy have to assign tasks and supervise the implementation of upgraded RCS. The policy also lays out an ambitious plan of establishing hydro-biological stations or limnological institutes within river area such as the Taihu Basin Authority of Ministry of Water Resources. A comprehensive survey of biological and ecological resources needs to be carried out before assessing river health in China. Biological resources can be better preserved by planning river functions and assessing river health.

'The views of fully implementing River Chief System' was proposed by the General Office of the CCP Central Committee and the State Council. Thereafter, an upgraded RCS was implemented successfully in Jiangsu Province; this system enriched and expanded the purview of RCS. In upgraded

RCS, eight predominant tasks were presented as follows: (1) Strict management of water resources, and strict examination and evaluation of water resources had to be performed. (2) Strengthen the protection of aquatic resources and realize the harmony of humans and nature. (3) Promote methods to control water pollution in rivers and lakes and establish water circulation system, which is robust and innovative. (4) Govern aquatic environments comprehensively and facilitate the development of beautiful countryside. (5) Implement ecological remediation methods in rivers and lakes and maintain high-quality aquatic environments. (6) Ensure sustainable management and protection of rivers. (7) Strengthen the supervision of law enforcement and promote comprehensive law enforcement within watersheds. (8) Upgrade integrated systems of rivers and lakes to ensure overall river management. In the upgraded system of Jiangsu Province, the main legal responsibility of authorities is well-defined; therefore, it is now possible to practically manage organization, expenses, and other stuff. This system emphasizes on dynamic supervision and network-based management. Table 3 summarizes the differences between following approaches: past-traditional methods, present-RCS, and upgraded-RCS.

Table 3. Comparison between past-traditional, present-RCS, and upgraded-RCS.

	Past-traditional system	Present-RCS	Upgraded-RCS
Administrative responsibility	Departments including environment protection, water conservancy, housing construction, transportation, finance, agriculture etc.	River chief serves as the head officer dealing with all the river affairs	
Tasks	No specific and integrated overall tasks in river management	(1) Aquatic resource protection (2) Water pollution prevention and control (3) Ecological restoration (4) Shoreline management and protection (5) Water environment management (6) Law enforcement monitoring	(1) Strict management on water resource (2) Strengthen the protection of aquatic resources (3) Promote the water pollution control system (4) Carry out the comprehensive governess of aquatic environments (5) Put ecological remediation into practice (6) Make sustainable management and protection (7) Strengthen the supervision of law enforcement within watersheds (8) Upgrade the integrated functions of rivers and lake
Problems	Absence of a specific legal responsibility subject to the overall management Involved departments could	(1) The laws and regulations are still imperfect and the duties of river chiefs are not	Difficulty in full implementation and strict supervision

not cooperate and work in a proper way	empowered (2) A lack in integration, corporation and harmony during implementation. (3) Lack of efficient funding
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By the end of 2018, a thorough four-level RCS will be established by Chinese government: the upgraded system will encompass all provinces, cities, counties, and townships in China. Interestingly, successful implementation of upgraded system is far more important than planning. Chinese government has to invest a large capital for planning and implementing this ambitious project. Chinese authorities need to urgently solve chaos caused by poor coordination and cooperation between different departments of river basin management. Owing to lack of public participation and supervision, water problems cannot be solved swiftly. To implement the upgraded system with high efficiency, Chinese government should make decisions with a macroscopical mindset. The innovative water policy should cover the whole watershed of rivers and lakes in China. These measures should ensure sustainable development of river basins and surrounding regions, bringing great prospects to economy. Consequently, social progress should be achieved with these path-breaking measures. Next, the system of ‘One strategy for one river’ had to map out a specific solution for each river by adequately considering factors governing regional planning, economic development, and pollution level. Finally, a long-term mechanism needs to be established and improved to improve aquatic environment of rivers and lakes in China. By circulating reports on a large scale, many people can be encouraged to participate in river management and supervision (figure 3).

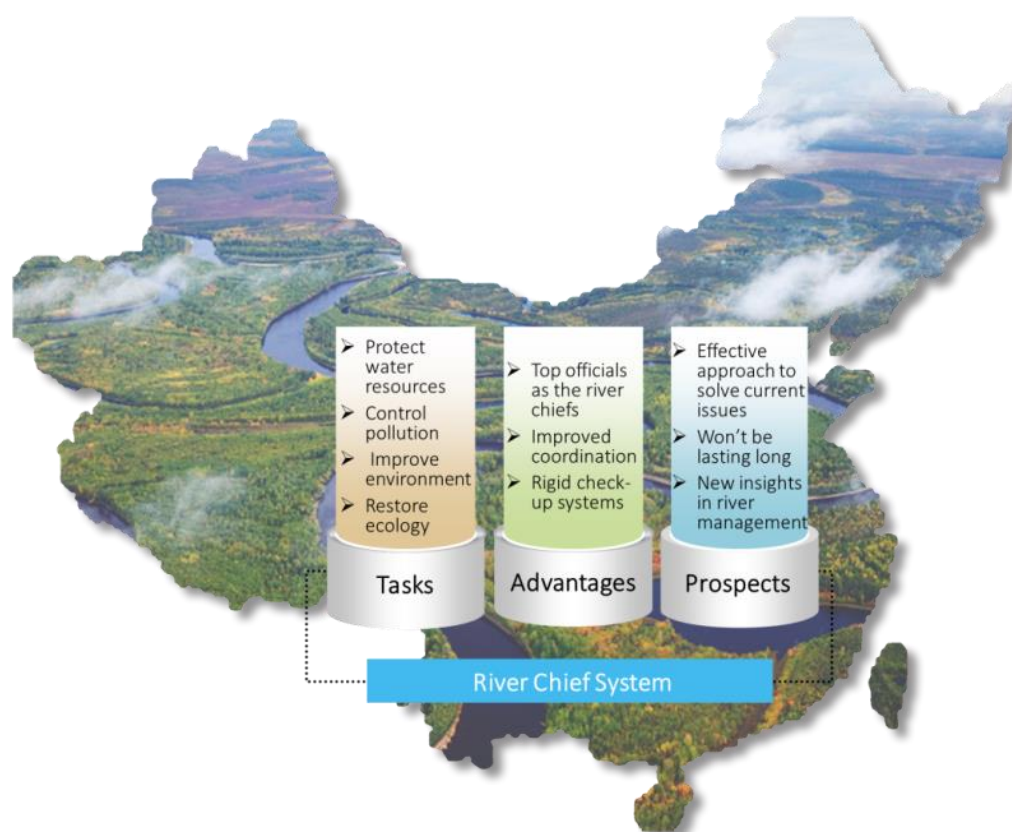


Figure 3. Tasks, advantages, and prospects of River Chief System in China.

5. Future of RCS: problems and perspectives

In the past decade, Chinese people have witnessed the conceptualization, development, implementation, and initial success of RCS in China. With this system, flood control standards have improved substantially. Moreover, the system has optimized the transfer/dispose of water resources in China. The quality of aquatic environments has ameliorated, contributing to the recovery and remediation of ecological environments. After exploring RCS at a preliminary level, it was completely implemented in China. Thereafter, the work level and management system of RCS was improved frequently. Despite making substantial progress, we still encounter problems and difficulties in implementing upgraded version of the system. First, the corresponding laws and regulations are still not compatible with RCS. As a result, river chiefs are still not empowered with legal authority. Consequently, the works of river chiefs are considered as mere formalities; successful implementation of tasks could not be achieved in the real-sense. Secondly, responsibilities of each department are still not specific. Sometimes, it causes confusion among co-workers and targets goals are achieved with low efficiency in a buck-passing situation. Thirdly, different departments still show a lack of integrity, cooperation, and harmony during implementation. Although river control and management works have been unilaterally proposed by authorities, we still lack a comprehensive governance strategy for water areas.

Chinese government still has to make arduous efforts in exploring and implementing RCS perfectly. Administrators should provide multiple-channel guarantees, which can immensely help river chiefs in exercising their responsibilities; these aspects include laws, regulations, management, technology, information, and public participation. With this approach, a sustainable system can be developed for effective river management. The system can be further matured with specific laws and regulations to control the quality and safety of water. Government, public, and media must participate wholeheartedly to achieve this objective.

Japan, USA, and European countries also suffered from serious river pollution despite being developed economies. This problem was very acute during the period of industrial revolution.⁸In these countries, river functions and ecological structures were recovered by remediation of river ecology, administrative actions, and perfect laws and regulations. After 40 years of reform and opening, RCS was conceptualized and implemented in China. In other words, it was implemented when most citizens had median income in China. Therefore, it was possible to comprehensively manage water conservancy system in China. At this stage, the system has an effective administrative capacity to solve complicated water issues. Moreover, water conservancy system has special historical significance in China. However, there are numerous reasons to believe that this system would not last long given the deteriorating aquatic environment in China. Therefore, it needs to be immediately substituted by mature legal systems, which can ensure river management and solve thorny issues of water quality and safety. These legal regulations must be framed by leaders of Communist Party Committees. These regulations must be implemented by Chinese government. Moreover, social cooperation can be improved by increasing public participation. This would guarantee successful implementation of novel regulations put forth by the legal system in China. Finally, RCS reflects routine characteristics of migration, which are governed by regulations of Chinese government. The upgraded RCS provides new insights in the design of river management system; this information can be used by other developing countries to solve problems related to water safety and quality.

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