

# The changing role of the China Three Gorges Corporation in the Yangtze River: exploration from hydropower development to comprehensive watershed management

## *L'évolution du rôle de la China Three Gorges Corporation dans le fleuve Yangtsé : exploration du développement hydroélectrique à la gestion globale des bassins versants*

Dianchang Wang<sup>1</sup>, Chong Li<sup>1</sup>, and Ruimeng Zhou<sup>2\*</sup>

<sup>1</sup>Department of Environment Protection, China Three Gorges Corporation, Beijing, China

<sup>2</sup>Yangtze River Environmental Engineering Research Center, China Three Gorges Corporation, Beijing, China

**Abstract.** As China's largest clean energy group and the world's largest hydropower development company, China Three Gorges Corporation (CTG) accounts for 3/4 of hydropower installed capacity, where most of which are distributed in the Yangtze River Basin. Since 2017, CTG has formally entered the field of water pollution control, taking the "water" as the core and the sewage treatment of cities/towns along the river as an entry point. From a technical point of view, with the advantages of hydropower dispatching and operation, the integration of water resources protection, water pollution control, as well as water ecological restoration will be gradually completed to achieve the "one water" control goal. From a management point of view, through the means of government-enterprise cooperation model, the establishment of a jointly sharing mechanism by relevant stakeholders, as well as the market-oriented commercial operation, the implementation and supervision of the watershed administration will be strengthened. CTG has started a new exploration of enterprises participating in the comprehensive governance of watershed management, which will provide ecological priority and sustainable development experience for the watershed management of the world.

**Résumé.** En tant que plus grand groupe d'énergie propre de Chine et plus grande société de développement hydroélectrique au monde, China Three

---

\* Corresponding author: [zhou\\_ruimeng@ctg.com.cn](mailto:zhou_ruimeng@ctg.com.cn)

Gorges Corporation (CTG) représente les 3/4 de la capacité hydroélectrique installée, dont la plupart est distribuée dans le bassin du Yangtsé. Depuis 2017, CTG est officiellement entré dans le domaine de la lutte contre la pollution de l'eau, en prenant « l'eau » comme noyau et le traitement des eaux usées des villes le long du fleuve comme point d'entrée. D'un point de vue technique, avec les avantages de la répartition et de l'exploitation de l'hydroélectricité, l'intégration de la protection des ressources en eau, du contrôle de la pollution de l'eau, ainsi que de la restauration écologique de l'eau sera progressivement complétée pour atteindre l'objectif de contrôle d'une seule eau. Du point de vue de la gestion, à travers les moyens du modèle de coopération gouvernement-entreprise, la mise en place d'un mécanisme de partage conjoint entre les parties prenantes concernées, ainsi que l'opération commerciale axée sur le marché, la mise en œuvre et la supervision de l'administration du bassin versant seront renforcées. Le CTG a commencé une nouvelle exploration des entreprises participant à la gouvernance globale de la gestion des bassins versants, ce qui fournira une priorité écologique et une expérience de développement durable pour la gestion des bassins versants du monde.

## 1 Introduction

Comprehensive watershed management refers to planning, managing and organizing the use of land, water and other resources at the basin level, in order to provide goods and services without negatively affecting soil productivity and water resources. [1] The management method that helps achieve optimal resource utilization has an extremely important position in environmental protection and development.

Comprehensive watershed management is one of the key fields of China's ecological civilization construction. The watershed is a special natural resource, it's a complex system with hierarchical structure and overall functions. [2] Spatially, Watersheds often span administrative regions, and there is an inseparable connection between each section of the watershed. Problems like over-exploitation, water pollution, soil erosion occurring in the upstream will lead to the affections in the downstream. Functionally, the watershed integrates multiple functions such as flood control and drainage, water supply and shipping, as well as ecological development. Therefore, the watershed should be treated as a whole water ecosystem.

As time goes on, people gradually realize that one of the effective ways to solve the increasingly serious environmental problems is to systematically and comprehensively manage natural resources, ecological protection, as well as economic development in the basin as a unit. [3] In this regard, the comprehensive management of the Tennessee River Basin in the United States is a typical case. There are already many countries in the world realizing the importance of following the laws of nature and conditionally implement the development plans to obtain the comprehensive benefits of water resources.

## 2 Development of the Yangtze River Basin

### 2.1 Water Resources Utilization

Yangtze River has been the mother river of China since ancient times. Yangtze River, especially the middle and lower reaches of it, has a large population and rich products. Since the 1980s, with economic growth, the water resource utilization in the Yangtze River has also been further expanded. The regional GDP of the 11 provinces and cities along the river accounted for more than 45% of China, while the population accounted for more than 40% [4].

The history of water resource utilization in the Yangtze River Basin is also since ancient times, from irrigation and boating to flood control and hydropower development. Due to the excessive development of the Yangtze River, the current situation in the entire basin in terms of water quality, water quantity, as well as biodiversity has become very severe. Some river sections, especially those in the major cities along the river, have serious water pollution and prominent lake eutrophication problems. Meanwhile, the heavy pollution and energy-consuming industries have brought greater environmental risks to the water environment of the watershed. Facing the interweaving of new and old problems, water resources protection under the new situation has a long way to go.



**Fig. 1.** Map of the Yangtze River Economic Belt.

### 2.2 Hydropower development

The construction of the Three Gorges Dam is an essential symbol of water resources development in the Yangtze River Basin. It integrates its water resources in flood control, power generation, shipping as well as other aspects. [5] It has huge comprehensive benefits and is of strategic importance to the sustainable development of China's economy. As China's largest power station, the Three Gorges Dam has significantly alleviated China's energy shortage, improved its energy structure and reduced pollution. The completion of the dam has made full use of the hydropower resources of the Yangtze River and provided sufficient clean energy for the economically developed areas in the middle and lower reaches of the basin.

However, the construction of water conservancy projects has not only led to economic development, but also caused a series of environmental problems. The discharge of sewage and garbage in the upper reaches of the Yangtze River has been increasing, while the pollution control has been lagging behind, and so the water pollution of the watershed has continued to increase and has further deteriorated trend. [6,7] Meanwhile, after the dam was completed and the water was stored, the self-purification capacity of the water in the reservoir area was reduced, and the water environment problems were still severe.

Although the construction of water conservancy projects will bring about a series of environmental impacts and problems, it should also be viewed from a dialectical perspective. On the one hand, regarding the negative externalities of water conservancy projects, continually pursuing development and transformation is very necessary, starting from the aspects of green development, ecological dispatching, water supply, etc., to minimize adverse effects as much as possible, and to relieve environmental pressures. [7] On the other hand, for the positive externalities of water conservancy projects, its function should be fully utilized, such as giving full play to its effectiveness in flood control and drainage, clean energy development, etc.

### **2.3 Watershed Administration Management**

The current water resources management system of the Yangtze River Basin has assigned different functions to different departments for implementation and supervision. Specifically, Water Conservancy Department is responsible for water source protection and water conservancy project construction; Urban Construction Department is responsible for urban water supply and groundwater drainage; the Bureau of Geology takes rural water conservancy and groundwater; Environmental Protection Department takes urban sewage discharge; Fishery Department takes the protection of aquatic organisms; Forestry Department takes wetlands; Transportation Department takes inland navigation; While the Ministry of Health takes drinking water safety.

Although this multi-supervision mechanism ostensibly concentrates the power of many departments, it cannot achieve the “one water” goal, nor can it assume the responsibility of comprehensive river basin management. There are obvious conflicts between water resources and water environment management mechanisms, which hinder the effective implementation of integrated river basin management measures.

From the perspective of physical geography, the watershed is a whole concept. However, the division of administrative regions has brought about the division of watershed management, which affects the comprehensive deployment of watersheds to a certain extent. As a large-scale enterprise rooted in the Yangtze River Basin for a long time, the China Three Gorges Corporation (CTG) has advantages in the unified watershed management, it plays to a leading role to avoid institutional obstacles as mentioned above, and to promote the development of comprehensive watershed governance in both terms of management and technology.

### 3 CTG moves from Hydropower Development to Comprehensive Watershed Management

#### 3.1 Importance of Yangtze River Protection

Flood prevention, power generation, and shipping are the initial missions of the Three Gorges Dam. However, with the increasingly serious environmental problems of the Yangtze River Basin, CTG is constantly seeking changes and trying new explorations. The concept of **"Yangtze River Protection"** came into being. The decision to promote the Protection is an inherent requirement for sustainability and a higher level of development.

In the past few decades, the environmental governance industry has continued to grow. From the traditional point source pollution control to urban/rural sewage/garbage plants, and then to the regional remediation of water environment in recent years. Although from the perspective of the project content, the water environment project in a single area contains multiple elements such as sewage treatment plants, river channels etc., which is quite comprehensive already, it is still fragmented governance regarding the level of the whole Protection. As it's shown from a series of environmental management projects carried out by CTG in the early stage, water environment governance under the condition of regional division is still the main focus, and the regional linkage and the comprehensive governance/management mechanism of large river basins have not been fully formed.



**Fig. 2.** Total energy generation of the CTG in different categories (TWh).

#### 3.2 "One Water" Control Goal

The integration of "one water" is an important concept in the construction of the Yangtze River Protection. It refers to the continuous improvement of the water quality as the core value, keep promoting the advancement of water pollution control, water ecological restoration, and water resources protection. Enhancing the integrity of major protection can be achieved by measures like strengthening system governance, building up the monitoring system for sewage outfalls, and jointly implementing cross-sectional water quality monitoring and early warning etc.

The proposal of the Yangtze River Protection is the embodiment of the concept of "one water". Hydropower development, clean energy exploration and the Protection are also integrated. Considering the entire basin as "one water" to better transiting the focus point from development to protection. From the previous "focusing on energy development in the

upstream while focusing on pollution control in the downstream" to current "focusing on source protection in the upstream while focusing on water ecological governance in the downstream", the concept of "one water" has been brought together to carry out joint dispatch in the Yangtze River Basin.

### **3.3 Water Pollution Prevention and Water Ecological Restoration**

With the continuous development of water resources in the Yangtze River Basin, the ensuing environmental conflicts have become the primary issue for its future development. Apart from the exploration of the comprehensive watershed management, carrying out water pollution prevention and water ecological restoration is also an essential mission at the current stage.

From "Develop of the Yangtze River" to "Protect of the Yangtze River", CTG has proposed a systematic solution to the problems of urban sewage governance and comprehensive water environment management. With taking the urban sewage governance as the starting point, while base on the total pollutant control, CTG has explored an integrated governance model of "factory network, river and lake shore", which will be piloted in 4 cities in the beginning, and then will be fully developed across the whole basin.

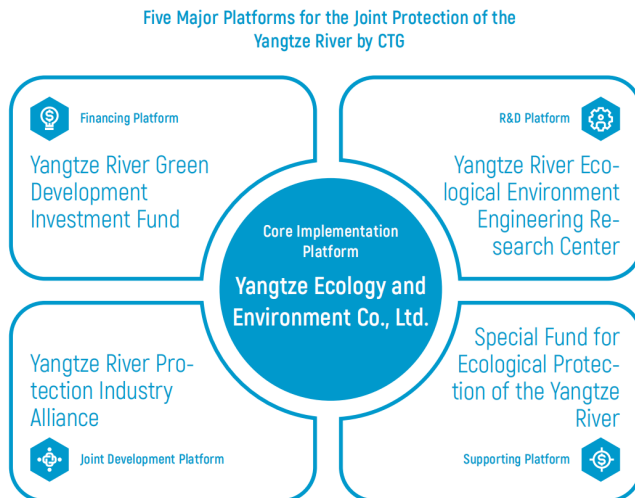
Over the past year, a number of environmental protection projects led by CTG have accelerated their implementation along the Yangtze River. By actively participating in the Protection and extending the industrial chain to the water environment, CTG has not only strongly promoted the ecological improvement of the watershed, but also cultivated new momentum for corporate development.

## **4 CTG's New Explorations in Enterprises Participating in the Comprehensive Watershed Management**

### **4.1 Urban Sewage Governance**

The Yangtze River Protection takes urban sewage governance as an entry point, and has already carried out pilot trials in four pilot cities: Jiujiang, Wuhu, Yueyang, and Yichang. Strive to explore a new water control mechanism through the implementation of a series of projects, and form a replicable and extendable experience.

The main methods of the urban sewage governance including: highlighting the key pollutant points, treat both surface and root problems, and select cooperative projects reasonably in the project reserve list. Focusing on the investment of sewage treatment plant and sewage pipe network survey, new construction, renovation, upgrade, operation and maintenance, as well as the water disaster prevention.



**Fig. 3.** Five Major Platforms for the Joint Protection of the Yangtze River by CTG.

### 4.2 Pipeline Governance

CTG is actively exploring new models and mechanisms for comprehensive governance of urban water environment, such as integration of power plants and rivers (lakes), equal emphasis on mud and water, different cities adopt different policies, as well as resource and energy recovery.

At present, there are five pollution sources in the water environment of the Yangtze River Economic Zone: urban domestic sewage and garbage, chemical pollution, agricultural non-point source pollution, ship pollution, and tailing pond pollution. At this stage, CTG takes the urban sewage governance as an entry point to advance the pilot and gradually carry out water pollution prevention and water ecological restoration, and clean energy replacement in cities along the Yangtze River Economic Belt.

### 4.3 Smart Water Systems

The ultimate goal of comprehensive watershed management is to achieve the overall fundamental improvement of the urban water environment quality. Under the guidance of this goal, CTG has decided to formulate a comprehensive urban water environment management plan.

The exploration of "Smart Water Systems" is an innovation of CTG in its new water governance model. In the past, China's water governance was not accurate enough, and it was difficult to solve these problems manually. This Smart Water System includes functions like water quality monitoring, prediction and forecasting, and smart scheduling. It achieves precise and smart governance through machines, programs, and software. For example, on a rainy day, sensors buried in the ground will collect and calculate the rainfall in real time, analyze how much rainwater will flow out of the pipeline, how should the storage tank be deployed to contain rainwater, and where should the treated rainwater flow.

#### **4.4 New capital model**

The Yangtze River Protection cannot achieve without financial support. CTG explores a new capital model through equity joint ventures, project cooperation, corporate mergers and acquisitions, etc. At the same time, CTG invests incremental funds to take over the stock assets of relevant urban sewage governance plants, pipelines and other water affairs platforms to continuously improve the scale of the governance and the efficiency of plant operations.

The local government obtains funds by transferring stocks of sewage treatment related assets to CTG through equity transfers and establishing joint ventures. On the premise of not increasing the scale of government debt, revitalize the stock of assets, drive new investment, increase the new effective investment in infrastructure such as sewage pipelines, to achieve the transformation of assets into capital/capital into shares, and to create a virtuous circle of assets, capital and projects.

On the one hand, the local government agrees to adjust the sewage treatment fee to cover the cost of sewage treatment and reasonable profit, and to establish a cost tracking and dynamic adjustment mechanism for sewage governance service fees. On the other hand, CTG and the

On the other hand, CTG has actively unites local enterprises to jointly develop integrated management of waste-water governance and development in the basin, and to explore the possibilities to achieve the collective value of ecological and economic benefits.

## **5 Conclusion**

The Three Gorges Dam plays a vital role in hydropower development, flood control and drainage. With the advent of a new development stage, CTG aims to achieve the transformation from hydropower development to comprehensive watershed management, as well as explore a new path for sustainable development in the Yangtze River basin.

The joint development of clean energy and environmental protection is the new strategy of CTG, who aspires to explore a replicable and extendable new mechanism in different directions, therefore, to promote the sustainable operation of the environmental governance industries, and to provide better environmental services for provinces/cities in the Yangtze River Economic Belt.

The watershed is "one water". The entire river basin must be protected and restored as a complete unit to reflect the scientific and effective nature. All the industries including water transportation, hydropower development, flood control, irrigation must be subordinate to serve the ecological protection and restoration of the watershed.

Currently, CTG is actively exploring a franchise mechanism for the integration of factory networks, rivers and lakes, and stream (district) areas. However, due to the significant characteristics of industry segmentation and regional segmentation in the environmental field for a long time, the extent of coordination of local governments and the rationality of project planning also affect the establishment of regional linkage mechanisms. As the requirements for comprehensive watershed management have moved from discharge compliance and total control to cross-section compliance and regional compliance, the requirements for governance-related technologies will gradually shift from single water governance technologies to integrated and smart water technologies.



In addition, CTG also has the pressure to "complement" the current technical deficiencies in some fields, to strengthen basic research and technology integration, formulate management regulations and intelligent methods. To sum up, the role of CTG in the transformation of comprehensive watershed management has already begun, but there is still a long way to go. The China Three Gorges Corporation (CTG) has launched a new exploration for Chinese enterprises participating in the comprehensive watershed management, which will provide ecological priority and green development experience for the watershed governance. The Yangtze River is also expected to become an extendable model for the management and governance of major rivers in the world.

## Reference

1. R.G. Lee, R. Flamm, M.G. Turner, et al., Watershed management: balancing sustainability and environmental change, 6, **4**, 240-249 (1995)
2. N. Johnson, H. M. Ravnborg, O. Westermann, et al., User participation in watershed management and research, CAPRI working papers, 3, **6**, 507-520 (2001)
3. W. D. Leach, P. P. A. Sabatier, Stakeholder partnerships as collaborative policymaking: Evaluation criteria applied to watershed management in California and Washington, *Journal of Policy Analysis & Management*, 21, **4**, 645-670 (2010)
4. Zhang Yanfang, Legal Perspective of Water Environmental Protection in the Three Gorges Reservoir Area, *Journal of Environmental Management College of China* (2008)
5. Hai-Yun W, Small Town Environmental Protection Planning in Three Gorges Region, *Journal of Anhui Agricultural Sciences* (2010)
6. F. Liang, Y. Sun, Implement and Innovate Environmental Protection Measures, Promote Green Protection of Cultural Relics in the Three Gorges Area, *Frontiers of Engineering Management (English Version)*, 1, **4**, 330 (2014)
7. C. Yong-Bai, L. I. Sheng-Rong, Environmental Impacts and Environmental Protection Progress of Three Gorge Hydroelectric Project on the Yangtze River, *Design of Hydroelectric Power Station* (2001)