

Research on the Strategy for Building a Yangtze River Digital Geographic Information Monitoring System

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Abstract: With the advent of the digital era, the Yangtze River basin has entered a stage of high-quality development. To adhere to the new development concept oriented by the construction of ecological civilization, we need to put forward new strategies to cope with the challenges of digital technology to better meet the needs of river basin management. Based on the dynamic development of digital twin basins and digital monitoring systems, the theoretical analysis framework of management and governance of the Yangtze River basin is built according to the internal logic of building intelligent water conservancy construction. It explains the high-quality development mechanism created by the cooperative management mechanism of water conservancy departments and social parties and the water resources circulation mechanism. In addition, we explore the possibilities of high-quality development goals in the digital era, from river basin culture to building construction and industrial transformation. The goal of the management and administration of the Yangtze River basin is to ensure water and ecological security that meets the expectations of the people in the basin and continuously improve water resource quality and regional satisfaction. To achieve the goals, we take measures such as strengthening data control based on the internal circulation of data quality, constructing a mechanism for interaction and feedback between data and user quality perception, and establishing an evaluation system to achieve high-quality development of digital twin basins and digital monitoring systems. Finally, they will promote the general protection of the Yangtze River and the high-quality development of the Yangtze River Economic Belt to satisfy humans.

1. Introduction

The management of the Yangtze River Basin is one of the primary responsibilities of the Ministry of Water Resources and a key part of intelligent water conservancy construction. It can be divided into basic and non-basic governance, comprising digital twin basins and digital monitoring systems. The Ministry of Water Resources assigned water conservation organizations at all levels to coordinate basin planning and supervision to achieve high-quality development in protecting the Yangtze River economic belt. Since the digital era, data has become the key to watershed management, and quality has become an evaluation index. Unlike traditional water conservancy management, intelligent water conservancy emphasizes digitization, networking, and intelligence. Therefore, this paper puts forward the digital twin basins and digital monitoring system issue, and high-quality development provides the goal for watershed management [1].

The digital twin basins are derived from the digital mapping with the physical watershed as the core. Its connotation contains intelligent simulation and is also a tool for precise decision-making. From a structural perspective, the digital twin basin focuses on the holistic element, the entire process, and the comprehensive scope. It combines data, models, and algorithms to realize modernization watershed management slopes. However, this is only in theory. Currently, digital twin basins have implemented a unique path based on demand traction, application supremacy, digital empowerment, and capacity improvement. The comprehensive improvement of intelligent water conservancy has changed the working mode of the water conservancy department, reflected the innovation of the water

conservancy department, and will rewrite the development pattern of the Yangtze River Basin. Therefore, intelligent water conservancy supports the construction of ecological civilization in the Yangtze River Basin. Therefore, the discussion of digital twin basin and digital monitoring systems must consider the perspective, science, accuracy, and security, and the pattern should be prominent. Therefore, we put forward the proposition of high-quality development under the new situation [2].

In short, high-quality development is the fundamental condition and guarantee for realizing intelligent water conservancy construction. In practice, the construction of intelligent water conservancy has made progress, but there are also areas for improvement. The water conservancy department still needs to identify the practical path for digital twin basins and digital monitoring systems, so it is still working hard. Therefore, the construction of intelligent water conservancy needs to be accelerated, which is not only the responsibility of the water conservancy department but also the historical mission of the Yangtze River Basin.

Based on the above background, this paper proposes a strategy for the Yangtze River digital geographic information monitoring system construction, which aims to promote the high-quality development of digital twin basins and digital monitoring systems. The problems in river basin management are solved by literature review and case analysis. The main content is to analyze the challenges and opportunities faced by the Yangtze River digital geographic information monitoring system in the current situation and propose corresponding strategies and measures. In addition, this study deeply explores data security, technological innovation, and institutional guarantee, which has important theoretical significance and practical value.

2. The Intelligence of Digital Twin Basins and Digital Monitoring System Realizes the Great Reform of Yangtze River Governance

2.1 The Intelligent Transformation of Digital Twin Basins: The Multi-integration of Bashu Culture and Shanghai Culture

Digital twin basin is a concept developed with digitalization, which highlights the concept of intelligent water conservancy and the innovation of the water conservancy department and reflects the transformation and upgrading of river basin management since the digital era. However, obtaining uniform and accurate results is still tricky when we construct the definition or essence with some criteria, such as data quality, model accuracy, and computational power level.

2.2 Digital Monitoring System, User Needs, and Market Trends: from the Three Gorges Project to the South-to-North Water Diversion Project

The digital monitoring system is an essential standard for watershed management, and it is a real-time expression of watershed status. The digital monitoring system and intelligent operation and maintenance platform discuss the multiple definitions of a digital monitoring system from data quality, analysis, and application. In addition, some scholars believe that digital monitoring can improve the efficiency of watershed management or the quality of the management. The digital monitoring system is more intelligent, automated, and visualized to some extent, which belongs to the intelligent water conservancy science with the purpose of high-quality development. The development history of the digital monitoring system can even be traced back to the Three Gorges Project. Its principal activities include water level monitoring, reservoir operation, flood control, and flood prevention.

Furthermore, the concept and technology of digital twin basins are closely related to the planning and design of the South-to-North Water Diversion Project. Due to digital monitoring, the water conservancy department has become a critical responsible party for river basin management [3]. The theory's main contribution to digital monitoring systems in the new era is to propose a watershed management model based on data-driven and intelligent decision-making. Therefore, the concept of a digital monitoring system initially focused on watershed management and management based on data standard attributes.

3. Digital Twin Basins and Governance Challenges Brought About by Digital Monitoring Systems

3.1 The confusion: Excessive Data Openness Has Caused an Imbalance in the Governance System

Compared with digital basins, digital twin basins emphasize the relationship between data and basins, which is dynamic, real-time, and intelligent. Although some experts have questioned that the data may not directly relate to the basin, most scholars argue that the data can rationally evaluate the basin. Some researchers proposed a classic construction model that includes four elements: data collection, data processing, data analysis, and data application. Since then, this model has become a typical tool for constructing digital twin basins, thus developing the concept of intelligent water conservancy. It is believed that the digital twin basin is operable and empowering. Only when the data interact with the situation digital twin basins will play a role. Therefore, the digital twin basin is the result of intelligent water conservancy. Moreover, scholars have summarized digital twin basins as a two-layer model: a digital mapping model based on physical watersheds and an intelligent simulation model based on mathematics. The former focuses on data acquisition and processing, while the latter focuses on data analysis and application, also called data-driven and intelligent decision-making. Digitalization has experienced some failures in practice, but from the perspective of the new era and new situation, we have improved the management level of water conservancy governance, and the concept of high-quality development has gradually become the consensus of the research and practice.

3.2 Digital Monitoring System: Humanized Operation of Technology

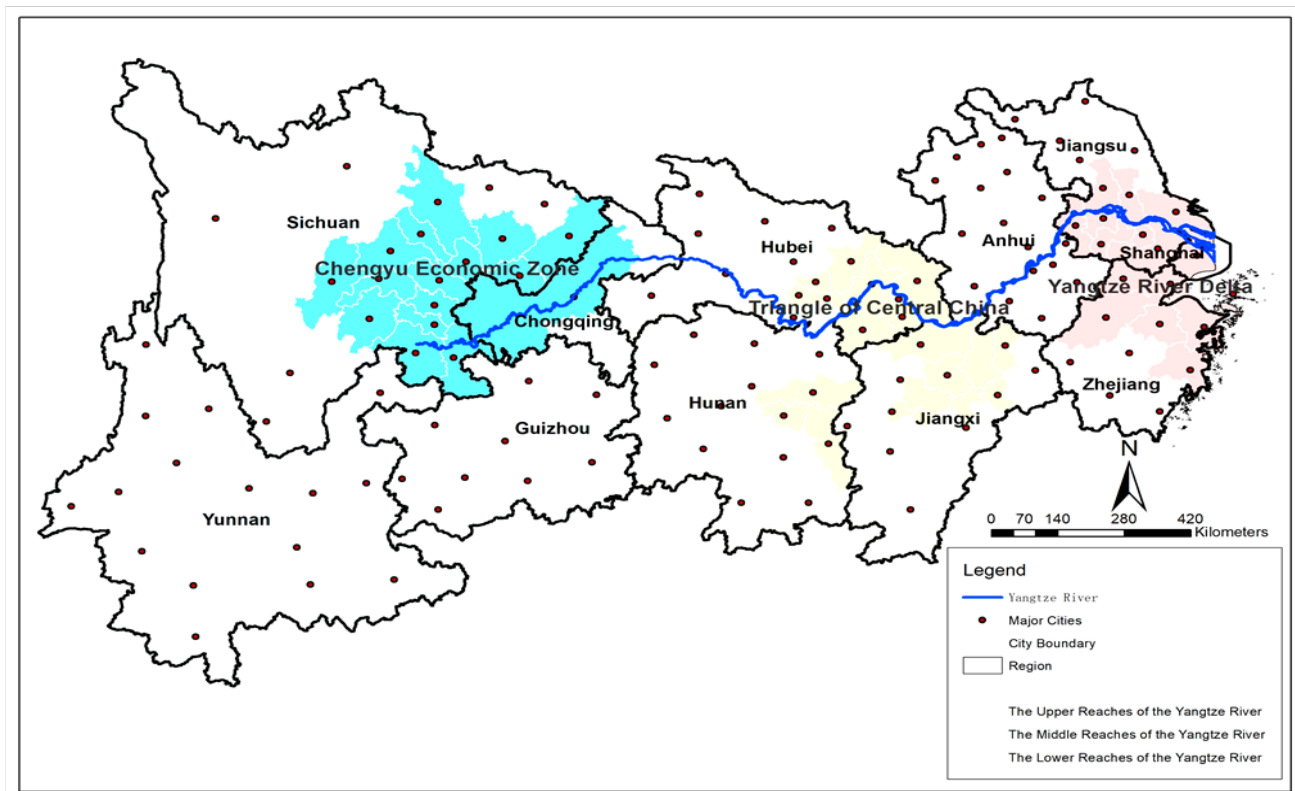


Figure 1 Yangtze River digital geographic information monitoring system

Digital monitoring system focuses on humanized operation under the influence of technology. It is the application of technological determinism thinking in constructing a digital monitoring system. To make up for the shortcomings of the lack of human nature under the guidance of technology, it has entered the research field as an alternative model: the framework of the human-oriented digital monitoring system. The basic concepts of the framework are as follows. First, the digital monitoring system should ensure the realization of humanized operation. Second, set professional standards for

humanized operation output. Third, use artificial intelligence, big data, and other technologies to capture humanized operations' needs, characteristics, and influence. Fourth, we apply a multi-dimensional evaluation method to evaluate the effect of humanized operation. The framework of humanized operation is connected with the digital monitoring system's goal, content, method, and mechanism. In addition, it emphasizes human care and improves the digital monitoring system's adaptability, inclusiveness, and sustainability [4]. Yangtze River's digital geographic information monitoring system is shown in Figure 1.

3.3 The Birth of Derivative Risks under the Rule of Artificial Intelligence: From the Protection of Cultural Relics in the Three Gorges to the Ecological Protection of the Yangtze River

The protection of the Three Gorges cultural relics is the main content of the cultural protection of the Yangtze River Basin, reflecting the value of cultural heritage and the historical and cultural status of the Three Gorges area and the Yangtze River Basin through digital technology [5]. The Three Gorges region has a long history and is rich in humanities. It is one of the birthplaces of ancient Chinese culture. The abundant water resources and convenient transportation have laid the foundation for the economic development of the Three Gorges region. Some components of the application and development of artificial intelligence technology in protecting cultural relics in the Three Gorges are gradually forming, such as intelligent identification, analysis, and display. Artificial intelligence and evaluation systems have also been paid more attention. However, from the perspective of artificial intelligence governance, the practice of some artificial intelligence technologies is still in its infancy, contrary to the logical framework and generation mechanism of ethics and law, resulting in problems related to data security, privacy protection, and responsibility attribution [6].

4. Countermeasures for the Industrial Transformation and Development Process of River Basins under Technological Challenges

4.1 Two-Way Upgrade: Historical Changes from Sichuan River Trackers to Yangtze River Shipping

From the perspective of industrial transformation, Yangtze River shipping is the fundamental link between industrial transformation and development in the basin and economic and social development. With waterway construction and maintenance efforts, the navigation capacity and traffic structure of the river have improved. Digital transformation is the primary challenge of Yangtze River shipping and is of great importance for the development of Yangtze River shipping. Nowadays, Yangtze River Shipping strengthens digital transformation control with technological innovation. There are three main forms: The first is intelligent dispatching. Intelligent scheduling is used for information sharing and collaborative optimization between ships and ports. The second is the standardization construction. The standardized control of the Yangtze River shipping is realized through the development of digital standards for ships, ports, waterways, etc., and the disclosure of digital standards to society. The third is to re-engineer the internal processes of the digital platform. In recent years, China Transportation Construction Group has used big data, cloud computing, and the Internet of Things to enhance shipping intelligence, improving transportation efficiency and safety. However, compared with European inland rivers, the digital level of the Yangtze River shipping needs to be further improved [7].

4.2 System Optimization and Co-governance: Transformation and Upgrading from the Yangtze River Economic Belt to the Yangtze River Cultural Belt

From the perspective of co-governance, the institutional response system cannot accurately provide the synergistic effect needed by the Yangtze River Economic Belt. We need the relevant information and negotiation mechanism of provinces and cities along the river, and the core of this problem may be the theory of co-governance. The co-governance theory describes the institutional response to the system as “big first, then small, first internal before external”. The development efficiency of the Yangtze River Economic Belt directly reflects the level of collaborative governance.

According to the Yangtze River Transportation Administration under the Ministry of Transport, the total throughput of goods and containers through ports along the Yangtze River is 3.16 billion tons and 19.4 million TEUs. However, most information is about the ecological environment, resources, energy, and industrial transformation, while information on cultural identity is relatively scarce. Usually, cultural identity is challenging to count or evaluate. To sum up, information asymmetry and imperfect consultation mechanisms cause obstacles in collaborative governance.

4.3 Rectification Technology: Cultural Inheritance from Yao Ji Goddess to the Three Gorges Charm

Cultural heritage needs technical support in river basin protection. In the technology mechanism, digital technology is an effective and standard tool and plays an essential role in cultural inheritance. Therefore, cultural inheritance is not only a technical concept but also a concept of humanities. Therefore, the cultural inheritance based on restoring the river basin has become the core. The practice of cultural inheritance is generally an innovative way gradually formed based on digital technology, although it contains traditional attempts. From the goddess Yao Ji to the charm of the Three Gorges, cultural inheritance is always related to the characteristics of the river basin. Cultural heritage is committed to humanistic care to meet the needs. However, when technology is overemphasized, it also brings about a dilemma: the phenomenon of technological domination. In general, cultural inheritance has room for improvement in content selection, form presentation, and effect evaluation. The mechanism needs further improvement, which is also an essential task of cultural inheritance.

5. Conclusion

Watershed governance has entered a new era, which puts forward new challenges and requirements for watershed industrial transformation. Technical challenges are a symbol of the complexity of watershed management and a means of development. Furthermore, it is in line with the urgent need of river basin coordination and maintenance of river basin security, and reflects the inherent requirements of river basin governance. Institutional response is to construct the theoretical analysis framework and practical mechanism of river basin governance with the assistance of technology. In recent years, modern information technologies such as digital twins have promoted watershed governance, and digitalization has enabled the accuracy of watershed governance. This study is in line with the internal logic of watershed development. Therefore, the technology based on digital twin also provides a new approach for watershed management. In conclusion, people should take measures to promote the sustainable improvement and development of the system, which is helpful to correct the technology and manage the basin.

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