

A Study of the Relationship Between the Development of Hydraulic Engineering and Social Change at the End of the Warring States Period

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Abstract: The later period of the Warring States is a significant era of great development and transformation in the history of China, marked by numerous achievements in politics, science and technology, culture, and the economy that have profound impacts on both the contemporary period and future generations. There were tremendous developments and significant advancements in the field of water conservancy engineering, playing an irreplaceable role in social transformation. This paper aims to provide an overview of the social transformations at the end of the Warring States period, with a focus on the development of water conservancy projects across various states. This paper summarizes and analyzes the impact of the development of water conservancy engineering during this period on social change, offering a unique perspective that enriches the understanding of the interplay between technological innovation and societal transformations during this critical period in Chinese history.

Keywords: Late Warring States period; Hydraulic engineering; Integration; Social change

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1. Introduction

With the advancement of productivity in the later period of the Warring States, a large number of iron tools were widely used in social production, significantly enhancing people's willingness to transform nature and their ability to utilize water. In response to the increasingly fierce need for unified warfare, all states made the control of water disasters and the construction of water conservancy projects important developmental topics, actively carrying out water conservancy projects. These projects played a positive role in agriculture, military, flood control, and transportation, greatly promoting the process of social transformation and unification.

2. Overview of the construction of water conservancy projects at the end of the Warring States period

All countries in the later period of the Warring States attached great importance to water conservancy projects and assigned personnel to oversee the construction and use of these projects. It is widely known that the representative water conservancy projects of the late Warring States include the Dujiangyan irrigation system, the Zheng Guo Channel, and the Shao Bi Reservoir project, among others. Their main functions include navigation, irrigation, and flood control. The construction of these water conservancy projects could prevent water and drought disasters to the greatest extent, improve crop soil, and thereby accelerate the increase in agricultural production levels and promote further development of various aspects of the social economy. Water conservancy projects could also improve transportation conditions in various countries, promote regional communication, and create favorable conditions for later unification ^[1]. At the same time, many comprehensive water conservancy projects built in the late Warring States played an important role in social development. The Dujiangyan irrigation system, built during the Warring States period, was the first comprehensive water conservancy project in Chinese history. The project was supervised by Li Bing, the governor of Qin Province, and it still plays an important role in economic and social development today. According to historical records such as “*Shi Ji*”, the main functions of the Dujiangyan include irrigation, flood control, transportation, and log floating. Its main structure consists of the water dam at the head of the channel, the rolling water outlet, and the water diversion dam. The fish mouth diversion dam divides the Min River into two parts, with the inner river mainly serving transportation and agricultural irrigation, and the outer river primarily for flood discharge. The ingenious design of the Dujiangyan effectively utilizes the natural shape of the Min River bed to cause the main current to oscillate at different water levels, maintaining an appropriate water level in the inner river and preventing the irrigation area from suffering from waterlogging or drought. The rolling water dam is located at the right side of the inner river near the bottleneck area, which can utilize the natural meandering of the river to flush sediment and clear the channel, thus avoiding silting up of the river and the intake area, and ensuring the smooth flow of water. The inlet of the Dujiangyan is located between the Liao-zhu and Yulei mountains, resembling a bottleneck shape, also known as the bottleneck. Its main function is to control the flow of water from the inner river into the plain area, allowing excessive water to flow through the Feisha Yan into the outer river area, thereby ensuring the safety of the inner river irrigation area. The various structures of the Dujiangyan work together to form a benign system, achieving the functions of flood control, irrigation, and transportation, and can automatically control water levels and sediment discharge. It effectively integrates natural environments with artificial dams, providing favorable conditions for regional economic development. A similar approach was also adopted in the design of the Zheng Guo Channel, where two branch canals were used to clear sediment and regulate water intake, meeting the needs of flood control, transportation, and agricultural irrigation. The construction of such water conservancy projects promotes agricultural development, improves the ecological environment, and enhances the synchronous increase of ecological benefits and economic benefits in the region.

3. The development of water conservancy projects at the end of the Warring States period to create favorable conditions for agricultural reforms

The development of water conservancy projects in the late Warring States period created favorable conditions for agricultural reforms, as evidenced by several key aspects. Firstly, soil improvement. The comprehensive improvement of soil improvement technologies was a driving force for agricultural development in the late Warring States period. With the development of water conservancy projects, many countries have already gained the ability to classify and improve soil, based on factors such as color, properties, and fertility. People

recognized the importance of fertilization, gained rich experience in planting, and understood that ensuring adequate sunlight and ventilation for crops could promote their growth. Meanwhile, the widespread use of various iron tools and the promotion of plowing with oxen led to the comprehensive development of irrigation, significantly increasing crop yields and achieving comprehensive development in agriculture, thereby significantly improving the level of social and economic development ^[2]. Secondly, silting and land reclamation. In the late Warring States period, influenced by factors such as a warm and humid climate and the degradation of wetlands, the area of flood and waterlogged lands increased, resulting in a unique landscape of salt springs and lakes in northern regions. To address these issues, all countries actively developed agricultural water conservancy projects to transform the low-lying wetlands and saline-alkali lands surrounding water sources, continuously improving the agricultural production conditions in irrigation areas, increasing cultivated land area, and thus establishing a mode of silting and land reclamation for agricultural water conservancy ^[3]. According to historical records, the earliest large-scale irrigation canal system in the country was the Zhangshui Canal in Wei, which mainly used turbid water from the Zhang River to irrigate the barren farmlands in Yan, significantly improving the agricultural production conditions and ecological environment in this area, thereby significantly improving people's living standards. In the late Warring States period, the Zheng Guo Canal constructed by the state of Qin also had the effect of silting and land reclamation. Located in the northern part of the Guanzhong Plain, with its starting point at the Jing River's Hukou and flowing into the Luo River to the east, a distance of about 300 miles, the main function of this canal was to introduce the high-organic content Jing River water into the low-lying saline-alkali and marshy lands in the Guanzhong area, to improve soil conditions and increase grain yields, thereby creating favorable conditions for Qin to unify the six states.

4. Development of water conservancy projects and integration of transportation routes at the end of the Warring States period

China's various regions of the rivers are mostly east-west. Before the Warring States period, waterway transportation was mainly completed within the natural waterways, and the inconvenience of transportation between the north and south seriously affected the economic development. At the end of the spring and autumn periods, countries built canal projects one after another, transforming the natural waterways to facilitate the transportation of the north and south, but most of the water conservancy projects are relatively small in scale, and scattered distribution in the southern region. At the beginning of the Warring States period, Wu prioritized the construction of He Shui connecting Ji Si and Gan Gou connecting Jianghuai in the course of the struggle for supremacy of the six states so that the Yangtze River and the Yellow River waterways were initially connected, but only the connection of the eastern ditch of the Central Plains was completed, and there was no comprehensive connection of the network of waterways of the Central Plains region. After entering the middle of the Warring States period, King Hui of Wei moved the capital to Daliang and organized the construction of water conservancy projects connecting the Yellow and Huai rivers ^[4]. To facilitate the connection between Cai, Chen, Zheng, Song, and other states and Wei, and to improve the control over the Central Plains, King Hui of Wei, during his reign, diverted the Yellow River water through the construction of water conservancy projects to Pudianze and passed it to Daliang, and dug canals in the northern part of Xingyang, and gradually established the main trunk of the Honggou, which started from Daliang, and went down to enter the Yingshui in the south, and the direction of the channel was connected with the Danshui, Vishui, and Sui-shui of the region north of the Surabaya River, and the combination of the low lying terrain of the southeastern part of the Yellow-Huai Plains, which was a good example of the connection of waterways between the Yellow River and the Huaihai Plain. Combined with the low-lying terrain of the southeastern Huanghuai Plain, it established a

waterway transportation network with the Jianghuai and Huaihe Rivers as the east-west backbone, the Honggou as the north-south hub, and the natural waterways as the branches, connecting several vassal states. The water conservancy project connected the channels excavated by various countries into a whole through appropriate extensions, thus forming a waterway transportation network connecting the north and the south. At the end of the Warring States period, the shipping system became more and more perfect, the arteries of the water system were effectively communicated, the north and south transportation was more convenient, the agricultural production conditions along the coast improved, the level of industrial development significantly increased, and the formation of Puyang, Dingtao, and other commercial cities, the socio-economic development has made great progress, which also creates good material conditions for the unification of the country in the late period. In addition, the establishment of an integrated waterway transportation network can promote the connection between the north and south basins and the surrounding areas, accelerate the exchange of cultural ideas, and facilitate the communication and interaction of various ethnic groups, so that people develop the idea of national unity, which also laid the groundwork for the social changes at the end of the Warring States period ^[5].

5. The development of water conservancy projects at the end of the Warring States period to promote great social change

At the end of the Warring States period, the society was in a state of turmoil, and the countries paid more attention to the construction of embankments, and the frequent wars and mergers made the embankment projects of each country have the roles of defense, offense and water control. At the beginning of the Warring States period, many countries carried out large-scale construction of embankment projects to strengthen the flood discharge function of the river, improve the flood control effect, and to a certain extent achieve the effect of fighting on the water for land, through the flood silt fertilization of the river embankment for agricultural production, which can significantly increase the total crop yield. At the end of the Warring States period, the attacks between countries became more and more intense. To enhance their comprehensive strength, all countries carried out the construction of large river embankments, and connected the various embankments, to form a larger inland area of the Great Wall. The state of Chu connected the mountains in its territory with the land and extended the embankments towards the east, thus forming the structure of the Square City. The state of Qin used the rift valley Luo and the rift valley next to the river to complete the construction of embankments, and its defense capability was significantly improved ^[6]. Qi expanded its defense gates to the east and built the Great Wall embankment. Zhao connected the embankments of Bushui and Zhangshui to build the Southern Great Wall. Yan organized the construction of the Yishui embankment to form the structure of the Yishui Great Wall. It can be considered that the embankment at the end of the Warring States period had changed from a mere water conservancy project to a defense project. At the same time, the embankment, while playing the role of defense, can also have a certain instrumental effect on the invaders through waterproofing. For example, in 358 BC, when Chu attacked South Korea, the water swept the peripheral area of the Changguan. In 225 BC, Qin attacked Daliang, the capital of Wei, through the method of releasing water from the embankment, and Zhao also repeatedly blocked the incoming enemy army through the method of releasing water from the embankment of the Yellow River. In addition to the conventional attack method of destroying embankments and flooding enemy troops, the increasingly mature and perfected technique of opening canals and dams at the end of the Warring States period was effectively combined with the embankment construction technique, which could accurately strike enemy troops who were far away from the water source. For example, in 455 BC, the allied forces of Han, Wei, and Zhi launched a siege on Jinyang, and in the case of a prolonged attack, they adopted the method of diverting Fen water to irrigate the city. The amount of Fen water used to irrigate the city was small,

and it was not enough to produce an effective impact on the walls of the city, for this reason, the leader, Zhi Bo, chose to set up defenses in the upstream area of Jinyuan, and after storing up water, he built a high embankment around the city of Jinyang, and then chose to cut ditches and channeled the accumulated Jinyuan water into the area of the embankment. The height of the Jin water that flooded the city was approximately the city wall, and the city was like a zephyr after the flooding, an exceptionally miserable sight ^[7]. In 279 BC, Qin general Bai Qi marshaled his army to attack Chu, and in the case of a prolonged attack, he adopted the method of irrigating the city of Yanya with water, setting up an embankment in the northwestern part of the city of Yanya, utilizing the Yi water circulating in the southeast direction to accumulate water and opening a ditch to Yanya, and then breaking the embankment to release the water, and it was recorded in the history books that after the release of the water, the people of Yanya died with the flow of the water amounting to several hundred thousand, and the east part of the city was permeated with the rotting stench of the corpses as the water flowed ^[8].

6. Conclusion

At the end of the Warring States period, to adapt to the needs of social development and unification wars, as well as to enhance their military strength and military transportation capacity, all countries are actively carrying out water conservancy project construction. All kinds of water conservancy projects in the fields of socio-economic development, flood control, agricultural irrigation, transportation, and other fields play a huge role and profoundly affect social change. The discussion of water conservancy engineering in the late Warring States period helps people to understand the development history of the late Warring States period from different perspectives, grasp the law of change of history, summarize the experience of historical development, and provide important references for the comprehensive enhancement of the level of construction of contemporary water conservancy projects and the resolution of many social risks.

Disclosure statement

The author declares no conflict of interest.

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