A comparative study of Water Control Cultures in China, Japan, and South Korea

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Abstract. The number of World Irrigation Heritage Sites (WHIS), selected by the International Commission on Irrigation and Drainage (ICID), have reached 140 as of 2023, and 83 of them are located in Asia, China, Japan and Korea, which accounts for more than 65% of the total[1]. This shows that the value of the Eastern Irrigation Project is being recognized worldwide. As an irrigation project, the engineering technology used and the effect of irrigation on the people are one of the most concerned topics, but the spiritual value behind the project are less explored. This paper is based on the investigation and comparison of varied Oriental irrigation heritages of China, Japan and Korea in the register, extracting the common Oriental water control culture of the three countries, and proposing the use of such a culture to help the collaboration around heritage protection in East Asia.

1. Introduction

The water control culture in the East, centered on China, has a long history, and many Oriental water conservacy projects have been left behind by the oriental peo-ples in the course of millennia of practice. These unique oriental "ideologies of nature", such as “tian ren he yi” (the unity of heaven and humanity)[2] from China, “onozukara” (being natrually)[3] from Japan, and “manmulrilryu” (All things in one category)[4] from Korea, convey eastern philosophies like adapting to the local conditions, sparing more and blocking less, and taking and using in moderation. They indicate the wisdom within varied water control cultures, showing the immanent unity of nature and humanized word that has withstood the test of history and time, and they are the reenactment of the dialectical materialist view of nature.

In the context of "Belt and Road", the cultural elements contained in the World Heritage Irrigation Structure (WHIS) of China, Japan and South Korea can not only strengthen the cultural ties between the three countries but also help them to protect and inherit their respective traditional cultures.

2. The concept of Eastern water culture

The “water culture” of China emerged on the periodical Harnessing the Huaihe River in 1988. In 2009, Lei Chen, the then Minister of the Ministry of Water Re-sources, proposed a basic framework of "water culture system" consisting of spiritual, institutional, and material culture[5]. In the general preface of The Chinese Water Culture Book Series[6], it is written that "China is a country with a long tradition of water control. In the long-term practice, the Chinese nation has created great material and spiritual wealth, forming a unique and rich water culture"[7]. In Chinese Water Culture Book Series - A Comparison of Chinese and Foreign Water Cultures, the broad framework of the relationship between "water culture" and "water conservancy undertaking" is simplified to a culture carried by water conservacy projects[8].

Moving to the Japanese "water culture", in "Water Culture Reflected in the Region - The Future of the Region Guided by Water - A Regional Activation Method for Preserving and Regenerating Water through Water Culture" published by the Ministry of Land, Infrastructure and Tourism, Ministry of Water Resources, water culture is defined as "the process of water utilization (effective daily water intake) and water control (flood control), in which the tangible and intangible culture and traditions are born. These culture and traditions include rituals, beliefs, traditional crafts, facilities such as waterwheels and weirs, water-centered lifestyles, and children's water games”[9].

Compared to the rich multifaceted "water culture" research in China and Japan, the research on Korean "water culture" focuses on individual heritage or folklore, and there is no systematic "water culture" research system. The term "water culture" is not clearly defined either.

Overall, although there is no unified interpretation of "oriental water culture" in the international academic field. The modern understanding of "oriental water culture" can be interpreted as the aggregation of internationalized material and spiritual cultures around water, which, conveyed by varied water conservancy projects, is preserved in the historical experience of water control and the savvy utilisation of water.

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3. The core of Oriental water control culture

“Relying on nature to survive” is a typical character of agricultural society. This is partly realised by building up water conservancy projects to ensure irrigation, prevent floods, and contribute food cultivation, which is the core of Oriental water control culture. Although as time goes by, some ancient project are no longer used for irrigation but have become tourist attractions instead (some examples include Sayamaike Reservoir, one of the most ancient Japanese water conservancy facilities, and Byeokgol-je Reservoir in Korea), there are also some of them that still play significant roles, one example of which is Quebei Pond, the oldest Chinese water conservancy project dated back to 600 BC that still covers 42 thousand acres of farming lands. It can be seen that the ultimate goal of diverting water for the benefit of people in each country has never changed, and the oriental wisdom and spirit of water control contained in the water conservancy projects of the three countries, which were born in the rice culture of agricultural civilization, are also in common.

China, Japan and Korea share the belief that "everything has a spirit, and every-thing has a life once it has a spirit", and that humans and nature are inseparable. In China, people have been pursuing the spirit of "the unity of heaven and humanity" and "the law of nature is being what it is" since ancient times; in Japan, people hold the concept of "onozukara" and the attitude of living in both the reverence of and the appreciation for the nature; and in Korea, the "멋" (mot)[10] sense of natural beauty is born from the fusion of the Chinese and Japanese concepts of nature and indigenous natural thoughts, and the pursuit of the natural realm of "oneness of things". Japan and Korea are influenced by Chinese Confucianism and Taoism, as well as Chinese Buddhism, and have a high degree of similarity with China in terms of nature and nature beliefs, as well as folk culture. In short, a general Oriental Water Control Culture consisting of the three East Asian countries is disparate from the counterpart of the Western world.

3.1 Understanding nature based on local conditions

On the basis of a full understanding of the natural environment, it is the general rule of water control in the East to take advantage of the favorable conditions in the environment by responding to the characteristics of the terrain, water and natural climate. China has a large geographical area with many river systems, but the distribution is uneven and disasters such as droughts and floods occur frequently. For example, constructions like Dujiangyan Irrigation System[11], Tongjiyan Irrigation Scheme, Chatan Weir Irrigation System, and Changqu (Bai Qi) Canal are representa-tive water diversion weirs and dams built by taking advantage of the natural environment and water flow patterns such as topography and terrain[12]. In addition, there is also a radial water storage and irrigation project Quebei Pond, which is built with three dikes from the water-drawing depressions; the Zhuji Shadoof, which makes rational use of groundwater extraction and conservation; and the ancient Sakya Water Storage Irrigation System in Tibet, which was built along the Sa'gya River to overcome the high altitude[13].

In relation to the cases in Japan, its natural conditions have resulted in short and fast rivers, small watersheds, flash floods during the rainy season and frequent drought during the non-rainy season. In such a natural environment, Japanese water conservacy projects are mainly based on ponding and irrigation. Some examples include the Takinoyu-segi and Ohkawara-segi Irrigation System, which combine rivers and waterways to create artificial waterfalls and irrigation water[14], and the Mu-rayama Rokkamura-segi irrigation canal, which uses contour bridges and waterways to draw water. Other irrigation systems include the Teragaike Pond and Teragaike Waterway, which uses natural terrain to connect small ponds and form large reser-voirs to expand the irrigation area, and the Minamiieki-kawaguchi-yusui Irrigation System, which makes savvy use of the terrain to cut rocks and make canals by drilling holes and creating canals[15].

As for the situations in Korea, the topography of the Korean peninsula is high in the northeast and low in the southwest, and the rivers flow in a southwestern direction and are densely distributed, which are mostly recharged by rainwater and prone to flooding in summer. As a result, the forms of water conservancy projects in Korea are relatively identical, most of which follow the directions of rivers. Some representative sites include Byeokgol-je[16], Chukmanje Dam, Dangjin Hapdeokje, Manseokgeo-Dam, and so on. In addition, the Goseong Dumbeong, in which deep stone wells are built to prevent the backfilling of sediment while filtering the water in areas with underground water veins such as beaches, is also in place[17].

The design and construction of water control projects in each of the three countries are different, but they all seek to take advantage of the natural geography as much as possible without affecting the local natural environment too much. Based on the understanding and investigation of various aspects, they develop and utilize the water sources according to the local natural conditions, while understanding the nature in a comprehensive manner, so as to achieve the integration with the natural environment on the basis of benefit to the people.

3.2 Mainly sparing and following natural rules

Flooding is one of the major disasters that have plagued mankind until now, and it is also one of the central purposes of water control in the East. The Chinese story of Dayu's water control has been passed to the present, and the water control policy of "combining sparing and blocking and focusing more on sparing", which follows the rule of nature, is also in use nowadays. Taking Chengdu area, a Southwestern region in China, as an example, it has long been threatened by the flooding of the Min River. In this case, the major water control project of the area, Dujiangyan Irrigation System, does not occupy too much land, block the flow, or set up a pipe

network. Rather, it relies on the concept of taking local materials and following the trend of nature to solve the flooding of Chengdu. It even helps to irrigate 10,000 mu (about 6.67 million square meter) of fertile land and contributes to the opening of a new waterway. The same damless water diversions as Dujiangyan Irrigation System include Zhengguo Canal Irrigation System and Dongfeng Weir. In addition, the Liaohe River Irrigation District, built by using the bend of the river to increase water storage and reduce the impact of the water, and the Itshan Weir, built by using the flow direction of the river of "two mountains like bells that lock both banks", are also the best examples of concentrating on sparing in water control[13].

The Japanese water control method for floods is also based on the principle of sparing. In order to slow down the flow of water and divert it into the irrigation area on the basis of flood drainage, Japan mostly uses the method of building oblique weirs in accordance with the flow direction of the river. The representative ones are Yamadazeki Barrage and its irrigation system, Shirakawa basin irrigation system, Matsubara-Muro Irrigation System, and Kounomizo-Hyakutaroumizo Irrigation System[15].

In addition, the canal construction, irrigation and drainage systems in both Chi-na and Japan are designed in accordance with the natural and scientific layouts of local regions. Examples of this are the Lingqu Canal, which is used for irrigation and navigation by using the spar and the large and small scale Three-Seven diversions[13.] the artificial river Kurayasu River, which connects the Yoshii River and the Asahi River; and the Kounomizo-Hyakutaroumizo Irrigation System, which con-sists of the Hyakumagawa River that is connected by a gate type water gate, plays the roles of both irrigation and navigation, and connects the Yoshii River and the Asahi River[15].

The two countries, which have been fighting against floods for a long time, have not only summarized the methods of water control such as diversion and sparing, but also devoted themselves to turning harm into benefit by using a variety of original science and technology containing people's wisdom to develop comprehensive water control projects such as flood storage and irrigation, combined irrigation and trans-portation, and integrated irrigation and drainage.

3.3 Using natural resources with temperance and feeding nature in return

Zizhi Tongjian[18] states that "there is a large number of creatures in the earth, and there is a large limit to what can be made by human power. If we take and use these creatures with temperance, they are always adequate. Otherwise, there will al-ways be shortage." This means that uncontrolled exploitation and use will inevitably lead to the depletion of resources, and only by taking and using in a measured man-ner and feeding nature will human beings be able to live together and prosper.

In China, since the Tang Dynasty, the Ministry of Water had been regulating water rights[19] through laws and regulations to ensure the construction of water conservation projects and the use and protection of water resources. There were special officials in charge of the maintenance of water conservancy projects, and the government and the people worked together to manage the repair and maintenance. As a result, some of the "annual repair systems" in many areas, such as Dujiangyan Irrigation System and Sangyuanwei Polder Embankment System, has been inherited even today. The Confucian idea of "equalization" has profoundly influenced the distribu-tion of water rights, one example of which is the "time-sharing irrigation" system of Changqu (Bai Qi) Canal that "established restraint and helped to equally allocate water resources in an orderly manner". The Ningxia Ancient Yellow River Irrigation System in Ningxia Province, with its three-time-a-year irrigation system, demon-strates the scientific and circular use of water[12]; the Ziquejie Terraces protects and uses water resources in four ways: conservation, storage, transmission and irrigation. The four-way protection and utilization of water resources in the Zigongjie Terraces system contributes to a healthy and prosperous ecosystem in the terraces in which humans and nature live in harmony[20].

While the first water law in Japan, the River Law, was introduced after World War II, the earliest trace of institutional water control in this country can be dated back to the Muromachi era, in which the local self-governing organizations "So" were responsible for water control and protection, and there were different "water practices"[21] depending on the varied natural environments. For example, the Tsujunyousui Irrigation System uses water for one day in the upstream and one day in the down-stream, which distributes water equally and fairly while protecting the environment and landscape. In addition to “water practices", Murayama Rokkamura-Segi Irrigation Canal, which covers 30 villages, is another typical example of the scientific approach to water use by local residents. These villages use the annual grain yield to set water consumption and water fees. Moreover, the Kounomizo-Hyakutaroumizo Irrigation System, which has been protecting 125 hectares of water-conserving forests since the Edo period, has inherited the idea of "creating and protecting water"[15].

In Korea, although there was an organization called " surijohap "[22] to manage water irrigation and agricultural production during the Japanese occupation, it was mainly the " hyangnyak"[23], a local association of "two classes", that made public water allocation and irrigation plans. In some areas, this tradition of water use has been maintained. For example, within the Goseong Dumbeong Irrigation System, 256 water groups still work together to irrigate. There is also the Gangjin Lotus Small Reservoirs eco-irrigation system, where hundreds of small ponds are linked to create a double and triple cycle systems that makes efficient use of water while forming a small ecosphere; the Gudeuljang Irrigated Rice Terraces in Cheong-sando[24] is another case of the scientific use of water and the protection of water ecology, where the natural environment is reshaped by laying slabs and filling with red clay and arable soil, which not only increases the

rice harvest but also helps to spread biological species and maintain biodiversity.

All the irrigation projects in the three countries guarantee the equal use of water resources and the temperance in the use of water by the system of water abstraction and water right regulations. In the process, the efficiency of utilising water resources is also improved by scientific water use and water recycling; and water sources and natural symbiosis is also protected to maintain the ecological balance and the harmony between humans and nature.

4. Conclusion

Nowadays, water pollution, waste of water, over-exploitation of water and other "water problems" become more and more serious, which have become critical public issues and needs to be solved urgently. The Oriental Water Control Culture has been handed down to the present day, and as a crystallization of the wisdom created by the working people of the East for thousands of years, it owns breathtaking water engineering heritages and widely worshipped water control spirits. There is no need to elaborate the historical and cultural value of these Oriental Water Control Cultures. But more importantly, in today's knowledge-based countries, the dissemination and development of Oriental Water Control Culture has certain inspirational and practical significance, both in terms of increasing internal ties and cooperation within the East-ern region, and in terms of solving "water problems", building new values, and even technological innovation for the whole world. This is also the most fundamental guarantee for the further spread and development of Eastern water culture in the context of "Belt and Road".concepts of nature and indigenous natural thoughts, and the pursuit of the natural realm of "oneness of things". Japan and Korea are influenced by Chinese Confucianism and Taoism, as well as Chinese Buddhism, and have a high degree of similarity with China in terms of nature and nature beliefs, as well as folk culture. In short, a general Oriental Water Control Culture consisting of the three East Asian countries is disparate from the counterpart of the Western world.

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18. *Zizhi Tongjian* is a Chinese history book written by Sima Guang in 1065 AD. It records the historical events of China from 403 B.C. to 959 A.D., covering a wide range of political, economic and other aspects.
19. Water rights refer to the ownership of water resources and the usufruct rights that are created out of ownership.
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21. The term refers to the customary public conventions for water use in each region of Japan before modern society, such as the allocation of water upstream and downstream for diversion and irrigation.
22. The term can be directly translated as "Water Conservancy Association", which was an organization that was formed in 1906 by landowners or cultivators to manage and distribute water resources and water facilities in accordance with public regulations, but in reality, after Korea was completely colonized by Japan in 1909, the "Water Conservancy Association" became a food production cooperative formed by Japanese colonists in collaboration with local landowners in Korea in order to use Korea as a food production area and increase food production so that the food produced could be imported to Japan at a low price.
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