

Urban Development from the Perspective of Lou Gang Polder System: Taihu Lake, Huzhou as an Example

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Abstract—Lou Gang world irrigation project heritage in Taihu Lake is a systematic irrigation project integrating water conservancy, ecology and culture. Through the methods of historical documents and field investigation, this paper deeply analyzes the formation history, connotation and value of Lou Gang polder system: Lou Gang heritage, describes in detail the relationship between Lou Gang polder system in Taihu Lake and the development and evolution of Huzhou City, and initially explores the protection and Utilization Strategies of Lou Gang water conservancy cultural heritage resources in Taihu Lake from the current situation.

Keywords—Lou Gang, protection strategy, urban evolution, water conservancy cultural heritage.

I. INTRODUCTION

WATER conservancy cultural heritage is a kind of material expression of cultural relics, sites, buildings and a variety of non-material manifestations of culture gradually formed in the process of people engaged in water related activities. Water cultural heritage is the historical witness of human water control and management, so its remarkable characteristic is its historicity [1]. Water cultural heritage will present different historical and cultural characteristics in different times, regions and nations. The value of water cultural heritage lies in two aspects: the first is the record of history and culture, and the human water activities recorded in intangible cultural heritage describe the relationship between people and water. The second is the characterization of the social development level at that time. The historicity of water culture can reflect the overall development level of the society at that time.

Under the background that the protection of historical and cultural heritage is highly valued at present, with the rapid development and construction of the city, the water conservancy cultural heritage cannot be certified and evaluated, and its living environment is seriously threatened: the construction of a large number of modern buildings, the rapid expansion of traffic roads, the encroachment of urban drainage on the river territory, and neglect and destruction of water conservancy cultural heritage is common. With various reasons, such as the lack of protection awareness, the low efficiency of management system or the drive of local interests, many ancient valuable water conservancy projects are easily

replaced by modern projects, and even some scattered ancient and modern water conservancy projects disappear directly, which may cause the damage or loss of water conservancy cultural heritage.

II. HUZHOU CITY DEVELOPMENT AND EVOLUTION

In the process of urban development for thousands of years, the city will change due to various factors, which may be the human reason of a social group, or the natural result of a piece of water, of course, it is more about the combined effect of the two. In the process of urban evolution, the most valuable embodiment of urban development is urban form. Urban form is the external outline shape of urban space, the overall form of urban spatial structure, the shape and appearance of urban plane and facade, and also a spatial system composed of overall spatial shape, internal structure and their interrelations [2].

Huzhou, an ancient city in the south of the Yangtze River with a history of more than 2000 years, is the only city in the Taihu Lake Basin in the name of Taihu Lake. The formation of Huzhou's basic urban form can be roughly divided into two stages:

The first stage: Zicheng site - back mountain and face water. From the perspective of Zicheng site, one of the most complete and oldest ancient city sites in China (the earliest Huzhou City, located 14 kilometers away from the southern suburb of the current urban area), the city, which covers an area of 2 square kilometers and has a history of more than 2300 years, is the time when the ancestors of Huzhou mainly engaged in fishing and hunting. For the sake of flood prevention, war avoidance and disease prevention, the city is located on the mountain second terrace with back mountain and surface water, and its shape is set along the mountain front terrace (as shown in Fig. 1).

The second stage: Old City encirclement - water vein collection. Huzhou is adjacent to Taihu Lake in the north, where the East and West Tiaoxi converge in the southeast of Hucheng, and the East-West river transport water vein is connected, forming a crisscross and connected river water network. With the help of natural geographical conditions, the ancestors of Lake City have greatly developed the level of agricultural productivity, and the pattern of the city has also changed: the original Piedmont terrace has begun to decline, the city has rapidly accumulated and expanded at the confluence of East and West Tiaoxi, and the urban form has developed along the river. With the passage of time, the basic urban form of Lake City has been formed, and the urban style

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has begun to have a water town in the south of the Yangtze River (Fig. 2).



Fig. 1 Site selection of ancient Zicheng



Fig. 2 Basic urban form layout of Huzhou

III. AN IMPORTANT ROLE IN THE DEVELOPMENT AND EVOLUTION OF HUZHOU CITY: LOU GANG POLDER SYSTEM IN TAIHU LAKE

A. General Situation of the Polder System in Lou Gang, Taihu Lake

Lou Gang polder system of Taihu Lake (as shown in Fig. 3) is a river system connecting the surrounding cities of Taihu Lake area and Taihu Lake area to lead and discharge Taihu Lake water. The river system leading to Taihu Lake is called "Lou" or "port", and the river system parallel to the direction of the levee around the lake is called "pond". Zongpu Hengtang forms a large-scale water network pattern of Tangpu Hengtang. Zongpu (Lou) Hengtang is connected with each other in position, and there are polder fields in it, which are collectively called "Tangpu polder fields" or "Lou Gang polder fields" [3].

The Lou Gang polder system of Taihu Lake, which originated in the spring and autumn period and Warring States period, is a unique system of canals. After more than two

thousand years of development, the Lou Gang polder system of Taihu Lake formed a mature water composed of the Taihu Lake dyke, the canal Hetang, the lake Lou Gang, several Hengtang and Wanqing polder fields in the Northern Song Dynasty Benefit system. The abundant water in Taihu Lake area flows to the land through Lou Gang and irrigates the Hangjiahu Plain area. Nowadays, most of the Lou Gang has disappeared due to lack of protection. Only the system of Lou Gang polder in Huzhou area has survived to this day, and it still has a fresh vitality. Lou Gang body of Taihu Lake is a combination of water conservancy, economy, ecology and culture. It has comprehensive functions of drainage, irrigation and navigation, and plays an important role in the world water conservancy system.



Fig. 3 Distribution of polder system in Lou Gang, Taihu Lake

B. Historical Reasons for the Emergence of the Polder System in Lou Gang, Taihu Lake

In the ancient Western Jin Dynasty, the Han nationality had its first great migration in history. Due to the impact of the war, a large number of people from the North migrated to the Taihu Lake Basin in the south. However, the most difficult thing for the people from the north to survive is that there are more lakes and less land in the Taihu Lake Basin, and there is a serious lack of land resources for farming. The surrounding areas of Taihu Lake are mostly marshes and mudflats, which are soft fluid mud land. The proportion of water and soil accounts for half of each. It is very difficult to use them for farming crops. So how to separate them has become the key for people to obtain land.

The ancestors of Hucheng used bamboo, wood and other local materials, and made a net of bamboo strips as support and fence. They dug the silt containing a large amount of water into the fence, and the water would flow into the river through the gap, gradually forming the land [4]. In this way, the ancestors of Hucheng began to excavate Lou Gang on the beach of Taihu Lake, water and soil began to separate, and new land began to appear slowly. One by one, the Hengtang connecting Lou Gang

was excavated, and the land of Taihu Lake Basin was divided by Lou Gang, forming a chessboard pattern. The excavated soil was piled around the land, called "polder". The water flows outside the polder, and the field is formed inside the polder, forming the Lou Gang polder field on the beach of Taihu Lake (as shown in Fig. 4).

C. The Value of the Polder System of Lou Gang in Taihu Lake

In Lou Gang polder system of Taihu Lake, the low-lying areas are excavated into fish ponds, and the mud in the ponds is used to build banks, forming a unique "mulberry based fish pond" of "fish farming in the pond, mulberry planting in the pond base, silkworm rearing in mulberry leaves, silkworm feeding in fish with silkworm sand, fish manure pond, and mulberry choking in the pond mud" [5]. This is a classic circular ecological agricultural mode in ancient China, which plays an important role in the agricultural development of the surrounding areas of Taihu Lake Basin Use.

The main source of sediment accumulated in Lou Gang system of South Taihu Lake is Taihu Lake area. People living around Taihu Lake Basin adopt the water gate regulation mode of "Qingming gate opening and Chongyang gate closing" to reduce the effect of sediment overflowing and lake current wind force due to the northwest wind in autumn and winter and the prevailing season of north wind, so as to prevent the river from being blocked by sediment. It can be seen that according to the characteristics of wind direction and water wave in Taihu Lake area, the gate of Lou Gang is set to the northeast, which is an important anti silting technology for river system entering into the lake in ancient China. The rippling and Hengtang excavated between the polder system of Lou Gang is an irregular network structure with dense density, which fully demonstrates the water system regulation concept of layer by layer regulation and storage, and enhances the diffusion of mountain torrents and torrents as well as the ability of flood discharge and deposition at the downstream. In the process of historical evolution, the polder field of Lou Gang has experienced changes in the pattern of large, medium and small, and finally formed a polder field system with moderate scale and reasonable layout, which is convenient for people's daily construction and maintenance, and embodies the concept of "respecting nature and conforming to nature".

D. Operation Principle of the Polder System in Lou Gang, Taihu Lake

Lou Gang refers to the small river with frequent and continuous distribution from Tiaoxi to Taihu Lake for flood discharge [5]. The characteristic of water is continuous flow. The Tiaoxi alluvial plain, where Huzhou is located, was originally a narrow plain between Tianmu Mountain and Taihu Lake. The river course is short and fast, and the current is turbulent and fast. Therefore, the interconnection between the river course and the lake area in the plain area requires the control of the lake water and the river water. Otherwise, the lake water flooding in the Taihu Lake Basin will make the surrounding fertile farmland beautiful pond mulberry. On the contrary, when summer comes, if we do not take measures to

store water, a large area of land will face drought and crops will not survive.

Lou Gang system makes full use of the lake ripples in the middle and lower reaches of the East and West Tiaoxi to regulate and store the water body, and the rapids receive slowly to weaken the water potential. At the same time, through the man-made East-West river channels to accommodate and release flood, the flood in the East, Xitiaoxi and the plain can be diverted into the Taihu Lake area through the Lou Gang system, while the "Loutang polder" built with the natural polder as the main body can basically prevent the original river network from being damaged, and give full play to the role of regulation, storage, flood discharge and self-healing of the river network. In this huge and complex Lou Gang system (as shown in Fig. 5), in addition to the crisscross network water system, there are also details such as sluice and bridge, which become the key to regulating Lou Gang water conservancy system. The sluice is set at the place where each Lou Gang water channel connects Taihu Lake, which is the key part of the manual operation in Lou Gang water conservancy system. The sluice is set at the place where each Lou Gang water channel connects Taihu Lake, which is the key part of the manual operation in Lou Gang water conservancy system. When the upstream area of Lou Gang is flooded, Taihu Lake can share the flood pressure for Lou Gang area. However, in the dry season when there is no water source, the water level in Lou Gang can be lowered, which can lead Taihu Lake water to irrigate farmland and meet the daily production and living needs of residents. Under the joint action of the sluice and the bridge, we can adjust the water in and out smoothly according to the situation. Everything is in accordance with the nature and let the nature be at its disposal.



Fig. 5 The relationship between Lou Gang system of Taihu Lake and Huzhou City

E. The Connection between Lou Gang Polder System of Taihu Lake and Huzhou City

In the map of Huzhou, it can be seen that the north-south river - "Lou" - extends to Taihu Lake; the East-West River - "Tang" - traverses between them, between the longitudinal Lou of Hengtang is the "polder". The dense Loutang River and the scattered polder form a chess plate type polder system of Lou Gang (as shown in Fig. 6), forming a water conservancy system and a canal of "one Li, one longitudinal Lou, two Li, one

transverse Tang" Network.

The polder system of Lou Gang in Taihu Lake is mostly distributed in the southwest of Taihu Lake. It is called Lou Gang in the east of Daqian port, mainly responsible for the waterlogging of the plain area around Taihu Lake and discharging into the lake area; it is called port in the west of Daqian port, mainly discharging the flood into the lake of Dongtiaoxi and Xitiaoxi. In the 1980s, there were 74 Lou Gang in Huzhou City, 39 in Wuxing district and 35 in Changxing County. Based on the renovation of water conservancy cultural heritage over the years, Lou Gang in Huzhou City has been basically preserved.

The "pond" across the East and West intersects with the cross into hulou port, which can be used for irrigation and navigation, or for water transportation to connect the surrounding areas. Ditang and other Hengtang formed the river system network in Huzhou and connected with the Beijing Hangzhou Grand Canal, which became the accelerator of the local urban development in Huzhou. After years of water conservancy and cultural heritage renovation, the Changhushen channel, with Ditang as the core, has become a golden waterway for inland navigation in China.



Fig. 6 Chessboard like polder system of Lou Gang

F. The Influence of Lou Gang Polder System of Taihu Lake on the Urban Evolution of Huzhou

Lou Gang polder system in Taihu Lake has a very long history, which is an important water conservancy cultural heritage in the process of population growth and urban formation in Taihu Lake Basin. The formation and development of lougang polder system in Taihu Lake witnessed the natural and cultural changes in Huzhou. Huzhou area has the reputation of "the land of fish and rice, the granary of the world" and "Su Hu is ripe, the world is abundant" in Tang and Song Dynasties, and the reputation of "the area of wealth and Fu", "the palace of silk" and "the country of culture" in Ming and Qing Dynasties. The important position of Huzhou in modern history is closely related to lougang, polder and water transportation system of Taihu Lake.

During the Tang and Song Dynasties, a large number of people in the North moved south, which promoted the development of Tangpu polder system in Taihu Lake Basin. During the Ming and Qing Dynasties, Huzhou transformed from a major grain producing area into a silk mansion. Relying on Tangpu polder, Sangji polder and waterway transportation, the silk industry rose, with increasingly rich products and

commercial trade. It was during the Ming and Qing dynasties that a large number of well-defined and interdependent town nodes, gradually formed in the dense plain water network in the east of Huzhou.

The polder system of Lou Gang in Taihu Lake still plays an active urban role in irrigation, flood control and drainage, water environment optimization, convenient shipping and other aspects in the development of dangjinghuzhou. In terms of irrigation, Lou Gang of Taihu Lake is an important irrigation water source in Huzhou plain area. Due to the direct connection between Lou Gang and Taihu Lake, it can easily draw water from Taihu Lake in dry seasons such as summer to supplement and guarantee the production and living needs of residents in the surrounding areas. In terms of flood control and drainage, Lou Gang of Taihu Lake discharges the upstream flood, mountain flood and plain flood of Tiaxi River into Taihu Lake area to reduce the flood. In the aspect of water environment, through the guidance of Lou Gang land in Taihu Lake, the water exchange between Taihu Lake and plain area is accelerated, which plays a great role in improving the water quality. At the shipping level, the network like water network system of Lou Gang in Taihu Lake provides many conveniences for the river shipping in Huzhou.

IV. PROTECTION STRATEGY OF WATER CONSERVANCY CULTURAL HERITAGE

A. Cognition of Water Conservancy Cultural Heritage

In the process of urbanization construction and development, the water conservancy cultural heritage should be explained clearly, and the surrounding heritage with historical and cultural value should be declared and registered actively. On the basis of the increasingly perfect distribution of water conservancy cultural heritage, supported by the basic principles of authenticity, integrity and sustainability, the reasonable protection plan of water conservancy cultural heritage is implemented.

B. The Restoration and Management of Water Conservancy Cultural Heritage Needs to Be Combined with the Connotation of Regional Water Culture

Rivers and waterways are the carriers of water conservancy civilization. For rivers and waterways with a long history, we should pay attention to the historical and cultural value of the environment itself. The successful experience of ancient rivers and waterways lies in the coordination of their surrounding environment. The coastal vegetation on both sides of rivers and waterways is mostly local species, which have strong adaptability to the regional natural environment. Therefore, for the restoration and management of water conservancy cultural heritage, the essence of ancient river engineering technology cannot be ignored, supplemented by the participation of modern technology, to ensure the continuity of the life cycle of water conservancy cultural heritage as much as possible.

C. Promotion of Protection Level of Water Conservancy Cultural Heritage

The inheritance and continuation of water conservancy

cultural heritage protection lies in updating the value connotation of water conservancy cultural heritage and improving the ability and level of protection and inheritance. It is necessary to promote the renaissance of water conservancy cultural heritage through scientific and reasonable utilization: First, the way of inheritance and utilization of cultural heritage should be adapted to modern development, combined with local industrial structure and industrial development, moderately developed and comprehensively utilized. The second is to explore the cultural and scientific value of water conservancy cultural heritage, fully grasp the operation mode of water conservancy system, and improve the theoretical system of water cultural heritage research.

V.CONCLUSION

In the Jin Dynasty, the people who came here used their wisdom to excavate Lou Gang and turn the waste mud into fertile soil for farming. In this way, the beach around Taihu Lake was developed and utilized, and the basic urban form of Huzhou was formed. With the development of the times, it gradually became one of the centers of economic development in ancient China. Today, thousands of years later, Lou Gang of Taihu Lake still plays its role in water conservancy and continuously influences the urban speech process of Huzhou. After thousands of years, Lou Gang in Taihu Lake still exists, is still full of vitality, is still benefiting the people, and is still regarded as a great wealth of material and spiritual. Lou Gang in Taihu Lake is a unique regional water conservancy cultural heritage in China, and Huzhou is one of the earliest and only intact regions around the Taihu Lake basin where Lou Gang water conservancy system originated. Lou Gang water conservancy system provides the basis for the development of regional economy, politics, society and culture in Huzhou, and witnesses the natural and social changes of Huzhou City. Lou Gang, Taihu Lake has become the land of fish and rice and the home of silk. Lou Gang culture bears the weight of history. Huzhou, zonglou Hengtang, the legend of a city rising on the water, is not only the real "ancient city of Lou Gang", but also the "Lou Gang culture" that influences the ancient and modern times and witnesses the evolution of the city. Water conservancy cultural heritage as an important starting point of ancient people's site selection and residence selection has played a huge role in the past. Today, with the rapid development of the city, it is more necessary to give full play to the wisdom of the ancients to adapt to local conditions, continue to play the role of water conservancy cultural heritage, and nourish one side of soil and water.

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