A Study on the Water Mill Industry in Urumqi During the Republican Era

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ABSTRACT

During the Republic of China period, the development of hydraulic resources in Urumqi provided favorable natural conditions for the survival and development of the water mill industry. Under the stimulation of market demand, water mill industry has become an important economic activity in the local area. During this period, Urumqi's water mill industry mainly engaged in four types of business: incoming material processing, self-grinding and self-sales, outsource processing, and consigned processing. In addition, Urumqi has introduced "foreign water mill" equipment and technology from overseas, and established a "water mill peer guild" system in management, as well as various business models. The water mill industry plays a very important role in the social and economic development of Urumqi. It not only facilitates the daily life of the people, but also drives the development of hydraulic related industries related to water mills.

Keywords: *Urumqi, Water mill industry, Hydraulic environment, Market demand.*

1. INTRODUCTION

In traditional agricultural society, water mill is a power grinding device that people use hydraulic power instead of manual labor or energy storage to serve their production and life. It plays a crucial role in people's daily lives. Compared to manual mill or energy storage mill, water mill has unparalleled technological advantages in power sources, transmission devices, and other aspects. Its efficient and convenient characteristics were undoubtedly the most convenient, labor-saving, and efficient grain grinding and processing machinery before the emergence of steam driven and electric driven grinding machines. During the Republic of China period, the water mill industry in Urumqi still maintained a certain scale and presented new characteristics that were different from the past. This article explores the hydraulic environment, market demand, as well as the scale, distribution, and business operations of the water mill industry in Urumqi during the Republic of China period, revealing its rise and fall.

2. THE HYDRAULIC ENVIRONMENT AND MARKET DEMAND FORMED BY URUMQI'S WATER MILL INDUSTRY

Urumqi is located in the eastern section of the northern foothills of the Tianshan Mountains. As early as the Qing Dynasty unified Xinjiang, the construction technology of inland water mills was introduced to Urumqi by the reclamation soldiers, who utilized local hydraulic resources to process food for the soldiers. Water mills have become an important part of people's livelihood. During the Republic of China period, the water mill industry in Urumqi achieved significant development, and the use of water mills became more widespread. "When grinding wheat, pulling donkeys and horses, or using hydraulic power, the giant wheel spins rapidly and roars loudly, commonly known as a 'water mill'. It can be seen in any city or town with waterways, rivers, or giant rivers." [1] From the above, it can be seen that the water mill processing activity has a long history in Urumqi. From the Qing Dynasty to the Republic of China period, it was already important for people's livelihood and formed a certain scale. So, how can the water mill industry develop and grow in Urumqi? From the mechanism of its formation, its

development and growth must meet two basic conditions: first, there must be abundant hydraulic resources, and second, there must be market demand for the formation of the water mill industry. These two aspects are the fundamental factors that supported the development and growth of Urumqi during the Republic of China period.

2.1 Hydraulic Environment

From the perspective of environmental history, the hydraulic environment that formed the water grinding industry should pay attention to the abundance of water sources and the elevation of terrain. The location of Urumqi's water grinding industry is closely related to its specific natural geographical environment, among which sufficient water sources and high water potential differences are the prerequisite conditions for the formation of the water grinding industry. As is well known, places engaged in water mill processing industry must have sufficient hydraulic resources as support, otherwise water mills cannot obtain sufficient power, and water mill processing industry cannot proceed. The water resources in Urumqi can be roughly divided into two types: river water and spring water. The main river water is the Urumqi River, with a total length of 214 kilometers. It flows from south to north and runs through the urban area, with abundant water and high flow velocity. The terrain on both sides is low-lying, the site is open, and the water flow difference is large. According to the hydrological survey results in 1941, the flow rate of the Urumqi River is 4.5m^3/s at low water levels, and can reach 200m^3/s at high water levels. [2] Generally speaking, the water flow drop is 2-3 meters, the flow rate is 0.2-0.3m^3/s, and the utilized water energy is 2-3 kilowatts. Ordinary rivers or irrigation channels can build water mills as long as there is a water flow drop of more than 2 meters. [3] Therefore, the Urumqi River fully meets the conditions for building a water mill. In 1942, Li Zhuchen accompanied the Northwest Industrial Expedition to inspect the salt industry in Xinjiang. Along the way, he passed through Urumqi and recorded the abundant hydraulic power in the Urumqi River basin, which was greatly used for water grinding. "The Urumqi River is very fast, with a drop of about five meters per kilometer, so there are water mills everywhere along the river." [4]

The one with a larger spring water flow is Shuimogou, which "is located ten miles north of the city and has two sources. One comes from a hot water spring and the other flows from the top of Shuimogou. The two waters merge for forty miles and then flow northward through ancient pastures for ten miles, merging with the Urumqi River". [5] From the perspective of geographical location and water resource conditions, Shuimogou is located at the northern foot of the Tianshan Mountains. There are dozens of springs in the ditch that accumulate and flow into a stream, with clear water quality. It runs from south to north, with a large drop in water flow and abundant hydraulic resources. Especially in this area, the geothermal resources are abundant, and the ditch water is not icy in the harsh winter, forming a continuous mountain stream that flows year round. Therefore, farmers in the Shuimogou area utilize the abundant hydraulic power in this area to build water mills and process grain. “Shuimogou is twenty miles away from the city, with mountains, trees, and water. The water source comes from the mountain and gathers in the ditch. A fence is built along the ditch, and wheels are placed according to the fence. The water barrier fence, the flow stimulates wheel, and the wheels rotate and grind. Therefore, one wheel pulls six grinding wheels, day and night without stopping, making things easier and more efficient.” [6] Based on the above discussion, two conclusions can be drawn: firstly, the hydraulic resources in Urumqi are very scarce, and only the Urumqi River and Shuimogou can provide rich sources of power for the water mill industry; Secondly, the two water sources mentioned above have a significant drop and turbulent water flow, which creates favorable conditions for the development and growth of Urumqi's water mill industry.

Although Urumqi is not rich in hydraulic resources, due to the lack of competition with agricultural irrigation, the development of agricultural water conservancy has provided abundant power resources for the development and growth of the water mill industry. During the Republic of China period, Urumqi not only built a number of new irrigation projects, but also reinforced and renovated its existing water conservancy facilities, and basically built a relatively complete agricultural water conservancy irrigation system, forming an artificial irrigation canal network connected by main and branch canals. The water environment was improved, and hydraulic resources became increasingly abundant. Some rivers and canals irrigated farmland while people used hydraulic power to develop the water mill industry. "From the Nanguan section, Xihe Street section to the Shijiayuanzi section, all channels on the side of the Urumqi River are built with drainage channels every half mile or one mile according to the terrain. When the water volume increases during the flood or rainy

season, the gates can be raised and lowered at any time to adjust the water volume." [7] The improvement of agricultural water conservancy facilities has created a favorable water environment and abundant hydraulic resources in Urumqi. “A canal flows from southeast to northwest outside the city of Urumqi... On top of this canal, many private water mills have been built. The closest distance between the two mills is only 200-300 meters. From south to north, there are Qi Family Water Mill, Bao Family Water Mill, Wang Family, Fu Family, Li Family, Yang Family, Mawen Shangmo, Mawen Xiamo, etc. In addition to building a solid dam, there is also a flood discharge gate. Water mills usually have double mills, which can grind 5 dan of wheat in one night.” [8] Therefore, some agricultural water conservancy facilities not only serve as irrigation water sources for agricultural production, but also provide rich hydraulic water related services for the development of Urumqi's water mill industry.

2.2 Market Demand

The broad market demand is another fundamental condition for the formation of the water mill industry. In the tenth year of the Guangxu reign (1884), after the establishment of Xinjiang as a province, Urumqi became the capital of Xinjiang, replacing Ili as the political, economic, and cultural center of Xinjiang. It gradually became an important commercial city in northern Xinjiang, and people's consumption levels increased day by day. A large number of mainland residents also migrated to Urumqi, resulting in an increase in Urumqi's population. According to the statistical data of "Xinjiang Atlas", in the third year of Xuantong (1911), there were 4,699 households in the urban areas of Urumqi, totaling 23,097 people, 2,643 households in rural areas, totaling 15,897 people, and 10 commercial ports, totaling 97 people. [9] During the period of the Republic of China, the population of Urumqi continued to grow, especially after the outbreak of the full-scale Anti-Japanese War. Xinjiang became the rear area of the war, and the social environment was relatively stable. Mainland merchants and civilians migrated to Urumqi to avoid the war, resulting in an increase in Urumqi's population. From 1933 to 1942, the total population of Xinjiang reached 3.73 million, with an increase of about 1.2 million people in the past decade. From the early days of Sheng Shicai's reign to 1943, Xinjiang received a total of 38 batches of 14,776 mainland Chinese settlers and 988 refugees, totaling more than 16,000 people. After arriving in Xinjiang, most of these people were resettled in Urumqi and its surrounding areas. In addition, during the all-around war of resistance against Japan, Sheng Shicai implemented a foreign policy that was pro Soviet and pro Communist. Under the guidance of this policy, Sheng Shicai established a united front relationship with the CPC. At the invitation of Sheng Shicai, about 100 Communists and more than 400 "new barracks" soldiers came to Urumqi from the mainland to work. [10] At that time, some mainland businessmen, politicians, and literary figures came to Urumqi to engage in various industries. Among these newcomers, "20% of them serve in politics, 50% engage in business, and 30% are engaged in agriculture and animal husbandry." [11] By the late 1940s, the population of Urumqi had reached 107,700 people. [12] The expansion of population has led to an increasing demand for grain and flour, creating a favorable market demand environment for the development of the water mill industry. "After the Republic of China, with the increase of Urumqi's population, a broad demand for flour market was formed, and the sales volume and scope of flour continued to expand. Domestic sales mainly supplied local residents, restaurants, food processing plants, breweries, commercial warehouses, etc.; export sales were also supplied to Altay, Fuyun, various regions in southern Xinjiang, Kobdo, Ulyasutai, and other places in addition to neighboring counties." [13] It can be seen that the good demand and economic benefits of Urumqi's flour market, as well as the rich hydraulic resources formed by the Urumqi River and Shuimogou, ensured the long-term prosperity of Urumqi's water milling industry during the Republic of China period.

3. THE SCALE, SPATIAL DISTRIBUTION, AND BUSINESS OPERATIONS OF URUMQI'S WATER MILL INDUSTRY

During the Republic of China period, the water mill industry in Urumqi experienced new development in both scale and distribution. Urumqi also became the region with the largest number of water mills and the most developed flour processing industry in Xinjiang at that time. On September 22, 1917, Xie Bin traveled to Shuimogou and said, "Ten li Shuimogou has more than ten households working in water mill industries. The water spring is clear and the trees are dense, making it a popular destination in the suburbs of Urumqi.” [14] By 1937, Urumqi had 34 mill households, with a registered capital of 86.9 million taels of water mills, 41 mills, and 207 employees. During this period, Urumqi water mills were mainly concentrated in five places: Shijiayuanzi, Xidaqiao, Xiguan, Nanguan, and Nanliang. By 1940,

the number of water mill households in Urumqi's Shuimogou, Mohe Canal, and Shijiayuanzi reached 104, with 135 mills. Among them, there are 54 Hui households, 49 Han households, and 1 Tatar household. 43 households in Mohe Canal, with 62 water mills; 38 households in Shuimogou, with 41 water mills; There are 23 households in Shijiayuanzi Canal and 32 water mills. The above water mills can process 202500 kilograms of flour daily, which can meet more than 90% of the flour demand of Urumqi residents at that time. [15] With Mohe Canal, Shijiayuanzi Canal, and Shuimogou as water sources, Urumqi has formed four distribution lines of water mills. By the end of 1945, there were 66 water mill households and 92 water mills in Urumqi. During this period, the spatial distribution range of Urumqi water mills gradually expanded, and a large number of water mills were widely built in various places such as Nanliang, Nanjie Lane, Xihe Street, Xinqiao Street, Yinhe Street, and Shuimogou in Urumqi.

After 1945, the water mill industry in Urumqi showed a significant downward trend in both the number of water mill households and the number of water mill plates. This was mainly due to the "Three Zone Revolution" in Xinjiang, which caused political instability. The Kuomintang Xinjiang authorities used the so-called "military special needs" as an excuse to force mill households to voluntarily process flour. Originally, they were processing mixed flour, but took away the flour. Some governments used their power to pressure and often demanded bribes. Some mill households could not bear the pressure, reduced their business scope, and even rented or closed the water mill. At the same time, some mill households engaged in illegal operations, evaded taxes, and made huge profits, and were punished by the government and shut down. Some mill owners also rented water mills but went bankrupt due to high rent and lack of working capital, resulting in operating losses. Due to political instability, the agricultural water conservancy facilities in Urumqi are in a state of disrepair, with some river embankments collapsing, water channels silting up, water sources decreasing, and profound changes in the water environment in some areas, which have limited the development of the water mill industry. Later, in order to solve the problem of flour supply for the military in Urumqi, the Xinjiang Provincial Government rectified the water environment in Shuimogou and established a flour factory here in October 1948. The factory can grind about 18,000 kilograms of flour per day and produce 500,000 kilograms of flour per month. After the completion of this factory, Urumqi's military supplies will be abundant. [16]

In terms of business operations, during the Republic of China period, the business of Urumqi water mills can be roughly divided into the following types: the first is processing with incoming materials, commonly known as "pulling the jacket", which is a common operating method in the water mill industry. After the grain is cleared and screened by the processor, it is sent to the grinder, who is responsible for processing and charges a certain processing fee. The general charging standard is "one-tenth", which means processing 1 stone of grain will incur a handling fee of 1 bucket, and processing 10 kilograms of grain will incur a handling fee of 1 kilogram. However, due to the different types of processed grains, the standards for collecting processing fees may vary. The second is self-grinding and self-sales. Water mill owners purchase raw materials and process them themselves, then sell flour to meet the demand of the flour market. This method is profitable and flexible in operation, but the water mill owner needs to have strong funds and good transportation conditions. The third is outsourcing or commissioned processing, mainly for processing grain for the military, merchants, and government units, collecting processing fees or providing flour to customers based on the flour yield. The fourth is exchange processing. For the convenience of users, the water mill owner purchases a large amount of grain to be processed into flour and stored. When users need flour, they exchange the grain for flour based on the quality and flour yield of the flour. Among the above four businesses, "pulling the jacket" and self-grinding and self-sales are the main businesses of water mills. For example, during the period of the Comprehensive Anti-Japanese War, among all private water mills in Urumqi, "pulling the jacket" accounted for about 40% of the annual processing volume, self-grinding and self-sales accounted for about 50%, and the proportion of other businesses was extremely small. [17]

4. THE TRANSFORMATION OF URUMQI WATER MILL INDUSTRY

The Republic of China period was a period of rapid development in Urumqi's water mill industry, as well as a period of transformation from traditional to modern, mainly including the following aspects:

The first is the introduction of "foreign water mill" equipment and technology from abroad. Before the Republic of China, the water mill technology system in Urumqi was single, and the water mill was mainly composed of wooden flat wheel structures, using hydraulic power to drive the grinding disc and

basket screen to operate. Although this type of water mill was superior to dry mill, it advanced the grinding process from using livestock as power and manual operation to using water as power and semi mechanical operation. This was a major progress in production technology, but manual operations were still required for procedures such as adding materials and collecting noodles. During the Republic of China period, the water mill industry in Urumqi not only had a huge scale, but also its technological system gradually improved. Some mills in Urumqi began to introduce new water milling equipment and technology from the Soviet Union in order to increase flour production and quality, taking advantage of the geographical advantage of Xinjiang's proximity to the Soviet Union. In 1917, Ma Zhengyuan, a Hui ethnic group from Urumqi, purchased a Russian style flour grinder from Ili and installed it on the water source on the west side of Jianhu near the Urumqi West Gate to the West Bridge. The mill machine was purchased from Russia and the house adopts a Western architectural style, with a grand scale. Compared to traditional water mills, "foreign water mills" not only have a larger scale, but also have unparalleled technological advantages. Due to the fact that "foreign water mill" can replace human labor with machines in grain processing, this type of water mill has fast efficiency and low cost. It can process 40 dan of wheat per day, and the processed flour is delicate and white, which is popular among the people in the market. [18]

After the introduction of new water mill equipment and construction technology to Xinjiang, some merchants in Urumqi hired water mill construction technicians who had returned from the Soviet Union. They imitated the principles of Soviet water mill machinery and transformed the old soil water mill into a new vertical wheel water mill. They used two parallel grooves to change the wooden wheel into an iron wheel, which was impacted by water flow and rotated. The lower fan grinding plate was fixed, and the upper fan grinding plate rotated, increasing friction. At the same time, the new water mill has changed from manual feeding to wooden elevator feeding, and the flat basket sieve surface has been changed to a round basket sieve surface. This not only facilitates operation, saves labor and effort, but also has fast speed, high efficiency, and more grinding surfaces. It can process 23 stones of grain per day and grind nearly 10,000 kilograms of surface. After the opening of this new style "foreign water mill", the old style "Dangdang mill" was unable to compete. In fact, "during the Republic of China period, many rivers and channels in Urumqi were built with high-power Russian style water mills or improved water mills." [19]

The second is the emergence of a "water mill peer guild" system in management. After the outbreak of the Anti-Japanese War, due to a large number of military and public officials entering Urumqi, the demand for flour increased. Some units directly sought water mills to process grain, forming vicious competition among the same industry. At the same time, some water mill owners often do not consider the quality of flour, arbitrarily increase the flour yield, and use illegal means such as whitening and blending to make huge profits, resulting in constant conflicts and contradictions between mill owners and merchants. In this context, Urumqi mills also selected representatives based on the location of the water mill in order to coordinate various relationships and ease supply-demand conflicts, and organized the establishment of the "water mill peer guild". Its main role is to jointly study and solve internal problems in the industry, coordinate issues related to raw materials, finished products, taxation, grain prices, and other aspects. The establishment of the water mill peer guild has played an important role in regulating industry operation order, coordinating industry relations, and unifying industry business.

The third is that various business models have emerged. From historical records, before the Republic of China, the operators of Urumqi's water mill industry were mainly officials and wealthy merchants, and their business operations were mostly independent, with larger scale mills often employing a certain number of workers to complete. After the Republic of China, in addition to independent operation, the water grinding industry in Xinjiang also developed partnership and leasing operations. Due to the high cost of investing in the construction of water mills, which cannot be borne by ordinary people, the investors and builders of water mills are often wealthy merchants with strong capital. Therefore, during the Republic of China period, the separation of mills and mill owners in Urumqi's water mill industry gave rise to a new business model of renting out mills. Some mill owners, after building their own mills, rented out their own mills to others for operation in order to ensure high profits, while collecting rent from them. The emergence of various business models in the water mill industry is a result of the development of the commodity economy and has played a certain role in revitalizing the market economy.

5. CONCLUSION

In summary, this article has discussed the hydraulic environment, market demand, scale, and spatial distribution of the water grinding industry in Urumqi during the Republic of China period. Due to the complete dependence of the water mill industry on hydraulic resource conditions, although the Urumqi area is always dry and rainy, the surface water resources formed by the snow water from the Tianshan Mountains and the development of water resources in the Urumqi River and Shuimogou by the government during the Republic of China period provide indispensable prerequisites for the large-scale development of the water mill industry. Meanwhile, as an economic phenomenon, the increase in demand for flour caused by the population growth in Urumqi during the Republic of China period created a favorable market environment for the development of the water mill industry.

The water mill processing industry has been endowed with important economic significance by some scholars. In terms of the role of the water mill industry, it plays a very important role in the social and economic development of Urumqi. Not only does it facilitate the daily life of the people, but the development of the water mill industry has also driven the development of hydraulic related industries related to water mills. For example, Urumqi Shuimogou was originally an unknown waterway. In modern times, local people have utilized the abundant hydraulic resources of Shuimogou to build water mills and process food. By the time of the Republic of China, this area had become an important hydroelectric industrial cluster and a trading center for grain and flour in Urumqi. Some water mills not only engaged in grain processing, but also opened oil mills, paper mills, milling mills, fragrance mills, etc., especially for the purchase and sales of grain and oil crops. The store industry, which provided food and accommodation for personnel from other regions who came to process grain and oil, also developed correspondingly in Shuimogou. The emergence of various formats has added vitality to the development of Urumqi's commodity economy.

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