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Construction of the Grand Canal and Improvement in Transportation in Late Imperial China

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Abstract

In this paper, I outline how different major segments of the Grand Canal were built in the Ming and Qing periods. It is necessary to note that the construction was extremely arduous. It was over 1,700 kilometers long, crossing the four provinces of Hebei, Shandong, Jiangsu and Zhejiang. Many of its segments were built on uneven slopes, which added great hardship in maintaining navigable water levels. Because of these construction difficulties, the construction of the Canal was a continuous project for three centuries, starting from the early fifteenth century and ending with the late seventeenth. I show that in this long process of the construction how the Ming and Qing governments solved the problems they met, and finally succeeded in improving the transportation between northern and central China. I also discuss whether the Grand Canal was the major factor which stimulated the growth of long-distance trade between northern and central China.

Keywords: Grand Canal, Transportation, Late Imperial China

1. Introduction

Adam Smith argued that trade resulted from unequal advantages. In response, Karl Polanyi pointed out that the institutions for trade had to be established before unequal advantages could be exploited. The terms of trade resulted in price, and where people bought and sold markets might be created. But not all exchange created a market.

According to Polanyi, long-distance markets, that is, markets serving long-distance trade, do not develop from local trade or local markets. Local markets are essentially neighborhood markets, frequented by housewives, where growers of grain or vegetables and local craftsmen offer their wares for sale. Though local markets are important to the life of the community, they are not the origin of long-distance trade. Long-distance trade has to overcome the difficulty of transportation, which is not a major problem in local trade. (Note 1)

Scholars, Wu Chengming for instance, have stressed the importance of the construction of the Grand Canal to the development of long-distance trade between northern and central China in late imperial China. (Note 2) Although G. William Skinner suggests the prevalence of macro-regional economic independence in the nineteenth century, he agrees that the "great sideways T", which was composed of the Yangzi River and the Grand Canal, succeeded in reducing the transport cost between north China, middle Yangzi, lower Yangzi, southeast coast and Lingnan, the five of China's eight marco-regions. (Note 3) Further his study, Yeh-chien Wang shows a formation of an integrated market of rice encompassing these regions in late imperial China. He finds that the price level of rice was increasingly higher from Suzhou to its northern cities, like Jinan and Tianjin, on the Canal. (Note 4)

In this essay, I shall outline how different major segments of the Grand Canal were built in the Ming and Qing periods. It is necessary to note that the construction was extremely arduous. It was over 1,700 kilometers long, crossing the four provinces of Hebei, Shandong, Jiangsu and Zhejiang. Many of its segments were built on uneven slopes, which added great hardship in maintaining navigable water levels. Because of these construction difficulties, the construction of the Canal was a continuous project for three centuries, starting from the early fifteenth century and ending with the late seventeenth. I shall show that in this long process of the construction how the Ming and Qing governments solved the problems they met, and finally succeeded in improving the transportation between northern and central China. I shall also explore whether the Grand Canal was the major factor which stimulated the growth of long-distance trade between northern and central China.

To begin with, the following section discusses why the Ming government needed a canal. It must be realized that canal, or other inland routes, was not the only channel for people to travel from the Yangzi delta to Beijing. Before the Ming dynasty, the Yuan (1279-1368) had built its capital at Beijing, and, without the benefit of the Canal, had transported grain from the delta to the capital successfully via the coast.

2. The abandonment of sea transport

The reason for building the costly Canal was administrative - the transport of grain tribute from the provinces to the imperial capital, Beijing. Beijing is located on the arid North China Plain. Because of the dry weather, the Plain was unable to produce sufficient grain to support the bureaucracy that was centered at Beijing and an army that was not only stationed at the capital but also spread out over the northern border regions. This endemic shortage of grain was occasionally aggravated by famine caused by flood and drought. One of the major causes of these natural disasters was the silty nature of loess, found widely distributed over the North Plain. (Note 5) As loess could not retain water, during the summer season, heavy rainfall would cause flood, but too little would cause drought. (Note 6) As a supplement to the local grain supply in the capital, a continuous transport of tax grain from the provinces, especially the agriculturally productive lower Yangzi, was necessary.

In the Yuan, the government transported tax grain to Beijing by sea. Every year, sea-going junks, laden with three million *shi* of rice, traveled from Liujia *gang* in the Yangzi delta to Tianjin near Beijing. The sea transport of grain proved successful. By the 1310s, the sea junks had been taking 2 million *shi* to the capital annually. By the 1320s, the annual volume increased to about 3 million *shi*. (Note 7)

Despite the success, the sea transport of tribute grain was terminated in the Ming because the new dynasty relocated the imperial capital. In 1368, the Hongwu emperor (1368-98) set up the capital at Nanjing. As Nanjing was located on the Yangzi, the transport of tribute grain became much easier. Instead of using the sea routes, grain boats transported grain to the capital on the Yangzi River. Because of this change, in the Ming, sea transport of the Yangzi grain became no longer necessary, except for a small shipment to the military garrisons in Liaodong. During the Hongwu reign, according to Wu Jihua, this shipment was less than 750,000 *shi* annually. (Note 8)

The sea transport of tribute grain was not revived even after 1421, when the Ming government had moved its seat back to Beijing. (Note 9) Going beyond the Yuan model for the grain tribute transport on the coast, the Yongle emperor (1403-24) decided to build canals on a large scale.

The superiority of canal transport over the coastal route is well argued in a memorial in 1412 by Song Li, the official in charge of the canal construction. Song pointed out that the same money needed to build a sea boat that could carry 1,000 *shi* of grain, could be used to build twenty canal boats with a total carrying capacity of 4,000 *shi*. (Note 10) From this memorial, it looks as if the cost of canal transport was a quarter that of sea transport. In fact, Song compared only the cost of boat construction, but did not account for the huge sums of money needed in the building and repair of canals. For this reason, despite Song's persuasive figures, it should not be concluded that the Yongle government preferred canal transport because of its low cost.

Hoshi Ayao, in his work on the Ming grain tribute system, suggested that the hazard in coastal transport was a reason for the building of the Grand Canal. As evidence, he cited the frequent accidents in sea transport of military rations from the Yangzi delta to Liaodong in the early Ming. (Note 11) However, it is necessary to note that the Liaodong military shipments were conducted on a journey much longer than the grain tribute transport in the Yuan with Tianjin as its northern terminus.

The discontinuity of coastal transport was probably based on an administrative concern. In the early Ming, the so-called Japanese pirates (*wokou*) had been active along the coast. In 1371, in the hope of stopping the pirates from communicating with the continent, the Hongwu emperor imposed a strict ban on private sea travel. However, the measure was of little avail. From the late fourteenth to the early fifteenth centuries, there were still frequent reports of piracy along the coast. (Note 12) These pirates robbed sea junks, taking from them, among other goods, shipments of government food ration being transported to the Liaodong military garrison. (Note 13) Failing to suppress them, the Ming government probably moved the transport from the coastal route to an inland route so as to guarantee the safety of the grain tribute delivery after the move of the capital to Beijing.

Nevertheless, the shift of the bloodline to an inland route was by no means easy. The Canal came about in stages as the Ming government tried to solve the problems it had to face.

3. Constructing the northern segment of the Canal

Map 1 shows the rivers and canals that linked Hangzhou and Beijing in the early Ming. In the south, two canals built in the Sui dynasty, which were known as the Jiangnan Canal (Jiangnan *he*) and the Li Canal (Li *he*), provided for transport between Hangzhou and Huaian. (Note 14) Huaian city located near, but not on, a tributary of the Yellow River. (Note 15) On this tributary, nevertheless, boats could sail upstream into the Yellow River to Xuzhou, and then from Xuzhou through the Si River to Jining. The transportation from Jining north to Linqing also seems to be easy. Two canals built in the Yuan, known as the Jizhou Canal (Jizhou *he*) and the Huitong Canal (Huitong *he*), had linked the two cities. (Note 16) From Linqing to the north, boats could travel to Tianjin via the Yu River and then to Tongzhou via the Bai River. On the last segment of the transport route, the Yuan government also built the Tonghui Canal (Tonghui *he*) in 1293 to facilitate transport between Tongzhou and Beijing. (Note 17) Therefore, in the early Ming, in-shore water

transportation had been quite convenient, except for a short distance by land from the Huaian city to the Yellow River.

However, it is hard to appreciate transport difficulties on a two-dimensional map. When the actual geographic relief is taken into consideration, in-shore water transport from Hangzhou to Beijing was a more complicated matter than is presented above. It must always be borne in mind that the Ming government delivered no less than 3,000,000 *shi* of grain every year via this route. Therefore, any small barrier on the route could be a huge obstruction to grain movement. From the south to the north, the first transport difficulty was on the short land route from Huaian to the Yellow River. It is necessary to note that land transportation, even for a few kilometers, posed great difficulty to the delivery of bulky products like grain.

Sailing on the Yellow River from Huaian to Xuzhou, however, was no easy matter either. The stretch of the Yellow River from Huaian to Xuzhou was shallow, and, therefore, dangerous for heavy grain boats. In the river segment near Xuzhou, huge and sharp rocks hidden or exposed dotted the river. These rocks created rapid currents that made this the most dangerous stretch of the river on the way to Xuzhou. (Note 18)

Leaving the Yellow River, grain boats arriving in Shandong met with new navigation difficulties. First of all, the terrain of the route between Xuzhou and Linqing was not even. It was like a high bridge with Nanwang as the highest point. Therefore, from Xuzhou to Nanwang, boats actually crawled on an uphill route against the flow of the small Si River. Second, the two canals built in the Yuan dynasty had, by the early Ming, largely become silted because of poor maintenance. Third, even after these canals were dredged, they were still too shallow to meet the anticipated increase in traffic. It must be realized that when the Yuan government built the canals in Shandong, it aimed to facilitate the annual delivery of a much smaller amount of grain than the Ming dynasty quota, for the Yuan grain fleet delivered to the capital only 300,000 *shi* annually, collected in Shandong, compared to 3,000,000 *shi* in the Ming, collected in the lower Yangzi. (Note 19) In other words, between the Yuan and the Ming, the traffic was increased by about ten times.

The last transport problem occurred in the metropolitan areas. The distance between Tongzhou and Beijing was only about 35 kilometers, but the transportation was carried out on land with an elevation of 40 meters. In the late thirteenth century, as mentioned above, the Yuan government had built a short canal, known as the Tonghui Canal, to improve the transportation of this route. Nevertheless, the Tonghui Canal had been deserted in the early Ming.

To summarize, in the early Ming, in-shore transportation required great improvement before it could be used for grain tribute delivery. The improvement works had had to solve the following problems: (1) the awkward transportation overland between Huaian and the Yellow River; (2) the shallowness of the Yellow River between Huaian and Xuzhou; (3) the malfunction of the Yuan canals between Xuzhou and Linqing, and (4) transportation overland between Tongzhou and Beijing. In 1411, by the order of the Yongle emperor, and in preparation for the move of the capital, Song Li began a transport improvement project. Under Song Li's supervision, by recruiting hundreds of thousands of laborers and investing tremendous state resources, the Ming government solved the first three problems within a few years.

Song improved the navigability of the Yellow River and the Shandong canals. With the help of 300,000 laborers, he rebuilt and enlarged the Yuan canals in Shandong. As illustrated in Map 2, the new waterway, called the Huitong Canal, connected Linqing in the north to Xuzhou in the south. In order to raise the water level of the transport route south of Nanwang, Song re-directed a tributary of the Yellow River at Henan province to Jining, flowing from Jining to Xuzhou, and then to Huaian. In 1412, the improvement works were basically completed. In that year, Beijing was able to collect 1,000,000 *shi* of grain through this new waterway. Three years later, with new-found confidence, the Ming government formally abandoned the sea transport of grain. (Note 20)

In 1415, alongside the abandonment of sea transport, the Yongle emperor ordered Duke Chen Xuan to take charge of the inland transport of grain tribute. Chen built a fleet of 3,000 flat-bottom boats for the shipment of 3,000,000 *shi* of grain from the Yangzi region. (Note 21) These boats were hauled up to Huaian, but from there, they were one by one put on rollers made of tree trunks and pulled by trackers to the Yellow River. This method of transportation was obviously arduous, slow and costly. In response to this transportation problem, Chen dug a short canal from Huaian City to Qingkou, where it joined the Yellow River. This canal was called the Qingjiangpu Canal (See Map 2 inset). (Note 22) The Qingjiangpu Canal was only about 10 kilometers in length, but it played the important role of linking the Li Canal to the Yellow River. With the completion of the Qingjiangpu Canal, a continuous inshore transport route by water was accomplished between Hangzhou and Tongzhou, near Beijing. The last leg of the journey from Tongzhou to Beijing was conducted over land.

Because Tongzhou was located at the end of canal transport for the Yangzi, it became the northern terminus of the grain boats. As the delivery of the grain tribute from Tongzhou to Beijing by cart was slow, the Ming government built imperial granaries at Tongzhou for the storage of grain. A century later, Censor Wu Zhong (*jinshi*, 1517) attributed the under-development of this route to objection by cart owners and customs officials in Tongzhou who feared that their benefit would be lost if any change was introduced. (Note 23)

In short, although the Yuan dynasty's Tonghui Canal, which linked Tongzhou to Beijing, was not rebuilt in the Yongle reign, after construction of canals on a large scale in northern China, the inland transportation in the Ming empire was greatly improved. By the Yongle reign, a boat leaving the Yangzi could sail all the way to Tongzhou. This was unimaginable before the Ming. Because of this transport advancement, the transport cost between Hangzhou and Beijing was reduced.

Nevertheless, the Yongle reign was only the initial stage of the canal age. After the Yongle period, the Ming government continued to make improvement to that imperial waterway. In 1527, for instance, under constant threat from northern nomadic tribes, the Ming court repaired the Tonghui Canal to speed up the transfer of grain stock from Tongzhou to Beijing. (Note 24) The repair work was completed in the same year. The repair of the Tonghui Canal, however, did not reduce the status of Tongzhou as the northern terminus of southern grain boats. Since the distance from Tongzhou to Beijing was an uphill route, the repaired Tonghui Canal was too shallow for the employment of heavy grain boats. To deal with this transport problem, the government had to build three hundred lighters (*bochuan*) for the transshipment of grain at the Tongzhou terminus. Despite this inconvenience, the Tonghui Canal reduced the transport cost from Tongzhou to Beijing by half. According to Wu Zhong, the official in charge of the repair, the transport cost was 0.1 tael by cart, but only 0.55 tael by lighter. (Note 25)

Greater transport improvement, however, was to come in central China. In the following section, I shall show how an independent canal was constructed in the Ming and the Qing periods when the Chinese government had to deal with the transport problem posed by the Yellow River.

4. Restraining the Yellow River

From the Yongle reign onwards, the segment of the Yellow River in Jiangsu province, from Qingkou to Xuzhou, became the southern transport route for the grain boats from the Yangzi delta (See Map 3). However, the Yellow River was too unstable to be a reliable transport route because of silting. (Note 26) In the lower reaches of the river, where the gradient was gentle, the silt carried down by the river accumulated rapidly on the riverbed. As the silt raised the level of the riverbed, the river burst its banks and shifted its course, not only causing large-scale flooding but also disrupting the Canal.

In the first half of the fifteenth century, the Huai River system flowed fast enough to carry the silt brought down by the Yellow River out to the sea. Starting from the mid-fifteenth century, however, the grain transport was increasingly endangered by the gradual instability of the Yellow River, as a reaction to silting in its lower course, it shifted back to its northern course to find new outlets to the sea. A disastrous shift occurred in 1448, when the Yellow River overflowed its northern bank into Shandong, departing from the course of the Huai. The raging floods not only destroyed the dykes guarding the Huitong Canal, but also left tons of silt at the bottom of the canal. In the south, the transport route between Xuzhou and Qingkou, which had been supplied with water from the Yellow River, also dried up, paralyzing the grain transport. Similar shifts happened again in 1452, 1489 and 1493. The Grain transport was stopped on each occasion of these shifts. (Note 27)

In its attempt to maintain the course of the Yellow River in the south, the Ming government began to construct stronger dykes. In the early sixteenth century, powerful dykes guarded the northern bank of the course between Xuzhou and Qingkou. (Note 28) From the east of Henan province to the sea, a long wall of dykes was built.

The dykes from Henan eastward prevented the Yellow River from shifting back to the north, but could not solve the chronic problem of silt accumulation in the lower course of the river. Prevented by the dykes from breaking out onto a northward course, the Yellow River shifted its course frequently to their south. In the sixteenth century, especially during the Jiajing reign (1522-66), the Yellow River shifted frequently between the courses known as the Wo, the Ying, the Kuai and the Sui Rivers before merging with the Huai River. (Note 29) (See Map 2) As the flow of the Yellow River changed from time to time, it was hard for the Ming government to maintain a navigable water level on the transport route between Xuzhou and Qingkou.

In response to the instability of the Yellow River, the Ming government attempted to construct more canals. For example, in 1560, the New Nanyang Canal [Nanyang Xin *he*] was dug to facilitate the transportation in the southern segment of the Huitong Canal. The project was in fact a removal of the short transport route from the west to the east of the Zhaoyang Lake between Nangyang and Liucheng (See Map 3). The new channel was protected from flood attacks from the Yellow River because it was located on a higher landscape, while the Zhaoyang Lake could serve as a buffer for the flood water coming from the west. (Note 30)

However, the construction costs of the canals were high. The New Nanyang Canal was budgeted at 70,000 taels, but the actual cost was ten times this amount. (Note 31) From then on, the Ming government was cautious about constructing more canals.

Instead of constructing more canals, in the second half of the sixteenth century, the Ming government turned to stabilizing the Yellow River. The prevailing theory of river conservancy was "binding the rivers to scour the sediments"

(*shushui gongsha*). Under that theory, a high velocity of water flow not only prevented the sediments in the water from being deposited on the riverbed, but also scoured the riverbed of the sediments that had accumulated there. In order to increase the velocity of the Yellow River, officials Zhu Heng (1512-84) and Pan Jishun (1521-95), who put this theory into effect, blocked all tributaries, and left only a single outlet from Xuzhou to Qingkou. They built strong dykes along not only the northern bank, but also the southern bank of the Yellow River. This was the first time in Ming history that the southern bank of the Yellow River was also heavily guarded with dykes. (Note 32)

However, in reality, it was impossible to build dykes in every segment of the Yellow River in central China. The government had to leave gaps at Xuzhou as well as Qingkou, the two points where the Yellow River met the New Nanyang Canal and the Huai respectively. As a consequence, those gaps became the new centers of flood attacks. Moreover, following the practice of "binding the rivers to scour the sediments", as the river flowed faster, these flood attacks became more violent. In response, the Ming government built more dykes.

The first major construction work to follow was the building of the Gaojia Embankment. The Gaojia Embankment was designed to adjust the flow of the Yellow and the Huai Rivers at Qingkou. (See Map 4) As shown earlier, "binding the rivers to scour the sediments" of the Yellow River required the direction of the Huai into Qingkou. However, because the Yellow River was higher in elevation than the Huai, the flow of the Huai was often forced back by the strong current from the Yellow River, causing large-scale flooding in the Huai basin. As a measure to strengthen the flow of the Huai River at Qingkou, in 1578, under the supervision of Pan Jishun, the Gaojia Embankment was built along the eastern bank of the Hongze Lake, into which the Huai was directed. The increased velocity of the Huai River as it flowed out of the lake towards Qingkou allowed it to overcome the strong flow of the Yellow River and continue its course to the east. (Note 33)

The Gaojia Embankment affected the canal transportation at Qingkou, for at this intersection of the Yellow River and the Huai River was also the Qingjiangpu Canal. If the flow of the Yellow River made it difficult to navigate from the Qingjiangpu Canal northwards prior to the construction of the Gaojia Embankment, with the embankment, the increased flow made navigation even more hazardous. When the canal junks arrived at Qingkou, they met strong currents from not only the Yellow River, but also the Huai. As a result, Qingkou became the most dangerous point for boat travel between the Qingjiangpu Canal and the Yellow River.

Meanwhile, Xuzhou, where the southern section of the Canal in Shandong entered the Yellow River, remained a centre of flooding. To fight against the flood water, Xuzhou officials also built high embankments to protect the prefectural city. According to an eyewitness account by Wang Shixing (1547-1595), well known for his travel records, in the last decade of the sixteenth century, the river embankment beside Xuzhou had been built to a height that was equal to the outer city wall. (Note 34) Even then, the lowland outside the city was often flooded.

By the seventeenth century, it was obvious to Ming officials that a feasible measure to alleviate the flooding and facilitate the grain transport was the building of a canal that was completely independent of the Yellow River. However, the Ming imperial treasury had been exhausted from the building of the New Nanyang Canal and other building efforts, and it could only complete this stretch of the canal segment by segment (See Map 5).

In 1603, after submitting a proposal with a low budget of 230,000 taels, Li Hualong, the Director-general of the Grand Canal (Hedao Zongdu), was successful in seeking approval from the court to construct a long canal to replace a segment of the Yellow River. Two years later, the Jia Canal [Jia *he*] was opened. (Note 35) The canal was built on a higher terrain east of the Yellow River between Xiazhen, the southern terminus of the New Nanyang Canal, and Zhihekou. The Jia Canal drew water from not the Yellow River, but the New Nanyang Canal with its water supply from the lakes in southern Shandong. For this reason, the Jia Canal was completely independent of the Yellow River. Another characteristic of the Jia Canal was its scale. The canal was about 130 kilometers in length, reducing quite a long stretch from the Yellow River as the transport route. (Note 36)

However, throughout the remaining years of the Ming dynasty, from Zhihekou east to Qingkou, grain transport still relied on the Yellow River. Flooding continued, except for a change of centre from Xuzhou to Zhihekou, the new intersection point between the Yellow River and the Canal. In 1623, before the collapse of the Ming dynasty, the construction of the New Tongji Canal (Tongji Xin *he*) had extended the canal east only as far as Suqian County. (Note 37)

The Grand Canal was ultimately completed in the early years of the Qing dynasty in the late seventeenth century. In 1678, with the approval of the Kangxi emperor, Jin Fu (1633-92), the Director-general of the Grand Canal, was allotted 2,500,000 taels of silver for the construction of a canal bridging the New Tongji Canal and the Qingjiangpu Canal. In 1686, the 186-kilometer-long Zhong Canal [Zhong *he*] was built for this purpose. (Note 38) Only then, after almost three centuries of effort, was the transport route completely divorced from the Yellow River, except for a single point at Qingkou.

Qingkou was hazardous, as three rivers merged at this point -–- the Yellow River, the Huai and now the Si River from

the Zhong Canal. From the Kangxi to the Qianlong reign, the Qing government took several measures to guarantee the smooth flow of these three rivers in and out of Qingkou. These measures included frequent dredging of the riverbed at Qingkou, and increasing the height of the Gaojia Embankment. (Note 39) Neither of these measures made Qingkou any less hazardous for canal junks. Crossing Qingkou, the boatmen had to steer their junks with great care. George Staunton, a member of the Macartney mission to China, who made this crossing from the north on November 2, 1793, left the following description of the seriousness with which boatmen sacrificed to the river deities as they had to cross the Yellow River at Qingkou.

The amazing velocity with which the Yellow river runs at the place where the yachts and barges of the Embassy were to cross it, rendered, according to the notions of the Chinese crews, a sacrifice necessary to the spirit of the river, in order to ensure a safe passage over it. For this purpose, the master, surrounded by the crew of the yacht, assembled upon the forecastle, and holding, as a victim, in his hand a cock, wrung off his head, which committing to the stream, he consecrated the vessel with the blood spouting from the body, by sprinkling it upon the deck, the masts, the anchor, and the doors of the apartments; and stuck upon them a few of the feathers of the bird. Several bowls of meat were then brought forward and ranged in a line across the deck. Before these were placed a cup of oil, one filled with tea, one with some ardent spirit, and a fourth with salt: The captain making at the time three profound inclinations of the body, with hands uplifted, and muttering a few words, as if of solicitation, to the Deity. The loo or brazen drum were beaten in the mean time forcibly; lighted matches were held towards heaven; papers, covered with tin or silver leaf, were burnt; and crackers fired off in great abundance, by the crew. The captain afterwards, made libations to the river, by emptying into it from the vessel's prow, the several cups of liquids, and concluded with throwing in also that which held the salt. All the ceremonies being over, and the bowls of meat removed, the people feasted on it; and launched afterwards, with confidence, the yacht into the current. As soon as she had reached the opposite shore, the captain returned thanks to heaven, with three inclinations of the body. (Note 40)

As Staunton shows, before crossing Qingkou, sailors sacrificed to spirits with reverence and awe; and after they had succeeded in leaving Qingkou, they felt that it was a gift from Heaven. The description vividly shows the unpredictable risks involved in travel as late as the eighteenth century, even through the transportation between central and northern China had actually been greatly improved.

5. Conclusion

In the early fifteenth century, when the Yongle emperor established the Ming capital at Beijing and decided to supply it with grain brought up through inland waterways, he opened a new era for political administration in China. As a result of his decision, the canal age emerged in China. In the early decades of this age, the government built canals in northern China. However, the gradual instability of the Yellow River urged the Ming government to extend the canal to central China. This canal extension came about slowly because it was costly, but it never stopped. When the Ming government collapsed in 1644, facing the same grain supply problem in Beijing, the Qing government continued the construction of the Grand Canal. Ultimately, in 1686, the full length of the Canal was completed, linking Hangzhou in the Yangzi region to the capital, Beijing.

The construction of the Grand Canal reduced substantially the transport cost between central and northern China. However, we must not exaggerate its effect on transport improvement. In the eighteenth century, canal transportation was still risky and awkward. Qingkou, where the Huai, the Canal and the Yellow River met, was extremely hazardous. North of Qingkou, the canal was built on an uneven terrain, which made the canal expensive to maintain and to travel on. In order to guarantee sufficient water supply throughout, the Ming government installed locks to adjust water level, and passing through these locks, boatmen had to hire trackers to pull their boats upstream, or even transfer their goods to small lighters if the water level had been substantially reduced by drought. Transshipment was viewed as such a necessity that the government allowed each large grain boat from Hubei, Hunan and Jiangxi to be accompanied by a small lighter with a carriage of a hundred *shi* for the purpose. (Note 41) Because of the high transport cost, in the early eighteenth century, local official Lan Dingyuan (1680-1733) was opposed to the canal transport of grain tribute. In a memorial to the Yongzheng emperor, he stated:

According to your servant‘s observation, along the Canal in Shandong and Zhili, as water is insufficient, [grain] transport is difficult. [Because of the shallow water, transport soldiers] have to pay fees for transshipment and spend time at grain depots. They have their boats hauled for a whole day, but can only travel a few dozen *li*. (Note 42) That requires a lot of labor and incurs financial expense. Generally speaking, the delivery of a *shi* [of grain tribute] to the capital costs more than ten *shi* of grain. (Note 43)

Lan pointed out that the cost of grain transport from the south via the Canal to Beijing was ten times the original price. This estimate reflects the high cost of canal transport.

In this light, what made the Grand Canal the major long-distance trade route in the eighteenth century was not convenience (relative, for instance, to coastal shipping). Perhaps we should draw our attention to other factors that

encouraged merchants to transport their goods by the Canal. (Note 44)

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Yeh-chien Wang. (1992). Secular trends of rice prices in the Yangzi delta, 1638-1935. In Thomas G. Rawski & Lillian M. Li (Eds.), *Chinese History in Economic Perspective* (pp. 35-68). Berkeley: University of California Press.

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Zhao Shiyan and Jie Xisi. (early fourteenth century). *Da Yuan haiyun ji*. (Repr. In *Xuetang congke*, vol. 1, n.p., 1915, pp. 79-87).

Notes

Note 1. Karl Polanyi. (1957). *The Great Transformation.* Boston: Beacon Press, (Chapter 5).

Note 2. Wu Chengming. (1985). *Zhongguo ziben zhuyi yu guonei shichang.* Beijing: Zhongguo shehui kexue chubanshe, pp. 217-46.

Note 3. G. William Skinner. (1977). *The City in Late Imperial China*. Stanford: Stanford University Press, p. 234.

Note 4. Yeh-chien Wang. (1992). Secular trends of rice prices in the Yangzi delta, 1638-1935. In Thomas G. Rawski & Lillian M. Li (Eds.), *Chinese History in Economic Perspective* (pp. 35-68). Berkeley: University of California Press.

Note 5. James Thorp. (1930). Soil. In John Lossing Buck (Eds.), *Land Utilization in China: Atlas; A Study of 16,786 Farms in 168 Localities, and 32,256 Farms Families in Twenty-Two Provinces in China, 1929-1933*. Chicago: Chicago University Press, pp. 134-5.

Note 6. Precipitation is least dependable in north China where it is the lowest and where over 80 percent falls in the summer months. See John Lossing Buck. *Land Utilization in China*, p. 2.

Note 7. See the record in Zhao Shiyan and Jie Xisi. (early fourteenth century). *Da Yuan haiyun ji*. (Repr. In *Xuetang congke*, vol. 1, n.p., 1915, pp. 79-87).

Note 8. Wu Jihua. (1961). *Mingdai haiyun ji yunhe de yanjiu*. Taipei: Academia Sinica, pp. 22-4. Wu cited several cases of sea transport in the early Ming from different contemporary sources for that argument.

Note 9. Wu Jihua argued that the move of the capital was based on a military concern: since the Ming northern frontier was frequently threatened by Mongol tribes, moving the capital to the north was an indication of the government's determination to hold the frontier. See Wu Jihua. *Mingdai haiyun ji yunhe de yanjiu*, p. 35.

Note 10. *Mingshi.* (1739, repr. 1974) Beijing: Zhonghua shuju, p. 4204.

Note 11. Hoshi Ayao. (1963). *Mindai sôun no kenkyû*. Tokyo: Nihon gakujustu shinkôkai, pp. 9-15.

Note 12. *Mingshi*, pp. 26, 29, 49, 31 and 88. See also Wu Jihua, *Mingdai haiyun ji yunhe de yanjiu*, pp. 25-31, 59-62.

Note 13. *Ming Taizu Gaohuangdi shilu*. (repr. 1961-6). Taipei: Shiyusuo, 166/4a.

Note 14. For a brief introduction to the construction of these two canals, see Ouyang Hong. (1988). *Jinghang yunhe gongcheng shikao*. Jiangsu: Jiangsusheng hanghai xuehui, pp. 70-96, and Ju Jiwu and Pan Fengying. (1985). *Jinghang yunhe xunli*. Shanghai: Shanghai jiaoyu chubanshe, pp. 174-364..

Note 15. Cen Zhongmian. (1957). *Huanghe bianqian shi*. Beijing: Shumu wenxian chubanshe.

Note 16. The Jizhou canal, linking Jizhou [Jining], and Anshan town in Dongping county, was built in 1282; the Huitong canal, linking Anshan town and Linqing, was built in 1289. See Ouyang Hong. *Jinghang yunhe gongcheng shikao*, pp. 176-81.

Note 17. *Yuanshi* records that when the Kublai Khan returned from Mongolia to Beijing in 1293, he was fascinated to see the lake near Beijing crowded with boats, and he rewarded the chief hydrologist, Guo Shoujing. See *Yuanshi* (1369-70; repr. 1976). Beijing: Zhonghua shuju, p. 3852.

Note 18. Tani Mitsutaka. (1991). *Mindai kakôshi kenkyû*. Kyoto-shi: Dôhôsha, pp. 27-49. Cai Taibin also provides a clear description of this issue. See Cai Taibin. (1992). *Mingdai caohe zhi zhengzhi yu guanli*. Taipei: Shangwu yinshuguan, pp. 47-59.

Note 19. There is no existing record to show the amount of the grain tax collected by the Yuan government from Shandong. However, the *Da Yuan haiyun ji* notes that because of the poor inland transportation, the Yuan government could transport no more than an annual amount of 300,000 *shi* from Shandong to the capital. See Zhao Shiyan and Jie Xisi. *Da Yuan haiyun ji*, p. 36.

Note 20. *Mingshi,* pp. 4204-5.

Note 21. Gu Yingtai. (1658; repr. 1994). *Mingshi jishi benmo.* Shanghai: Shanghai guji chubanshe, p. 100.

Note 22. Tani Mitsutaka. *Mindai kakôshi kenkyû*, pp. 331-5.

Note 23. The cart owners were opposed to the building of a canal because it would erode their livelihood. Customs officials were worried that once when the canal was built, they would find it more difficult to levy customs at Tongzhou because boats going to Beijing would not have to unload their goods at Tongzhou. See Wu Zhong. (1558; repr. 1992). *Tonghui he zhi*, pp. 13-5. Beijing: Zhongguo shudian.

Note 24. When Beijing was besieged by Oirad tribes in 1449, for fear that the imperial grain stored in Tongzhou might be seized by the enemy, some Ming officials suggested burning down all granaries there. See Wu Zhong. *Tonghui he zhi,* p. 51.

Note 25. Wu Zhong. *Tonghui he zhi*, pp. 6-7, 27-8.

Note 26. Shi Nianhai. (1991). You lishi shiqi Huanghe de bianqian tantao jinhou zhili Huanghe de fanglue. *Zhongguo lishi dili luncong* 1, 291, 296. Data collected in the 1950s suggests that the amount of silt annually carried by the Yellow river in Xinxiang county, Henan, was no less than 34 kilograms per cubic metre, and the average yearly amount of silt carried by the Yellow River from Xinxiang to its lower reaches and the sea was 1,380 million tons, or about 920 million cubic metres, sufficient to build an embankment a yard high and a yard wide going 23 times round the equator. See Teng Tse-hui. (1955). *Report on the Multi-Purpose Plan for Permanently Controlling the Yellow River and Exploiting its Water Resources*. Beijing: Foreign Language Press, p. 13.

Note 27. *Mingshi*, pp. 2016-24.

Note 28. *Mingshi*, pp. 2021-7.

Note 29. Major shifts happened in 1534, 1537, 1540, 1545, 1546, 1557, 1564 and 1565. For documentation of these shifts, see Cai Taibin, *Mingdai caohe zhi zhengzhi yu guanli,* pp. 74-81).

Note 30. For a detailed description, see Tani Mitsutaka, *Mindai kakôshi kenkyû*, pp. 117-45).

Note 31. *Ming Shenzong Xianhuangdi shilu.* (repr. 1961-6). Taipei: Shiyusuo, 36/5a-b.

Note 32. In 1572, for instance, under the supervision of Zhu Heng, powerful dykes were built along the southern bank of the Yellow River from Xuzhou east to Suqian. (See *Mingshi*, p. 3041.) Between 1578 and 1580, Pan Jishun even built outer dykes, known as *yaoti*, from Xuzhou to Suqian on the southern bank, and from Xushou to Pi county, and Suqian to Qinghe on the northern bank, to consolidate the flow of the Yellow River. (See *Mingshi*, pp. 2051-3.) For a summary of Pan Jishun's works on dyke building, see Fang Ji. (1957). Mingdai zhihe he tongcao de guanxi. *Lishi jiaoxue* 9, 17-24, 52.

Note 33. Tani Mitsutaka. *Mindai kakôshi kenkyû*, pp. 376-9.

Note 34. Wang Shixing. (repr. 1597), Guangzhi yi. In *Wang Shixing dilishu sanzhong*. Jiangsu: Shanghai guzhi chubanshe, p. 266.

Note 35. *Mingshi*, pp. 2125-6. The proposal to dig the Jia canal had been presented in 1575. However, as it required a budget of 1,500,000 taels, the court turned it down. See *Mingshi*, p. 2123.

Note 36. For a detailed description of the Jia canal, see Tani Mitsutaka. *Mindai kakôshi kenkyû*, pp. 152-275, and Cai Taibin. *Mingdai caohe zhi zhengzhi yu guanli*, pp. 107-14.

Note 37. *Ming Xizong huangdi shilu.* (repr. 1961-6). Taipei: Shiyusuo, 72/5a-b.

Note 38. Hou Renzhi provided a detailed description of the River Conservancy, including the construction of the Zhong Canal by Jin Fu. See Hou Renzhi. (1936). Jin Fu zhihe shimo. *Shixue nianbao* 2, no. 3 (1936), 43-88.

Note 39. Ouyang Hong. *Jinghang yunhe gongcheng shikao*, pp. 264-9.

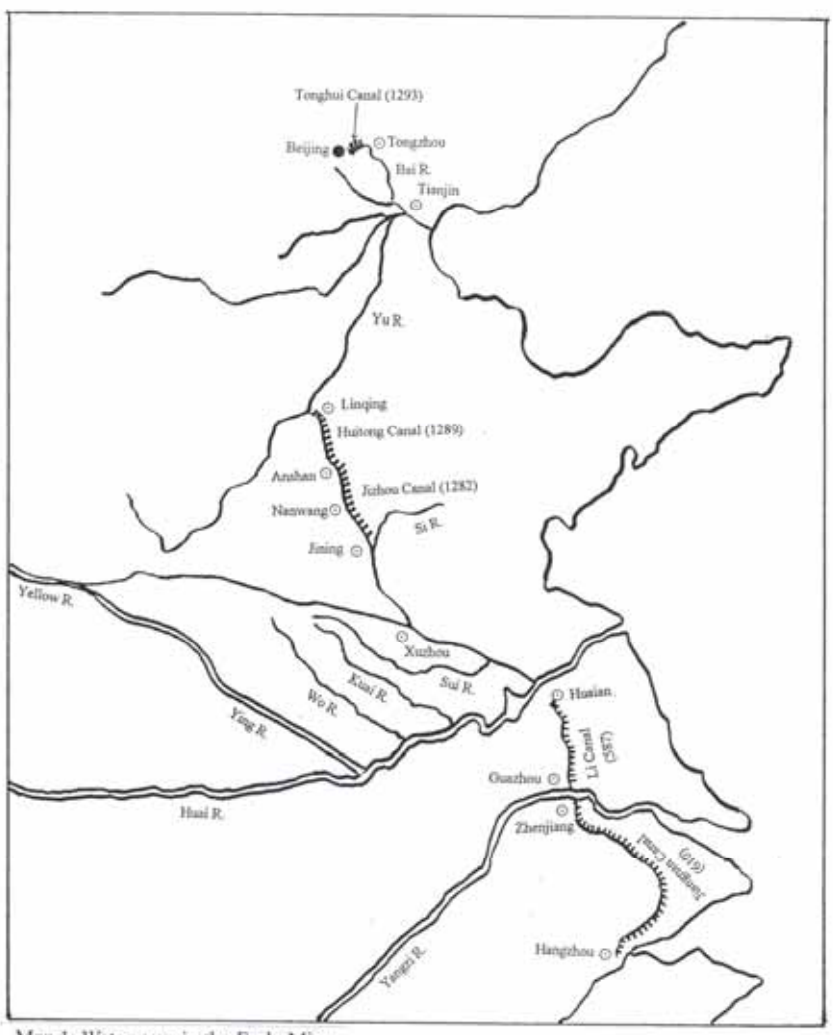
Note 40. George Staunton. (1797). *An Authentic Account of an Embassy from the King of Great Britain to the Emperor of China.* London: G. Nicol, pp. 403-4.

Note 41. *Caoyun quanshu.* (1735; repr. 1987). Beijing: Shumu wenxian chubanshe, pp. 167, 872.

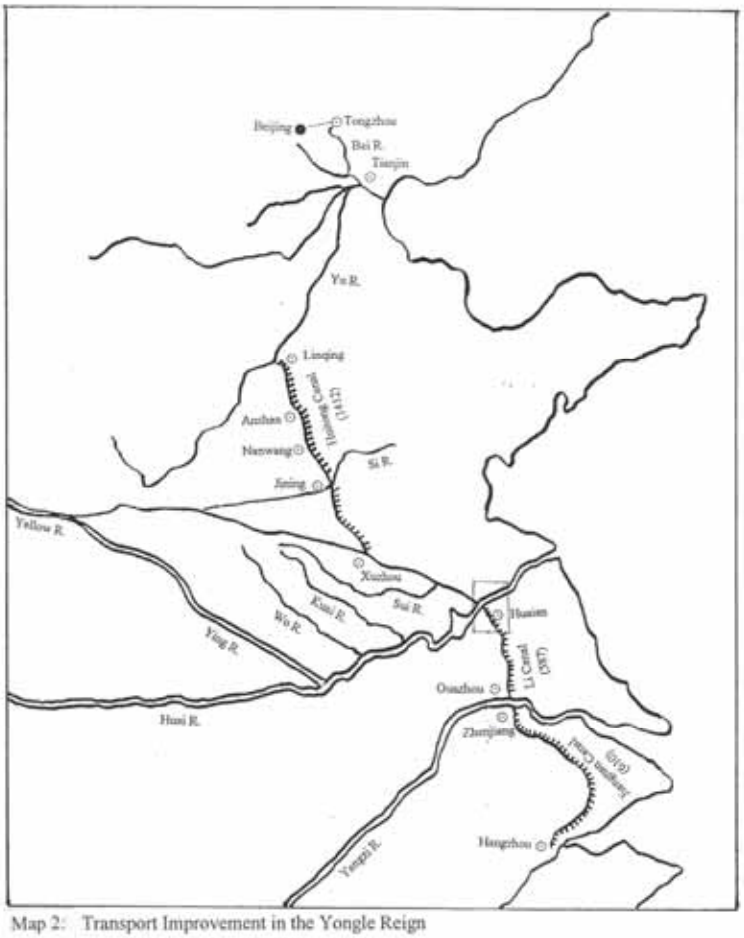
Note 42. One *li* equalled 1,800 *chi* in the Qing, that is 558 metres approximately. See Liang Fangzhong. (1980). *Zhongguo lidai hukou tiandi tianfu tongji.* Shanghai: Renmin chubanshe, pp. 526, 542.

Note 43. Lan Dingyuan. (n.d.). Caoliang jianzi haiyun shu. (n.d.; in *Qing jingshi wenbian*, Beijing: Zhonghua shuju, 1992, repr. from He Changling, ed., *Huangchao jingshi wenbian,* 1886, first printed in 1827), 48/19a-21b.

Note 44. Nakahara Teruo, Xu Tan and Zhang Zhaodong have pointed out that the canal trade was in fact subsidized by the Qing state through the administration of the tribute grain transport. The government allowed transport soldiers to carry a certain amount of duty-free goods to Beijing, but it was common for them to sell the shipment allowance to merchants for the transport of goods on the Grand Canal. See Nakahara Teruo. (1959). Shindai sôsen ni yoru shôhin ryûtsu nitsuite. *Shigaku kenkyû* 72, 67-81; Xu Tan. (1992). Ming-Qing shiqi yunhe de shangpin liutong. *Lishi Yanjiu* 1, 80-5; and Zhang Zhaodong. (1992). Qingdai caoyun yu nanbei wuzhi jiaoliu. *Qingshi Yanjiu* 3, 67-73.



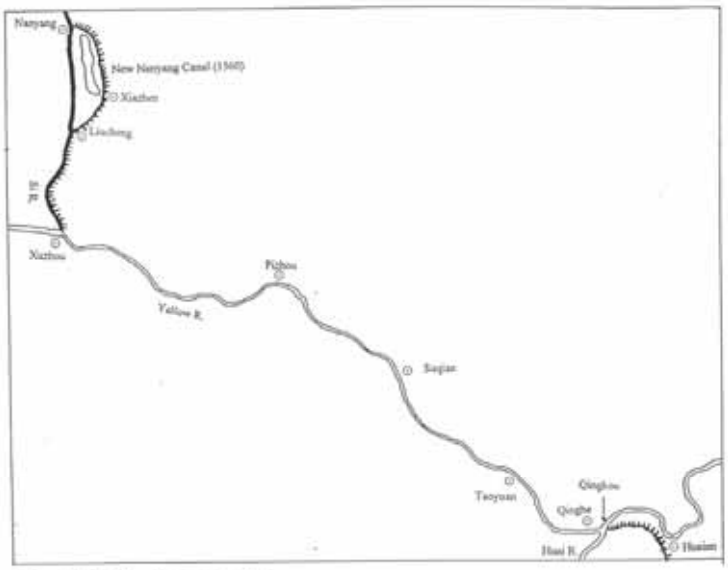
Map 1: Waterways in the Early Ming



Map 2: Transport Improvement in the Yongle Reign

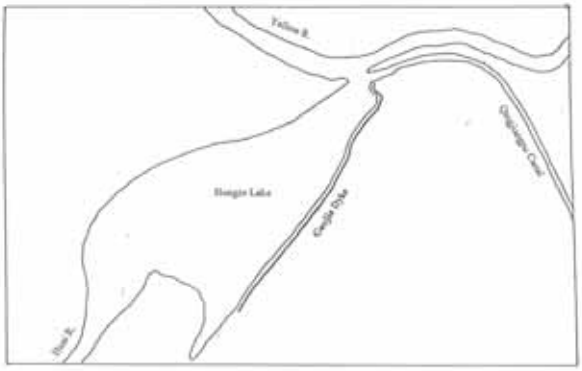
Qingjiangpu Canal

Source: Cai Taihen, *Mingdai caohe zhi shengzhi yu guanli*, diagram 35



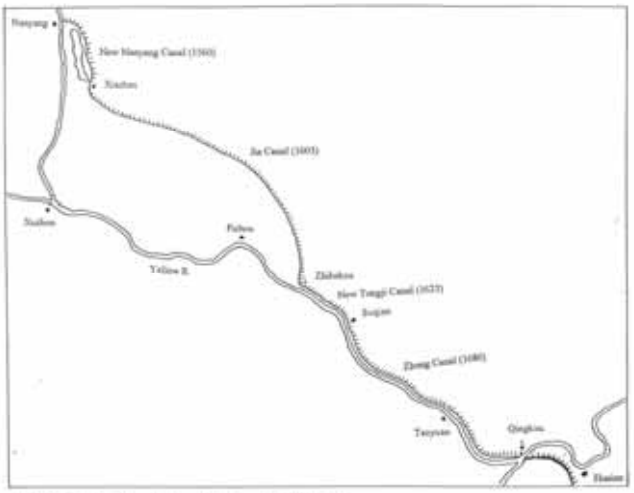
Map 3: The New Nanyang Canal

Source: Ouyang Hong, *Jinghang yunhe gongcheng shikao*, p. 200.



Map 4: Goujia Embankment

Source: Ouyang Hong, *Jinghang yunhe gongcheng shikao*, p. 225.



Map 5: Construction of Canals Along the Yellow River

Source: Ouyang Hong, *Jinghang yunhe gongcheng shikao*, p. 200.