

Hydraulic Theory and Hydraulic Engineering Projects of the Wusong River (吳淞江) Basin Between the Sixteenth and Nineteenth Centuries*

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Introduction

There are a number of diverse research topics and an abundance of research concerning the Jiangnan region, which saw rapid economic growth compared to other areas since the Song Dynasty. Such plentiful research is gradually expanding into a discourse on examining the meaning of economic development and transformation in the Jiangnan region during the Ming and Qing Dynasties. Yet on the other hand, there are efforts to look to the Jiangnan region during the Ming and Qing Dynasties to find the driving force for China's rapid economic development today.¹ This shows that the significance of economic

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1 Regarding the two different positions concerning the economic growth of the Jiangnan region during the Ming and Qing Dynasties, refer to Philip C. C. Huang, *The Peasant Family and Rural Development in the Yangzi Delta, 1350-1988* (California: Stanford University Press 1990); Li Bozhong (李伯重). *Agricultural Development in Jiangnan, 1620-1850* (New York: St. Martin's Press 1998); Chung Chulwoong, Chungkuk Kūndae Kyōngjye ae daehan Jeopkūn Pangpup" (An approach to the economic development in modern China - Focusing on the research by Philip C. C. Huang) *Yōksahakpo* (Journal of Historical Studies) 151,

transformation that took place in the Jiangnan region since the Song Dynasty to this day can be translated into many different ways, and there is a lot of information to be reconsidered and reexamined.

In this aspect, the issue of hydraulic engineering in the Jiangnan region during the Ming and Qing Dynasties is not an exception to this trend. Karl A. Wittfogel's argument that the construction of large-scale water control facilities was possible through an absolutist regime in premodern Asian society² is no longer valid. However, Mark Elvin's study asserts that Chinese society was subjected to a "technological lock-in" due to the great burden placed on society in terms of labor and materials for the construction and maintenance of hydraulic facilities. This reminds us that Wittfogel's thesis, in which he defined Chinese society as a hydraulic society, was not completely unfounded.³ Furthermore, Elvin's argument poses a potent question the existing studies that emphasize the expansion of hydraulic facilities as an important precursor for the development of agricultural productivity. Therefore we now have an opportunity for a series of research to reexamine the significance of the issue of hydraulics in the Jiangnan region during the Ming and Qing Dynasties, despite existing research on the topic.

In this paper, I would like to make two main points. First, I will examine how the two major goals of the Chinese hydraulic engineering projects—the concepts of "flood control (治水)" and "irrigation (治田)"—were developed and transformed over time. "Flood control" is a concept

1996. In addition, for the attempt to find the origin of China's economic growth in the Jiangnan region, refer to Li Bozhong, *Zhongguo de zaoqi jindai jingli-1820niandai huating-lou xian Diqu* (Chinese Economy in Early Modern China-A Study on the GDP of Huating and Lou County Area in the 1820s, 中國的早期近代經濟 - 1820 年代華亭-婁縣地區 GDP 研究) (Beijing: Zhonghua Shuju, 2010).

2 He placed a great emphasis on the issue of organization. K. A. Wittfogel. *Oriental Despotism* (New York: Yale University Press 1957): 50-59.

3 Mark Elvin. Chung Chulwoong, trans., *The Retreat of the Elephants* (Seoul: Sagyejöl, 2011): 205 and 229.

of responding to natural disasters, such as floods, while “irrigation” focuses on the use of water. As a result, dredging was important in achieving flood control, while the link between reservoirs and streams was important in irrigation. These two types of hydraulic engineering projects were not opposing concepts. However, bureaucrats of the Ming and Qing Dynasties often believed the two different types of projects were based on conflicting concepts and had different purposes. Therefore, exploring the differences between the two concepts would allow us to fathom the way in which Ming Dynasty and Qing Dynasty bureaucrats understood hydraulics.

Second, this paper will trace the changes in the understanding of hydraulics in accordance with the changes in socio-economic conditions. The same type of hydraulic engineering projects were repeatedly carried out in the Jiangnan region. We can assume that the fundamental goals of hydraulic engineering projects were generally the same. Yet, there were different perspectives regarding the function of hydraulic facilities in commercial farming areas. Therefore repeated implementation of hydraulic engineering projects with the same goals and the rise of a new concept of irrigation in line with the socio-economic changes since the sixteenth century are two characteristics of hydraulics specific to the Jiangnan region. By highlighting these two trends, it will be possible to deduce how bureaucrats and commoners thought about the significance of hydraulic facilities. This study is particularly important since existing research tends to limit the issue of hydraulics excessively to rice farming.

This paper will focus on the time period between the sixteenth and nineteenth centuries. Considering the fact that foreign invasions as well as the transformation of the Chinese society following unprecedented growth occurred between the end of the eighteenth century and the nineteenth century, the nineteenth century can be seen as a turning point of history. Along with these internal and external changes, this paper also takes into consideration existing research that argues that efforts for land improvement in the Jiangnan region had been completed in the mid-nineteenth century.⁴ Meanwhile, this paper also attempts to redefine the

sixteenth century, shying away from the existing trend of research on the Ming and Qing Dynasties, which focus on the period of transition from the Ming Dynasty to the Qing.⁵ The most crucial changes that occurred in the sixteenth century, including the increase of areas to cultivate raw cotton and mulberry trees, and the appearance of the cotton industry and the silk industry, were the most prevalent in the Jiangnan region. It is also important to understand that aside from these socio-economic changes, large-scale hydraulic engineering projects began to take place in full force in the sixteenth century due to the deterioration of hydraulic facilities.

Lastly, I would like to mention some of the historical documents that have been consulted for this study. Due to the size of the economy and the importance of hydraulics in the Jiangnan region, there were numerous local gazetteers (地方志) and records of hydraulic technology (水利志) compared to other regions. These were the main historical sources used in this study. Moreover, *Collected Writings on Statecraft of the Ming Dynasty* (明經世文編) and *Collected Writings on Statecraft of the Reigning Dynasty* (皇朝經世文編), published in the Ming and the Qing Dynasties respectively, were also used as references. Through the *Collected Writings on Statecraft*, which are important historical materials on the Ming and the Qing Dynasties, it is possible to identify the problems the two dynasties confronted and to deduce the bureaucrats' ideas and thoughts on the issue of hydraulics.

4 Li Bozhong. Agricultural Development in Jiangnan, 1620-1850. Ibid. 28.

5 Regarding this point, refer to Wu Jincheng (吳金成). "Cong shehui bianqian shijue dui ming zhongqi shi de zai renshi" (A Re-examination of the History of the mid-Ming Dynasty through the Changing Trends of the Society, 從社會變遷視覺對明中期史的再認識). *Gudaiwenming* (Ancient Civilizations, 古代文明) 4 (2011): 80.

Hydraulic Engineering Projects along the Wusong River Basin during the Ming Dynasty

In his study, Shiba Yoshinobu argues that the development of water control facilities began in the southern region of Jiangnan and expanded to the eastern region. His argument is still strongly supported by numerous scholars. Moreover, he pointed out that 1) hydraulic engineering projects in the Jiangnan region during the Song Dynasty had been concentrated on the Qiantang River (錢塘江) system and the southern coast of Hangzhou Bay, and 2) the number of projects along the Wusong River Basin was very small.⁶ On the premise that the stagnation of seawater increased as a result of the natural formation of low hills and weakened drainability of the Wusong River from building a canal, he also mentioned that the construction of dykes along the coast to prevent the inflow of seawater was completed at the end of the Song Dynasty.⁷

Then what were the circumstances surrounding hydraulics along the Wusong River Basin during the Ming Dynasty, which were not explored in depth in Yoshinobu's research? Dredging became an important issue in the Wusong River area due to geographical reasons, as the water from Lake Taihu flowed into the Wusong River, and farmlands were formed in the area.⁸ Jia Dan (賈亶, 1038-1103) pointed out that while the increase

6 Shiba Yoshinobu (斯波義信). *Sowdai konan keizaishino kenkyu* (A Study on the Economy of the Jiangnan Region during the Song Dynasty, 宋代江南經濟史の研究). (Tokyo: Kyuko Shoin, 1988): 178.

7 Shiba Yoshinobu. *Ibid*: 185.

8 The Song Dynasty became interested in dredging in the Wusong River Basin due to frequent floods plaguing the areas surrounding Lake Taihu. Floods became frequent in the aforementioned region as water that used to flow into Lake Taihu began to flow into the Jing Brook (荊溪) after the five dykes constructed at the end of the Tang Dynasty were torn down. Feng Xianliang (馮賢亮). *Ming Qing jiangnan diqude huanjing biandongyu shehui kongzhi* (Environmental Changes and Social Control in the Jiangnan Region during the Ming and the Qing Dynasties, 明清江南地區的環境變動與社會控制) (Shanghai: Shanghai Renmin Chubanshe,

of farmlands around lakes triggered taxes to rise from around 170,000-180,000 *dan* of rice in the early Song Dynasty to around 340,000 *dan*-350,000 *dan* in the eleventh century, the sizes of most lakes in the Suzhou area were decreasing. Moreover, he stated that Suzhou is geographically located to accommodate the inflow of water from streams, and therefore not all surrounding areas should be turned into farmland.⁹ Jia Dan's point shows that excessive development of the areas along the eastern coast of Lake Taihu had been endangering the hydraulic system in the Song Dynasty. Another important hydraulic problem in the lowlands along the Wusong River involved tides in Yanguan (鹽官), which jeopardized not only Huzhou in the north but also Jiaxing and Suzhou, in the 15th year in the reign of Emperor Chunxi (淳熙) of the Southern Song Dynasty (CE 1188),¹⁰ just as Liu Hou (劉垺), who was in charge of rebuilding the Yanguan sea wall at the time, indicated. In fact, the construction of sea walls and dredging of the mouths of harbors were important hydraulic engineering projects in this region.¹¹ The map below shows the topography of the Wusong River area in the Ming Dynasty.¹²

2002): 240.

- 9 Jia Dan (賈宣). "Suzhou Shuili liushiliude" (Six Gains and Losses of Hydraulics in Suzhou, 蘇州水利六失六得), *Wuzhong Shuilitongzhi* (Comprehensive Records of Hydraulics in the Wu Area, 吳中水利通志) 8. Ma Ning (馬寧) ed. *Zhongguo Shuilizhi congkan* (China Water Conservancy Annals Series, 中國水利志叢刊) (Yangzhou: Guangling Shushe, 2006): 190.
- 10 Refer to "hequ(7)" (Rivers and Streams, 河渠) *Songshi* (History of the Song Dynasty, 宋史). (Seoul: Kyōngin munhwasa yōnginbon) 97: 2402.
- 11 Zhou Fengming (周鳳鳴). "Tiashang Shuilishiyishu" (On the Effects of Hydraulic Engineering Projects, 條上水利事宜疏). Zhang Guowei (張國維), *Wuzhong Shuiliquanshu* (The Complete Hydrological Documents of the Wu Area, 吳中水利全書). Ma Ning (賈宣). ed., *Zhongguo Shuilizhi congkan* (China Water Conservancy Annals Series, 中國水利志叢刊) 14 (Yangzhou: Guangling Shushe, 2006): 1899-1900.
- 12 *Zhongguo shuilishigao bianxiezu* (中國水利史稿編寫組) ed. *Zhongguo shuilishigao* (Draft History of Hydraulics in China, 中國水利史稿) 2 (Beijing: Shuilidianli

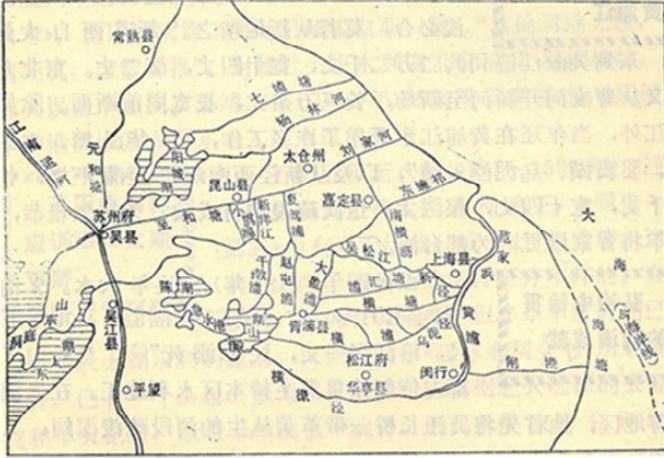


Figure 1. Map of Water Control Facilities in the Wusong River Basin during the Ming Dynasty¹³

Streams and rivers in the Wusong River area began from Lake Taihu and flowed east into the sea, forming what is called the Three Rivers: Wusong River, Lou River (婁江), and East River (東江). Among them, the

Chubanshe, 1989): 73.

- 13 Please see the following for the English pronunciation: 常熟县 (Changshu Xian), 元和塘 (Yuanhe Tang), 江南运河 (Jiangnan Yunhe), 苏州府 (Suzhou Fu), 吴县 (Wu Xian), 洞庭 (Dongting), 东山 (Dongshan), 东太湖 (Dongtai Hu), 吴江县 (Wujiang Xian), 平望 (Pingwang), 阳城湖 (Yangcheng Hu), 至和塘 (Zhihe Tang), 昆山县 (Kunshan Xian), 小虞浦 (Xiaoyu Pu), 新洋江 (Xinyang Jiang), 千墩埔 (Qiandun Pu), 陈湖 (Chen Hu), 急水港 (Jishui Gang), 湖水澱 (Hushan Dian), 七浦塘 (Qipu Tang), 杨林河 (Yanglin He), 太仓州 (Taicang Zhou), 夏驾浦 (Xiajia Pu), 赵屯浦 (Zhaotun Pu), 大盈浦 (Daying Pu), 青浦县 (Qingpu Xian), 横浦 (Heng Pu), 松江府 (Songjiang Fu), 华亭县 (Huating Xian), 横潦江 (Hengliao Jiang), 刘家河 (Liuja He), 东练祁 (Donglianqi), 南横沥 (Nanhengli), 浦汇塘 (Puhui Tang), 横塘 (Heng Tang), 新泾 (Xin Jing), 乌泥泾 (Wuni Jing), 闵行 (Minhang), 上海县 (Shanghai Xian), 范家浜 (Fanjiang Bang), 黄浦 (Huang Pu), 闸港 (Zha Gang), 海塘 (Hai Tang), 大海 (the Great Sea), 今海岸线 (current coastline).

channel of the East River had already disappeared during the Song Dynasty, and Huangpu River, which had been created as a result of dredging during the Yongle Era, used to be called East River.¹⁴ Lou River referred to the Liuhe Stream (劉河) that passed through Kunshan (昆山) and Taicang Prefecture (太倉州), and the Wusong River merged with the Zhongjiang River (中江), which branched off around the Wuhu area. When sediment that began to accumulate in this area during the Tang Dynasty could no longer be neglected in the early Ming Dynasty,¹⁵ Xia Yuanji (夏原吉, 1367-1430) argued during the Yongle Era that the Wusong River had to be diverted towards the Baimao River (白茅) and Liujiagang Harbor (劉家港), where the rate of water flow was faster.¹⁶

Xia Yuanji argued for the diversion of the Wusong River since the cost of dredging the Wusong River and moving all the sediment to the sea was amazingly high. Despite the dredging project headed by Xia Yuanji, which was considered to be relatively successful, sediment buildup in the Wusong River increased, raising the risk of flooding in the mid-Ming Dynasty.¹⁷ Therefore hydraulic engineering projects for dredging took place on a broad scale around the Suzhou and Songjiang regions as well as the Jiangnan region beginning in the mid-Ming Dynasty. In fact, most

14 The fourth year of Daoguang Era, “Shuili” (Hydraulics, 水利) 2. *Shuzhou Fuzhi* (Suzhou Gazetteer, 蘇州府志) 7: 43b.

15 For instance, the width of the Wusong River shrank from 20 *li* during the Tang Dynasty to nine *li* in the Song Dynasty, further narrowing down to 1 *li*. The 19th year of Jiaqing Era, “Tushuo” (Images and Charts, 圖說) *Shanghai Fuzhi* (Shanghai Gazetteer, 上海縣志) 1: 4b.

16 Xia Yuanji (夏原吉), “Susong Shilishu” (On Hydraulics, 蘇松水利疏). Chen Zilong (陳子龍) ed. *Ming Jingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 14 (Beijing: Zhonghua Shuju, 1997): 105.

17 According to the memorial submitted by Wu Yan (吳巖) in the 13th year of Emperor Zhengde’s reign (1518), the sediment accumulation reached a serious level between the fourth and the fifth years of Emperor Zhengde’s reign (1509-1510). Wu Yan. “Tiaoshang Shuili Shiyishu” (The Effects of Hydraulic Engineering Projects, 條上水利事宜疏). Zhang Guowei. *Ibid.*

of the 96 hydraulic engineering projects that took place in Suzhou from the Yongle Era to the end of the Chongzhen Era involved dredging.¹⁸

It would be impossible to explain the significance and the process of discussion surrounding the 96 hydraulic engineering projects that took place in the Wusong River area throughout the Ming Dynasty, but it would be possible to gain a crucial understanding of hydraulic policies along the Wusong River and the Jiangnan region through the records of the bureaucrats at the time. Regardless of the time, the ideal of hydraulics lay in the improvement of agricultural productivity,¹⁹ and this is reinforced by the well-known statement during the Ming and the Qing Dynasties, that “the wealth of the state lies in the southeast region, half of which is created by six prefectures: Suzhou, Songjiang, Changzhou, Hangzhou, Jiayi, and Huzhou.”²⁰ Therefore, bureaucrats of the Ming Dynasty attempted to control water through dredging, or in other words, “flood control”, to realize their goal of irrigation concurrently. For instance, in the sixth year of the reign of Emperor Wanli (1578), Investigating Censor Lin Yingxun (林應訓) claimed that the problems of

18 Hong Huanchun (洪煥椿) ed. *Ming Qing Suzhou nongcunjingji ziliao* (On the Rural Economy of Suzhou during the Ming and the Qing Dynasties, 明清蘇州農村經濟 資料). (Suzhou: Jiangsuguji Chubanshe, 1988), 317-323. This is also confirmed in one of the major records of water conservancy published in the Jiangnan region during the Ming Dynasty, titled “Shuiqi” (Flood control, 水治), in Zhang Guowei, *Ibid* 9: 1466-1537.

19 Refer to Feng Xianliang (馮賢亮). *Ibid*. 243. In fact, Lü Guangxun (呂光洵) pointed out that the a large amount of tax was collected from Suzhou, where water flow was smooth, while the smallest amount of tax was collected from Zhenjiang, where water flow was slow. Lü Guangxun, “Su Song chang zhen Shuili zong shou” (Comprehensive explanation on the Hydraulic System in the Jiangnan Region, 蘇松常鎮水利總說). Zhang Guowei. *Ibid*. 20 (Yangzhou: Guangling Shushe, 2006): 3223-3225.

20 It is interesting that there is a statement about how bureaucrats and the people of Beijing are also reliant on rice and grains produced in the Jiangnan region. Ye Shen(葉紳), “Qing she Shuili zhongchen shu” (Memorial for Establishing an Expert Official on Hydraulics, 請設水利重臣疏). Zhang Guowei, *Ibid* 14: 1813.

hydraulics for farmland would naturally be resolved through the dredging of the Wusong River.²¹ Hydraulic theories that Chinese bureaucrats proposed at the time included both flood control and irrigation. Let's take a deeper look into the reasoning asserted by Lü Guangxun (呂光洵, 1508-1580).²²

Lü Guangxun emphasized the importance of hydraulic facilities by stating that Suzhou and Songjiang prefectures account for a third of economic wealth of China. Then he identified the key factors in hydraulic facilities in the Suzhou area: 1) Dredging for better water circulation, 2) repairing the embankment to guarantee horizontal flow, 3) building a sluice gate to prevent landslides, 4) using the budget for water control based on the urgency of matters, and 5) establishing an official position to take charge of hydraulics. Specific explanation Lü added to justify the five points he made contains crucial information that shows the status of hydraulics in the Suzhou area at the time.

First, he emphasized the fact that there was sediment buildup in about 100 places in the upstream and downstream sections of the Wusong River. Then he asserted that the water from Lake Taihu needed to flow into Yangcheng (陽城) Lake, Kuncheng (昆承) Lake, and Sanmao (三泖) Lake. He also pointed out that water from Dianshan Lake should flow into the sea by dredging along the Wusong River. This was not different from the hydraulic engineering projects that Xia Yuanji had carried out. Moreover, the fact that Lü stressed the dredging of small streams that flow through farmlands shows how not only the main rivers but even small streams that

21 Lin Yingxun (林應訓). “Kaijiang gong fei shu lue” (Summary of Hydraulic Project Expenses, 開江工費疏略). the 23rd year of the Jiaqing Era, “Shanchuanzhi” (Landscape Records, 山川志) *Songjiang fuzhi*(*Songjiang Gazetteer*; 松江府志) 11. 1b.

22 For further arguments asserted by Lü Guangxun, refer to “Xiu xhuli yi bao cai fu zhongdi shu” (Way to Preserve Wealth related to Hydraulics, 修水利以保財賦重地疏) *Ming Jingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 211. Ibid. 1a-8a.

irrigated the farmlands experienced severe sediment accumulation. Believing that irrigation was at the root of flood control, Lü stated that the deterioration of the embankment was worse than 20 or 30 years ago. As a result, he claimed that if farmers can build the embankment during the off-farming season, they can naturally protect the farmland. He also made an argument for building a sluice gate to block off the seawater.

Lü Guangxun's assertion is important because ironically the same argument was generally made throughout different regions in China during the Ming and Qing Dynasties. This commonality is also clearly related to the ideals that lie behind the hydraulic engineering projects. Lü pointed out that urgent projects must be carried out prior to less pressing projects, as it will lessen the burden on the people and help secure the budget for the projects. He believed that carrying out hydraulic engineering projects all at once not only depleted the budget for construction but also left most projects unfinished. His remarks were targeted at projects such as large-scale dredging.²³

However, from the fact that Hai Rui (海瑞, 1514-1587) carried out a dredging project along the 70 *li* of the Wusong River Basin in the fourth year of Emperor Longqing (CE 1570), it is possible to see how urgent it was, when it should have been carried out a long-term plan. Furthermore, when natural disasters occurred, local officials who were worried about rising prices and shortage of grains in their jurisdiction refused to sell grains to the disaster areas. As a result, the disaster areas faced a double challenge of providing relief to its people and starting hydraulic engineering projects.²⁴ The fact that hydraulic engineering projects were carried out in dire and pressing situations can also be confirmed by Xu Xianqing (徐顯卿, 1537-1602). He claimed that dredging projects were

23 This is once again implied in the 19th year of Guangxu. "Shui" (Water, 水) *Zhenze xianzhi* (Zhenze Gazetteer, 震澤縣志) 2. 7b.

24 Hai Rui(海瑞). "Kai Wusong jiang shu" (On Hydraulics of the Wusong River, 開吳淞江疏). *Ming Jingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 309. Ibid. 9b-10a.

carried out whenever necessary to resolve the problem at hand without implementing a lasting measure (每因時疏濬, 以救目前). In Xu Xianqing's statement, it is important to note that once again the water flow in the Wusong River was blocked by sediment buildup.²⁵

As we can see from the assertions put forth by Lü Guangxun, Hai Rui, and Xu Xianqing, flood control projects during the mid-Ming Dynasty were ineffective at best. Starting in the Hongzhi Era, the Wusong River area was left congested afterwards.²⁶ If the goal of flood control lay in recovering the old waterways of the Wusong River area as Jia Dan argued, the reality shows that hydraulic policies in sixteenth century Ming China was faced with an obvious limitation.²⁷

When hydraulic policies for the Wusong River area, where streams, lakes, and the ocean can be found in close proximity, reached the breaking point, some people became interested in designing provisional hydraulic engineering projects to remedy the issue temporarily. One such individual was Yan Na (嚴訥, 1511-1584), who emphasized small-scale dredging instead of large-scale dredging that had been performed in the past.²⁸ Adding to this argument, Xu Jie (徐階, 1503-1583) defined the basics of flood control as “water reservoir” and “drainage.” He further

25 Xu Xianqing (徐顯卿). “Yu Lin Shiyu lun Shuili di er shu” (Discussing Hydraulics with Lin Shiyu, 與林侍御論水利第二書). *Ming Jingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 396. 5b-6a.

26 Wu Yan. “Xingxiu Shuili” (A Boom of Hydraulic Projects, 興修水利). *Wuzhong Shuilitongzhi* (Comprehensive Records of Hydraulics in the Wu Area, 吳中水利通志) 13. Ma Ning, ed. Ibid. 387.

27 Therefore the argument that there is no need to focus on recovering the hydraulic system of the past surfaces frequently. Qian Zhongxie (錢中諧), from the early Qing Dynasty, “Lun Wusong jiang” (Discussion on the Wusong River, 論吳淞江) *San wu Shuili tiao yi* (Discourse on Hydraulic Engineering in the Jiangnan Region, 三吳水利條議). Ma Ning, ed. Ibid. 16.

28 Yan Ne (嚴訥). “Baimaogang xinjian shizha ji” (Records of the Stone Sluice Gate Construction in the Baimao River, 白茅港新建石閘記) *Ming Jingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 279. Ibid. 1b.

elaborated that “large-scale” projects involve diverting the water from the Baimao River and the Wusong River to the sea, while “small-scale” projects focus on the inflow of water from the Baimao River and the Wusong River to the farmland. He then asserted that hydraulic engineering projects are more advantageous on a small scale as large-scale dredging not only requires high costs but is also difficult to start at once.²⁹

In fact, some of the bureaucrats claimed that if stagnant water can start flowing again by dredging the reservoir, it would be possible to drain water in case of floods and supply water in case of droughts. In addition, they commented that waterways for farmlands should be dredged by landlords.³⁰ As these accounts reveal, the concept of irrigation was formed as a way to reconcile the failure of flood control. In this aspect, the fact that emperors and bureaucrats of the Ming Dynasty did not make hasty decisions on large-scale hydraulic engineering projects³¹ is an important lead for reexamining the traditional concept of hydraulics in not only the Ming Dynasty but throughout Chinese history.

The most difficult problem in hydraulic engineering projects was the procurement of funding. Besides the worsening overall condition of the hydraulic system, expenses for hydraulic engineering projects rose as they involved merging small streams and tributaries together to form larger rivers. These artificial rivers were created to simplify the dredging process and particularly to improve water storability by increasing the

29 Xu Jie (徐階). “Yu Fuyuan lun Shuili” (Discussing Hydraulics with Fuyuan, 與撫院論水利). *Ming Jingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 245. *Ibid.* 10a.

30 The 23rd year of the Jiaqing Era, “Shanshuizhi” (Landscape Records, 山川志) *Songjiang Fuzhi* (Songjiang Gazetteer 松江府志) 11. This document surfaced in the Wanli Era.

31 Emperor Hongwu already mentioned this fact. In the 27th year of Emperor Hongwu’s reign (CE 1394), he ordered the bureaucrats not to perform reckless flood control projects (勿妄興工) and carry them out according to the geographical features. Zhang Guowei, “Zhaoming” (A Royal Message, 詔命), *Ibid.* 11. 1541.

size of the body of water within the embankment. However, due to the difficulties in allocating manpower and mobilizing financial resources for the project, it was impossible to achieve the ultimate goal of these projects.³²

Then how much was spent on a series of such hydraulic engineering projects? In the project to dredge about 1.8 kilometers, or 6,336 *zhang*, along the Wusong River during the Jiajing Era, a total of 43,000 workers were mobilized, and 13,395 *taels* of silver and 25,332 *dan* of rice were spent on the laborers.³³ The total number of laborers involved in the dredging of the Baimao River under the direction of Hai Rui, following the dredging project along the Wusong River, was 1,649,536, and they were paid 41,238 *taels* of silver.³⁴ Therefore a huge amount of money had to be spent in hydraulic engineering projects, but these projects only helped the bodies of water return to their previous condition (獲利如故).³⁵ Moreover, in most of the projects, bureaucrats often neglected the public nature of the hydraulic system, pursuing their own personal gains (背公營私).³⁶

32 Wang Jialun (汪家倫) and Zhang Fang (張芳). ed. *Zhongguo nongtianshuilishi* (History of Water Conservancy in China, 中國農田水利史) (Beijing: Nongye Chubanshe, 1990): 395.

33 Yan Ruhuai (顏如壞). “Kaijun Wosongjiang gonfwan jietie” (Document Announcing the Completion of Dredging of the Wusong River, 開浚吳淞江工完揭帖). *Wuzhong Shuilitongzhi* (Comprehensive Records of Hydraulics in the Wu Area, 吳中水利通志) 12. Ibid. 333.

34 Hai Rui. “Kaibaimaoheshu” (On Hydraulics of the Baimao River, 開白茆河疏) *Ming Jingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 309. 12a.

35 Yang Rong(楊榮). “Chongjian Mengduhe zhaji” (Records of Restoring the Sluice Gate along the Mengdu River, 重建孟瀆河閘記) *Ming Jingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 17. Ibid. 11b.

36 Refer to Hong Huanchun(洪煥椿) and Luo Lun(羅侖). ed. *Changjiangsanjiaozhou diqu shehuijingjishi yanjiu* (A Study on the History of Local Economy of Yangzi River Delta, 長江三角洲地區社會經濟史研究) (Nanjing: Nanjing Daxue Chubanshe, 1989): 112.

As a result, farmland owned by local potentates were retained during hydraulic engineering projects,³⁷ which were unable to be carried out in a scientific process in the modern sense. This was the reason Xu Guangqi (徐光啓, 1562-1633) asserted at the end of the Ming Dynasty that provisional projects would not be enough to eliminate the deep-rooted evils that have accumulated over the past 20 through 30 years.³⁸

Then how did hydraulic engineering projects during the Ming Dynasty affect the economy of Suzhou Prefecture? This topic requires detailed research, but the record of a statement by Zhao Yongxian (趙用賢, 1535-1596) regarding the size of farmlands in Suzhou and the amount of tax is useful in providing a glance into this issue. According to Zhao, the area of government-owned farmland and private farmland, which was 98,506 *qing* in the early Hongwu Era and 155,249 *qing* during the Hongzhi Era, decreased to 92,969 *qing* in the sixth year of Emperor Wanli's reign (1578). During the Wanli Era, the amount of taxes, which was at 2,038,894 *dan* in terms of autumn crops, had only risen by 571 *dan* compared to the Hongzhi Era.³⁹ Even if we consider the fact that the actual size of farmland and the amount of tax collected could be different from the given calculations, the numbers that Zhao Yongxian suggested are simply inconceivable. If Zhao's calculations are credible, hydraulic engineering projects in the Suzhou region during the Ming Dynasty, which required a number of workers and capital, certainly failed to

37 Hong Huanchun. ed. *Ibid.* 317.

38 Xu Guangqi (徐光啓). "Shuili" (Hydraulics, 水利), *Nongzheng quanshu xiaozhu* (Collated and Annotated Comprehensive Treatise on Agricultural Administration, 農政全書校注) 13. Shi Sheng-Han(石聲漢) ed. 322-323.

39 Zhao Yongxian (趙用賢). "Yiping Jiangnan liangyishu" (Discussion on the Land Tax and Corvee in the Jiangnan Region, 議平江南糧役疏) *Ming Jingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 397. *Ibid.* 2a-b. These tax amounts during the Wanli Era (1573-1620) are significantly less than the amount of tax collected during the Jiajing Era, which was 2,809,000 *dan*. Zhou Fengming (周鳳鳴). *Ibid.* 1896.

increase the wealth of the region.⁴⁰

There are no specific historical records about the opinions of bureaucrats regarding such circumstances in late Ming Dynasty. However, the situations clearly show that it was no longer possible to carry out hydraulic engineering projects that were planned from the perspective of pure hydraulics.⁴¹ As a result, in the late sixteenth century, the bureaucrats were unable to control the peasants from creating lake fields and secretly discharging water for irrigation, or the fishermen from opening sluice gates and casting their nets. Still, they did nothing more than argue that it is best for the people to voluntarily protect and operate hydraulic facilities.⁴²

Hydraulic engineering projects during the Ming Dynasty were often large-scale dredging projects to improve drainage, but their effects were very limited. As a result, the argument for irrigation projects that are practically necessary for farming, instead of flood control projects that take the whole hydraulic system into consideration, began to form in the mid- to late Ming Dynasty. However, as we can tell from the figures Zhao Yongxian mentioned, small-scale projects on the regional level were also

40 As a result, officials at the time mentioned that the actual production of Suzhou Prefecture may be different from its reputation as a wealthy area. Lü Guangxun. “Su Song chang zhen Shuili zongshou” (Overview of Water Conservancy in Suzhou, Songjiang, Changzhou, and Zhengjiang) *Wuzhong Shuiliquanshu* (Comprehensive explanation on the Hydraulic System in the Jiangnan Region, 蘇松常鎮水利總說) 20. 3225.

41 In this aspect, it is important to keep in mind Lü Guangxun’s assertion that while flood control was discussed in detail, drought was not as well discussed because Suzhou was a water village. He further argued for the need to draw in water for irrigation, instead of dredging. Lü Guangxun. “Suzhou fujing shuili shuo” (On Hydraulics of Suzhou Prefecture, 蘇州府境水利說) *Wuzhong Shuiliquanshu*. Ibid. 3234-3236.

42 Jiang Bao (姜寶). “Caoheyi” (About Caohe, 漕河議) *Mingjingshi Wenbian* (Collected Writings on Statecraft of the Ming Dynasty, 明經世文編) 383. Ibid. 13a and 15b-16a.

unable to produce desired effects. Moreover, it is quite interesting that despite the frequent records about the collapse of the hydraulic system, local records of hydraulic engineering, *Collected Writings on Statecraft of the Ming Dynasty*, and local gazetteers do not mention specific details about hydraulics related to commercial cultivation of crops, as far as I was able to research.⁴³

Commercial Cultivation and the Transformation of the Concept of Hydraulics in the Qing Dynasty

The Qing Dynasty had no choice but to inherit the failed legacy of the Ming Dynasty. Therefore intellectuals during the transition period from the Ming to the Qing had an accurate understanding of the grave hydraulic situation in Suzhou.⁴⁴ For instance, Gu Yanwu (顧炎武, 1613-1682) explained that “Land has formed in this area due to lake waters that intruded this area without any intervention in the past few decades, and all the farmland along the stream have dried up.” He added that there is no government official in charge of hydraulics and criticized the bureaucrats

- 43 This part needs to be researched further using documents that are similar to the local gazetteers and records of water conservancy published during the Ming Dynasty, and *Collected Writings on Statecraft* from the two dynasties, which has not been properly studied. Therefore the statement above can be provisional. However, this trend can be confirmed when comparing the *Collected Writings on Statecraft of the Ming Dynasty* to the *Collected Writings on Statecraft of the Reigning Dynasty* of the Qing Dynasty. For the point about the lack of research on these *Collected Writings on Statecraft*, refer to Susan Mann Jones and Philip A. Kuhn. “Dynastic Decline and the Roots of Rebellion”. John K. Fairbank ed. *The Cambridge History of China*. (Cambridge: Cambridge University Press, 1978): 149-150.
- 44 An example can be found in Mu Tianyan’s writing, which appears in the seventh year of the Guangxu Era, “Shuidao” (Waterways, 水道) *Jiading Xianzhi* (Jiading Gazetteer, 嘉定縣志) 6: 6a-b.

for shifting all the responsibility onto the people through forced labor for hydraulic engineering projects instead of devising practical measures for the problem.⁴⁵

In addition to Gu Yanwu's point, arguments for hydraulic engineering projects, suitable for the newly formed landscape that had already surfaced in the sixteenth century, frequently appeared in the Qing Dynasty as well. Many argued that since the Wusong River area was devoid of a river, there was no need for a large-scale restoration project (不必復舊時之大觀).⁴⁶ Yet on the other hand, the assertion that appropriate connections among the Three Rivers was the key to preventing floods in the Suzhou and Songjiang region persisted throughout the Qing Dynasty.⁴⁷ In this context, Wei Yuan (魏源, 1794-1875) continued to argue for the dredging of the five main waters: East River, Zhongjiang River, Lou River, Baimao River, and Qipu (七浦) River. After the so-called "Great Waters of the Year of the Ram (癸未大水)" in the third year of Emperor Daoguang's reign (CE 1823), a large-scale hydraulic engineering project was carried out to increase the capacity of streams in this region, since the bureaucrats recognized the importance of main waters.⁴⁸ This points to the fact that government officials at the time had

45 Hong Huanchun ed. *Ibid.* 335.

46 Qian Zhongxie. *Ibid.* 16.

47 Ling Jiexi(凌介禧). "Dongnan Shuili zongshuo" (A Comprehensive Introduction to Water Conservancy in Southeast China, 東南水利總說) *Dongnan Shuililue* (Book on Water Conservancy in Southeast China, 東南水利略). Ma Ning, ed. *Ibid.* 4. 458.

48 For instance, the capacity of Wusong River between the two ferry spots (Jingding du and Caojia du) increased from 904,998m³ to 4,728,641m³, as a result of the hydraulic engineering project in the third year of Emperor Daoguang's reign. Pan Wei (潘威) and Man Zhimin (滿志敏), "Jiangnan shuiwang zaichengshihua qianxi de gaizao" (Reconstruction of Water Control Facilities for the Urbanization of the Jiangnan Region, 江南水網在城市化前夕的改造). Zou Yilin (鄒逸麟) ed. *Ming Qing yilai Changjiangsanjiaozhou diqu chengzhen diliyu huanjing yanjiu* (A Study on the Urban Geography and Environment of the Yangzi River Delta since the Ming and the Qing Dynasties, 明清以來長江三角洲地區城鎮地理與環境研究).

fully grasped the fundamental nature of problems related to hydraulic engineering projects, yet the situation surrounding hydraulics in the Suzhou area still was not improved even until the nineteenth century.

A more detailed study is required to fathom the reason for the lack of effective measures for hydraulics during the Ming and Qing Dynasties in spite of the fact that the intellectuals and bureaucrats at the time had a clear understanding of hydraulic problems in this area.⁴⁹ A different argument that surfaced in the Qing Dynasty was an argument for the division of water dynamics (分勢).⁵⁰ Of course, the division argument was also criticized for the immense expense it called for. However, during the Shunzhi Era, Xu Xudan (徐旭旦) asserted that the main purpose of the division of water dynamics was to dredge river mouths without having to restore the old channels of the Three Rivers. Moreover, Xu argued that it would be more effective to prevent the accumulation of sediment in lakes that have not been blocked instead of restoring lakes that have been blocked.⁵¹ His argument was based on the fact that it is impossible to restore existing waterways in effect and that it is more advantageous in terms of hydraulics to follow the trend at the time.

Meanwhile, the issue of the cost of hydraulic engineering projects was

(Beijing: Shangwuyinshuguan, 2013): 344.

49 In this aspect, Xu Guangqi's point that officials are ignorant about the complicated hydraulic system and geographical differences is significant. Refer to Xu Guangqi(徐光啓). "Shuili" (Hydraulics, 水利), *Ibid.* 321 and "Nongben" (Agriculture as the Foundation, 農本) *Nongzheng quanshu xiaozhu* (Collated and Annotated Comprehensive Treatise on Agricultural Administration, 農政全書校注) 13. *Ibid.* 76.

50 This assertion was an attempt to improve the hydraulic situation, which has worsened since the Ming Dynasty through conservative means instead of progressive means. This division method had already been used by Pan Jixun in the Ming Dynasty for flood control of the Yellow River. Refer to E. B. Vermeer. "Pan Chi-hsun's Solution for the Yellow River Problems of the Late 16th Century" *T'oung Pao* second series 73. 1987. 52.

51 Hong Huanchun ed. *Ibid.* 328.

still not resolved in the Qing Dynasty. Particularly in the early Qing Dynasty when the administration and the lives of the people had not yet been stabilized, the cost of large-scale hydraulic engineering projects was heavily reliant on donations of potentates. This is exemplified by Mu Tianyan (慕天顏, 1624-1696), who emphasized that the cost to expand water control facilities have to depend on contributions during the Kangxi Era.⁵² Mu also asserted that main rivers can be dredged using government funds, but the funds for repairing reservoirs need to be delegated to the people as it was difficult to procure them.

As such, even in the Qing Dynasty, dredging of main waterways was emphasized while there was a considerable challenge in procuring the funding for hydraulic engineering projects. This is well reflected in a stele made during the Daoguang Era, which is an important historical source about the hydraulics of the Wusong River.⁵³ The inscription begins with the emperor's edict in the fifth year of Emperor Daoguang's reign (CE 1825) and contains information about large-scale hydraulic engineering projects performed between the seventh and seventeenth years of Daoguang Era (1827-1837).⁵⁴ According to the stele, the original purpose

52 Mu Tianyan (慕天顏). "Shuilizuminyu" (Enriching the People through Hydraulics, 水利足民裕). He Changling (賀長齡) ed. *Huangchao Jingshi Wenbian* (Collected Writings on Statecraft of the Reigning Dynasty, 皇朝經世文編) 26, "Huzheng" (Licaishang) (Administration of Household (Management of Wealth), 戶政 (理財上)): 28a.

53 This source can be found under the title "Daoguang nian jian zhengzhi Wusongjiang shuilibeiji" (Stele of Wusong River dredging in the Daoguang period, 道光年間整治吳淞江水利碑記) in Hong Huanchun ed. *Ibid.* 346-351.

54 Dredging projects during this time are briefly mentioned in the previously cited source: Pan Wei (潘威) and Man Zhimin (滿志敏). "Jiangnan shuiwang zai chengshihua qianxide gaizao" (Reconstruction of Hydraulic Facilities for the Urbanization of the Jiangnan Region, 江南水網在城市化前夕的改造). Zou Yilin ed. *Ming Qing yilai Changjiangsanjiaozhou Diqū chéngzhèn dìlǐ yǔ huánjìng yánjiū* (A Study on the Geography and Environment of Cities in the Yangzi River Delta since the Ming and the Qing Dynasties, 明清以來長江三角洲地區城鎮地理

of the project was to dredge all of the Wusong River, but only the Huangpu River was dredged during the project. The sediment buildup had worsened to the point that the area surrounding the river mouths had been turned into land, and only a trickle of water flowed in the downstream section of the river. In the end, the government decided to dredge the river when necessary and dispatched an official to identify the main waterways and reservoirs that required dredging operations. Therefore, we can see that the projects were carried out in a different way than it was originally intended.

Most of the inscription of the stele is related to the procurement of resources, and it shows the difficulty in appropriating the expenses for hydraulic engineering projects even in the mid-Qing Dynasty. Of the total cost for the projects, 265,732 *taels* were appropriated from the national treasury, but the shortage of 33,000 *taels* as well as future funding were to be procured by selling degrees and ranks in local governments on the prefecture and county levels. This is a reflection of the fact that the hydraulics issue was not improved at all even during the Qing Dynasty, leading to the continuation of the situation in which social capital for hydraulic engineering projects always had to be stocked up, as Mark Elvin pointed out in his study.

The situation regarding hydraulic engineering projects in the Qing Dynasty was not different from that of the Ming Dynasty. When comparing the historical documents from the two dynasties, it is difficult to find any evidence for the change in the fundamental concept of flood control in the Qing Dynasty compared to the Ming Dynasty. As a result, it is easy to find statements, such as: “When we have good hydraulics, we can prepare for droughts and floods. We will be able to collect enough land tax and stock up on plenty of rice and grains. On the other hand, if we do not prepare for floods or droughts, famine will come without warning. Then we will be unable to collect land taxes or provide relief for

the suffering people. Therefore it is clear which will be profitable and which will be harmful. All of this is not simply dependent on the will of the heavens but lies in men.”⁵⁵ The author of the above statement added, “When we value hydraulics, we can enrich the foundation of land taxes.”

However, we can see that the basic idea of the Chinese people--hydraulics as the basis of land taxes--went through a huge transformation starting in the sixteenth century in the Jiangnan region, with the decrease in the size of land for rice farming following the expansion of commercial crops, increased population, and urbanization. Since it is difficult to determine an accurate count of population of all of China in the Ming Dynasty, it is hard to calculate the rate of population increase in the Jiangnan region from the Ming Dynasty to the Qing Dynasty. Unlike the previous studies, there are arguments that the population pressure in the Jiangnan region during the Qing Dynasty was not as high,⁵⁶ but the fact that the Jiangnan region had been overpopulated compared to the size of farmlands in the Qing Dynasty is evidenced by a number of sources.⁵⁷ Therefore not only the purpose of increasing the land tax but also the production of food for each and every farmer gained heightened interest.⁵⁸

One of the typical arguments can be found in the writing of Jin Fu (靳輔,

55 Ling Jiexi(凌介禧). “Shuili wei tianfuzhiben” (Hydraulics, the Basis of Land Tax, 水利爲田賦之本) *Ibid* 5. 640-641.

56 Li Bozhon. *Ibid.* 20.

57 Refer to Niu Guanjie (牛貫杰). *17-19shiji Zhongguode shichangyu jingji fazhan* (Development of the Chinese Market and Economy between 17th and 19th Centuries, 17-19 世紀中國的市場與經濟發展) (Hefai: Huangshan Shushe 2008): 123-124.

58 Regarding this problem, it is important to examine whether the existing research results--that the Chinese government exercised superior and effective power for the distribution of food during the food shortage crisis in the eighteenth century--were also applied to the food production through proactive improvement of water control facilities. Regarding efficient food distribution by the government, refer to Pierre-Etienne Will, “The State, the Public Sphere, and the Redistribution of Food during the Qing Period” (*L'Etat, la sphère publique et la redistribution des*

1633-1692). He attempted to expand the hydraulic facilities to increase the capacity for supporting the population. He argued, “One able-bodied man can farm 12 to 13 *mu* of rice paddies. Fertile land of that size can produce 30 *dan* of rice, while less fertile land can produce 20 *dan*. Assuming that one person eats 1 *sheng* of rice, it is possible to feed 9 people with 30 *dan* of rice, and 5 or 6 people with 20 *dan*.”⁵⁹ Jin Fu went into the details about the amount of rice consumption because he believed that there were many more consumers than producers. At the time, he was interested in the situation of the northern part of Jiangnan. He asserted that the previous hydraulic engineering projects were only carried out in an attempt to minimize the damage instead of focusing on increasing the profit. Jin Fu believed that the issue of hydraulics lay in self-reliance (自食其力), or in other words, creating the foundation to resolve the food problem through self-reliance.⁶⁰

Meanwhile, the expansion of commercial crop cultivation served as a momentum to change the existing concept of hydraulics. In this regard, records of Qin Shan (欽善), known to have lived during the Jiaqing Era, is quite intriguing. One of the reasons for expanding commercial cultivation

subsistances à l'époque des Qing). Léon Vandermeersch(ed), *Civil Society against the State in the Chinese, Japanese, Korean and Vietnamese Traditions* (La société civile face à l'Etat dans les traditions chinoise, japonaise, coréenne et vietnamienne). (Paris: Ecole française d'extrême-orient 1994).

59 Jin Fu(靳輔). “Chengcaiyu xiang diyishu” (Memorial for Prioritizing the Creation of Wealth and the Production of Plenty of Food, 生財裕餉第一疏) *Huangchao Jingshi Wenbian* (Ibid) 26. 20a.

60 This was the reason why there were a number of projects for low-lying paddies surrounded by dykes, while hydraulic engineering projects were focused on rivers during the Qing Dynasty. Wang Jiange (王建革). “Shuiche yu yangmiao: Qingdai jiangnan daotian pailao yu shengchan huifu changjiang” (水車與秧苗: 清代江南稻田排澇與生產恢復場景). Li Wenhai (李文海) and Xia Mingfang (夏明方) ed. *Tianyouxiongnian-Qingdai zaihuangyu Zhongguo xehui* (Famine Year - Qing Dynasty Famines and the Chinese Society: 天有凶年 - 清代災荒與中國社會). (Beijing: Sanlian Shudian, 2007): 242.

was probably people's obsession with money. This was one of the factors that caused the transformation of numerous efforts put into the hydraulic facilities. In Qin Shan's statement, which was made in a conversation, he refuted the argument that "Growing raw cotton and rice at the same time results in the lack of rice production and degradation of soil, and it is harmful for the farmers since a hundred cotton plants can be exchanged with only 2 *dan* of rice" by asserting that both money and grains are important. He explained that if people have money, they do not need to worry about food. Rather, they can use the money for other consumptions, and therefore having money is much more convenient. He affirmed that giving up rice farming to plant cotton was not the worst plan.⁶¹

Qin Shan's point is in exact accordance with the transformation of agriculture in the Wusong River area. In fact, cotton has high tolerance for drought, and as a result, it is possible to cultivate cotton regardless of the water level in soil as long as it is fertile enough.⁶² Therefore cotton was produced mainly in hilly and mountainous areas, where there was a lack of irrigation facilities. Particularly, since the mid-Ming Dynasty, cotton production was expanded from the region east of the so-called hill range that connects Changshu and Fengxian in the middle to the south of the hill range.⁶³ In addition, the trend of increasing cotton production in the Qing Dynasty is also reflected in the memorial written by Gao Jin (高

61 For further points asserted by Qin Shan (欽善), refer to his writing "Songwen" (Questions about the Social Problems in Songjiang Prefecture, 松問) in *Huangchao Jingshi Wenbian* (Ibid) 28, "Huzheng" (Yangmin) (Administration of Household (Nourishment of the People), 戶政 (養民)): 19a-25a.

62 Xu Guangqi (徐光啓). Shi Sheng-Han (石聲漢), ed. & annot. "Cansanguanglei" (Kinds of Silkworm and Mulberry trees, 蠶桑廣類) *Nongzheng quanshu xiaozhu* (Collated and Annotated Comprehensive Treatise on Agricultural Administration, 農政全書校注) 35. 963.

63 Fan Shuzhi (樊樹志). *Ming Qing jiangnan shizhentanwei* (Observations of the Jiangnan Region during the Ming and the Qing Dynasties, 明清江南市鎮探微). (Shanghai: Fudandaxue chubanshe, 1990): 138.

晉, 1707-1778) in the 14th year of Emperor Qianlong's reign (1749). According to Gao, rice paddies accounted for only about 20 to 30 percent of farmlands in the Songjiang, Taicang, and Tongzhou area, and the rest was cotton fields.⁶⁴ Gao explained that this was not only because cotton cultivation is more profitable but also because the tributaries had been blocked, making it difficult to operate water wheels, raising the cost for rice farming.

In this way, the people's interest in hydraulic facilities decreased due to the rise in the production of cotton in certain regions. Moreover, as the variety of crops for cultivation increased, there were cases, in which the peasants disregarded their landlords' intention to grow rice and planted cotton instead. Landlords also were not keen on starting hydraulic engineering projects, due to the high costs.⁶⁵ This shows that the change in the economy of the Jiangnan region transformed the people's perspectives on hydraulics. Just as Zhang Ying (張英, 1637-1708) argued for people to change their opinions regarding land assets,⁶⁶ farmers and intellectuals came to be interested in profitability of improving hydraulic

64 Gao Jin (高晉). "Qinghaijiang hemianjianzhong" (Memorial for Demanding Simultaneous Cultivation of Rice and Cotton on the Seashore, 請海疆禾棉兼種疏) *Huangchao Jingshi Wenbian*(Ibid) 37, "Huzheng" (Nongzhengzhong) (Administration of Household (Administration of Agriculture), "戶政" (農政中)): 6a-b.

65 Kawakatsu Mamoru (川勝守). *Ming Qing konankeizaishi kenkyu* (Economic and Agricultural History of Jiangnan during the Ming and Qing Dynasties, 明清江南農業經濟史研究). (Tokyo: Tokyo Daigaku Shuppankai, 1992): 155.

66 Zhang Ying (張英). "Hengchan suo yan" (Fragmentary Remarks on Real Estate, 恒產瑣言). *Huangchao Jingshi Wenbian*(Ibid) 36, "Huzheng" (Nongzhengshang) (Administration of Household (Administration of Agriculture), 戶政(農政上)): 42b. In addition, refer to Chen Weicheng (錢維城). "Yiminlun" (On the Nourishment of the People, 養民論). *Huangchao Jingshi Wenbian*(Ibid) 11, "Zhiti" (Zhifaxia) (Main Points for Ruling the State (Application of Law), 治體(治法下)): 8a-b, which explained that people at the time showed more interest in money rather than farming.

facilities, rather than simply focusing on the production of grains.

Surprisingly, Qin Shan had an optimistic view regarding the hydraulics situation in Suzhou. To the argument that farmers no longer had the capacity that year to farm due to the damage from floods in the ninth and thirteenth years of Emperor Jiaqing's reign (CE 1804 and 1808), Qin Shan explained that the heavens must be lightening the burden on the Jiangnan region, since the tide has turned its direction towards Zhejiang Province, and the sand was blocked outside of Chongque (滙闕) in Huating (華亭) County from flowing into the region. Moreover, he asserted that schools of fish inhabit the wide river area in Suzhou, and that it was possible to farm the lands created by landslides, since less tax is levied from such areas. This calls attention to the time when people took advantage of tides to supply water to the farmlands during the Qing Dynasty,⁶⁷ and shows how ideas surrounding hydraulics became more flexible compared to the Ming Dynasty.

Another factor that played an important role in changing the perception of hydraulic facilities is deeply related to rice farming in the Jiangnan region at the time. There were two main varieties of rice in the Jiangnan region: indica rice (秈稻 *Oryza indica*) and japonica rice (秈稻, *Oryza japonica*). Indica rice produced a relatively large yield, had a high tolerance to drought, and grew well even in poor soil. However, it could not be preserved for a long period of time. On the other hand, japonica rice required fertile soil, and was used to pay taxes along with nonglutinous rice (粳米). Nonglutinous rice, in particular, was of high quality, usually found on the tables of the wealthy.⁶⁸ Among the three varieties, japonica rice and nonglutinous rice were a late-maturing variety, while indica rice was an early-maturing variety.

67 Wang Jiange (王建革). *Shuixiangshengtaiyu jiangnan shehui(9-20shiji)* (Ecology and Society of the Jiangnan Region between the Ninth and Twentieth Centuries, 水鄉生態與江南社會(9-20世紀)). (Beijing: Beijing Daxue Chubanshe 2013): 495-498.

68 Kawakatsu Mamoru. *Ibid.* 20-21.

In explaining the varieties of rice, however, Xu Guangqi stated that the late-maturing variety of rice is better for fertile lands, while less fertile land was suitable for the early-maturing variety. Moreover, he added that planting the early-maturing variety in fertile fields would not always be harmful, but planting the late-maturing variety in infertile fields would always fail.⁶⁹ This shows that even in poor soil, farmers planted more of the early-maturing variety, which was easier to grow. In other words, the interest in hydraulics was relatively low since it was difficult to build hydraulic facilities yet it was possible to grow rice on infertile lands.

Another reason why farmers shied away from the imperative idea that hydraulic facilities were necessary for farming was due to the appearance of the so-called spring flowers (春花), which had been widely cultivated in the Jiangnan region in the late Ming Dynasty. Spring flowers referred to plants and crops such as colza and barley. In particular, there was no need for paddy fields to farm barley, and it was able to be harvested in the spring, when food was short. The impact of barley farming was significant, as evidenced by records of stabilized grain prices and procurement of half a year's food due to barley farming.⁷⁰

Conclusion

Rice farming in paddies, which led agriculture for thousands of years and had been developed in the downstream region of the Yangzi River since the Song Dynasty, still remains the most essential means of agricultural production in China and a great driving force for supporting a massive population. Therefore, there is no need to add to the reason Chinese intellectuals and officials emphasized hydraulics as an important

69 Xu Guangqi (徐光啓). Shi Sheng-Han (石聲漢), ed. & annot. "Nongshi" (Farming, 農事) *Nongzheng quanshu xiaozhu* (Collated and Annotated Comprehensive Treatise on Agricultural Administration, 農政全書校注) 6. 145.

70 Kawakatsu Mamoru. *Ibid.* 117.

foundation for paddy-field farming. It was also not an exaggeration when certain scholars referred to China as a hydraulic society.

During the Ming and Qing Dynasties, the Wusong River was the most important water system to the west of Lake Taihu, but its water flow had not been stable since the Song Dynasty. As a result, Chinese bureaucrats attempted to achieve the ideal of water control through series of dredging projects since the early Ming Dynasty. However, as a significant part of the area had already been turned into land, it was difficult to achieve an efficient flood control level through large-scale projects. In addition, high costs for these projects were a burden on national and regional levels. We can assume that an excessive amount of construction fees would have limited the movement of the nation and its officials. Therefore, since the sixteenth century, the direction of hydraulic policy was changed to focus on irrigation to handle transitory challenges.

In the Qing Dynasty, where socio-economic development was more predominant than the Ming Dynasty, we can see that hydraulics had been approached in a more flexible manner. It is true that even in the Qing Dynasty, large-scale projects were much larger than those were carried out in the Ming Dynasty. However, instead of pursuing grain production, which was dependent on hydraulic facilities, bureaucrats and intellectuals of the time attempted to break away from the pressure to work with hydraulic facilities, which had little room for improvement, by growing a variety of crops. In this aspect, commercial farming of a variety of crops and the development of the handicraft industry in the Ming and the Qing Dynasties was the result of ineffective hydraulic systems.

Meanwhile, it is quite interesting that the records of hydraulic engineering from this region during the Ming Dynasty and *Collected Writings on Statecraft of the Ming Dynasty* rarely mention hydraulic issues related to the cultivation of commercial crops. This is a temporary conclusion, as this study did not take into account the local gazetteers (地方志) of the Ming Dynasty, which contain relatively more information. However, *Collected Writings on Statecraft of the Reigning Dynasty*, which are historical sources that are similar in nature to *Collected*

Writings on Statecraft of the Ming Dynasty, mention issues about hydraulics related to the cultivation of commercial crops. This may be an evidence that hydraulic engineering projects in the Ming Dynasty focused far more on achieving the ideals compared to those carried out during the Qing Dynasty. However, would it be an exaggeration to say that the lasting ideal of hydraulics, despite the repeated failures of hydraulic engineering projects, was the reason the Jiangnan region was able to remain the wealthiest region during the Qing and the Ming Dynasties?

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〈Abstract〉

Hydraulic Theory and Hydraulic Engineering Projects of the Wusong River(吴淞江) Basin Between the Sixteenth and Nineteenth Centuries

Chung Chulwoong

This paper attempts to explore the significance of the overall water control system and numerous water control projects in the Jiangnan region. Through a series of large-scale dredging projects, the Ming and Qing Dynasties attempted to achieve the goals of securing national tax revenue and guaranteeing the production activity for the farmers. However, due to the weakened hydraulic system, excessive expenses, and interests on various levels, large-scale hydraulic engineering projects were unable to achieve their original goals. Starting in the sixteenth century already, interests about practical one-time hydraulic engineering projects on a small scale began to surface.

Meanwhile, in the Qing Dynasty, when the socio-economic transformation developed more, a new awareness of hydraulics surfaced due to the expansion of commercial cultivation over a large amount of land in the Jiangnan region. This was the result of an attempt to break away from the heavy dependence on water control facilities that had little room for improvement by growing a variety of plants and crops instead of focusing solely on simple grain production. Therefore the cultivation of a variety of commercial crops and plants and the development of the handicraft industry in the Jiangnan region since the sixteenth century are two aspects of Chinese society that resulted from ineffective water control facilities. However, despite these limitations and failures, large-scale hydraulic engineering projects were carried out repeatedly due to the economic importance of the Jiangnan region and to the efforts to achieve the ideals of flood control.

Keywords: Jiangnan region, Suzhou Prefecture and Songjiang Prefecture, Wusong River, flood control, irrigation, repair cost, commercial crops, records of water conservancy, Collected Writings on Statecraft of the Ming Dynasty, Collected Writings on Statecraft of the Reigning Dynasty

〈국문초록〉

16~19세기 吳淞江 유역의 水利工事와 水利論

정철웅 (명지대학 사학과 교수)

이 논문은 명·청시대 강남 지역의 전반적인 수리 체계와 당시 활발하게 전개된 수리 공사가 지닌 의의를 고찰하기 위한 것이다. 명·청 두 왕조는 대규모 준설 공사의 지속적인 시행을 통해, 국가 세수의 확보와 농민의 생산 활동 보장이라는 목적을 달성하려 했다. 그러나 수리 체계 자체의 악화, 과도한 비용, 여러 계층의 이해관계 때문에 대형 수리 공사는 본래 목적을 달성하지 못했으며, 이미 16세기부터 단편적이며 현실성이 있는 소규모 수리 공사에 대한 관심이 등장했다.

한편 사회경제적 변화가 한층 더 진전된 청대에는 강남 지역에서 폭넓게 전개된 상업 작물의 확대로 수리 문제에 대한 새로운 인식이 등장하게 되었다. 이는 수리 시설에 의지한 단순한 곡물생산이 아닌 다양한 경작을 통해, 개선의 여지가 희박했던 수리시설의 압박으로부터 벗어나려 했기 때문이다. 그러므로 16세기 이후 강남 지역의 다양한 상업 작물 재배나 수공업 발전은 비효율적이었던 수리 시설에서 비롯된 또 다른 양상이기도 하다. 그러나 이런 현실적인 제약과 실패에도 불구하고, 대형 수리 공사가 반복적으로 진행된 이유는 분명 江南 지역이 지닌 경제적 중요성과 함께 治水가 지닌 본래의 理想을 달성하기 위한 것이라고 할 수 있다.

주제어: 강남 지역, 蘇州府와 松江府, 吳淞江, 治水, 治田, 수리비용, 상업 작물, 水利志, 明經世文編, 皇朝經世文編