



Feng Shui and Imperial Examinations: a case study on the 1849 severe flood in Nanjing and debates on flood discharge

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Abstract

Social adaptations to natural hazards in China were influenced by various social and economic factors including traditional cultures such as Feng Shui, also known as Chinese geomancy. This study examines not only the progressive processes and spatial distribution of the 1849 severe flood in Nanjing City but also subsequent countermeasures based on historical documents, maps, and digital elevation model (DEM) data. As an adaptation to extreme floods, a project that connects Xuanwu Lake to the Yangtze River was deeply debated to relieve the flood risk. Local elites and ordinary people of Nanjing City worried that the project may destroy the Feng Shui of the city, which may bring misfortune to local candidates in the Imperial Examinations, their future promotion, the prosperity of their families, and the development of the local society in the city. This indicates that, in the complicated traditional Chinese society, such traditional cultures may play an important role in determining social adaptations to climate change. However, these traditional cultural concepts may not lead to a consensus without specific institutional culture. Hence, in the complicated social background, the institutional culture was also fundamental to build social adaptations to climate change. The project that connects Xuanwu Lake to the Yangtze River was eventually completed in 1931, which shows that the cultural concepts are dynamic in a complicated traditional society and are continuously changed along with the influence of institutional changes, educational development, and the guidance of the media guidance.

Keywords Climate change · Extreme climatic events · China · Social adaptation · Concepts · Feng Shui

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1 Introduction

Global warming has induced an obvious and far-reaching impact on ecosystems and social systems (IPCC 2014). Subsequently, international scientific communities paid attention to the social impacts of climate change and corresponding social adaptations since the 1980s. A series of research programs have been launched to mitigate the impact of climate change and to adapt human society to changing climate. In the Past Global Changes (PAGES) project, understanding the process and interactive mechanism of the human-climate-ecosystem pattern at different time scales was regarded as a major research topic (PAGES 2009). The International Human Dimensions Programme on Global Environmental Change (IHDP) focused on analyzing and understanding human dimensions in response to the global environmental change in a human-nature coupled system (Jill, 2003).

As human society is a huge and highly complicated system, there are a variety of social adaptations to climate change, depending on the characteristics of human society. Previous studies have shown that the social adaptations to climate change are influenced and restricted by resource, technology, economy, and other factors (Klein and Smith, 2003, Brooks and Adger, 2005, Adger et al. 2007, Hornsey et al., 2016). Interestingly, the adaptations in various societies have been selected corresponding to their characteristics mainly in the complexity and high heterogeneity of cultures, which has drawn a great attention in academic communities. The unprecedented environmental pressures driven by the abnormal climate in the Late Holocene prompted the Akkadian, Classic Maya, Mochica, Tiwanaku to a lower subsistence level by reducing social complexity, abandoning urban centers and reorganizing supply and production systems, i.e., adapting to a long-term drought with a lower level of living conditions (de Menocal, 2001). Traditional cultures in Africa have both positive and negative impacts on social adaptations to climate change. For instance, deforestation (such as felling trees and setting off a wildfire) is a taboo in many areas of Southern Africa, which is helpful for local people to adapt to climate change well (Chisadza et al., 2015, Murphy et al., 2016). On the contrary, relative policies affected by social cultures (e.g., the issues of gender, social classes, status, and taboos) on the social adaptation to climate change remain hard to be implemented in some areas in countries such as Burkina Faso, Kenya, Madagascar, and Tanzania (Nielsen and Reenberg, 2009, Rakotonarivo et al., 2017). In some areas in Cuba and Canada, a tradition that shares food with other people facilitates relieving natural disasters (Sygna, 2005; James et al., 2006). Most of these multidisciplinary studies, combining with archaeology, cultural anthropology, and other disciplines, have displayed the unique role of culture as to how to cope with climate change in early human civilization or simple civilized societies. In addition, these studies lead to a big step forward to understanding the relationship between culture and social adaptation.

The Chinese culture has evolved continuously with a long development history over the last nearly 6000 years. Especially, China has formed a cultural system characterized by complex and rich content from a wide territory and a huge population (20% of the world's population) (Liang, 2005). The Chinese culture is an important cultural system in the world as it directly affects the philosophy for not only the people in China but also many overseas Chinese and people around the world.

China has systematic and abundant historical documents and materials, which provide valuable information on climatic events and their impacts during different historical periods, and social adaptations to cope with extreme events. These information may give an opportunity to investigate the impacts of historic extreme climate events and the corresponding adaptation mechanisms. With the help of these historical documents and materials, researchers have studied the impacts of the historic climate change with regard to wars, politics, population,

agriculture, economy, and society (Zhang et al., 2004, Fang et al., 2014, 2015, 2019, Pei, 2017). Nevertheless, how a traditional culture in a complex cultural system affects social adaptations relevant to these historic extreme events still needs further investigation, which will enhance our understanding of how the traditional Chinese society adapted to climate change and how a specific culture in a complex cultural system influenced on social adaptations to climate change.

Nanjing City is located between 32° 00" N to 32° 05" N and 118° 45" E to 118° 50" E, with the Yangtze River in the west and mountainous borders in the east. It has a northern subtropical humid climate with distinct seasons and abundant rainfall. As a prominent city with more than 2400-year history, Nanjing City is an important ancient capital in Chinese history. In the Qing dynasty (1644–1912), Nanjing was a station where the Liang Jiang Governor lived and worked. The Liang Jiang Governor had jurisdiction over the present Jiangsu, Jiangxi, and Anhui provinces and Shanghai City in the lower reaches of the Yangtze River. Besides, Nanjing was the center of politics and military and one of the largest cities that has a population of 700,000 (Cao, 2001; Jiang, 2013). Therefore, Nanjing had a crucial role in finance, taxation, food, goods, and materials for the Qing dynasty. In 1842, the *Treaty of Nanjing* was signed in the city of Nanjing at a part of the Yangtze River that runs through Nanjing. The Jiangnan Examination Hall, the largest and most influential hall for the Imperial Examinations in Chinese history, was also located in Nanjing.

Nanjing City, located in the Jiangnan Hills area to the south of the Yangtze River, has unique topographical and physiographical characteristics. It has a large high-elevation area in the west of the city, many ponds and rivers in the east and south of the city, and low-lying areas prone to be affected by backwater effects. Xuanwu Lake is located in the north of Nanjing City, and it is downstream of the mountain headwater area in the northwest of the city and flows into the Qinhuai River through the city. The water discharged from Xuanwu Lake may contribute to the inundation in Nanjing. In 1849, the plum rain season occurred earlier and lasted longer than normal years, which caused a severe flood over the middle and lower reaches in the Yangtze River (Yang and Zheng, 2008, Yan et al., 2011). A map of the study area and flooding grade in 1849 is shown in Fig. 1 using QGIS techniques. Flooding grade was graded by a rank method according to data from historical records in China (Yang and Han, 2014). The flood influenced 237 of 432 county-level places in 6 provinces in the middle and lower reaches of the Yangtze River; Nanjing City and surrounding areas were extremely inundated (Yang and Zheng, 2008). An increase in the water table of Xuanwu Lake caused by abnormal plum rains aggravated the inundation in the city, provoking the debates on a project that connects Xuanwu Lake to the Yangtze River. This is a representative case that shows the role of a specific traditional concept incorporated into the processes of social adaptations. This study reconstructed the 1849 flood event with methods in historical geography and analyzed the role of Feng Shui, a traditional Chinese culture, in a social adaptation derived from the debates on the project. This study provides a mechanism of how traditional culture in China affects the social adaptation to climate change and enhances our understanding of the complex processes and mechanisms that reflect a complicated culture in adapting to climate change.

2 Materials and methods

2.1 Materials

Detailed historical documents and materials are fundamental information for this study. From local chronicles, collected works, factual records, and compilations, the 1849 severe flood–

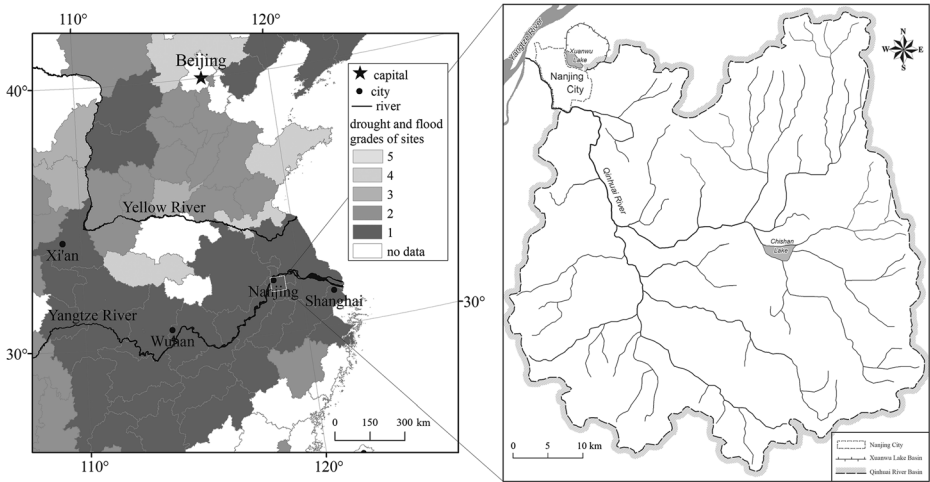


Fig. 1 Map of the study area and flooding grade in 1849. Figure note: The Yellow River in 1820 is shown

related information was extracted such as the inundated areas, progressive processes, disaster relief, and water system in Nanjing; historical data for Xuanwu Lake; and historical documents related to the debates of the project, connecting Xuanwu Lake to the Yangtze River, held in Nanjing from the Qing dynasty to the Republic of China. In addition to the digital elevation model (DEM) data, the maps of Nanjing at different scales in 1856, 1909, 1935, and 1950 were used to retrieve the historical geographic information of the city. All materials and corresponding information retrieved in this study are shown in Table 1.

2.2 Methods

This study employed a historical geography method with support from historical documents and materials, maps, and DEM. QGIS was used to re-render the distribution map of the 1849 flood in Nanjing City and to examine progressive processes, spatial distribution, and severity. In addition, historical analysis was applied to evaluate the influence of the concept of Feng Shui on society and a relevant mechanism according to the historical documents and materials listed in Table 1.

3 Results

3.1 Impact of the severe flood on Nanjing City

In 1849, the plum rain season in the middle and lower reaches of the Yangtze River has lasted for 62 days, resulting in three times of mean precipitation during the period, which caused severe inundation in Nanjing City (Yang and Zheng, 2008). Nanjing City was in severe inundation for 6 months from late May to late November. While the amount of rain in Nanjing was light for the first 20 days from late May to early June, it abruptly turned heavy on May 19, which has been recorded as an incunabular inundation in Nanjing City. The heavy rain lasted from early June to mid-July, resulting in more severe inundation in Nanjing City. Although the

Table 1 Materials and information retrieved in this study

Type of materials		Information extracted	Source
Historical documents	Local chronicles	The history of the water system in Nanjing encompassing the Qinhuai River, Qing Stream, and Xuanwu Lake	<i>Records of Houhu Lake and Xuanwu Lake in Jinling</i> <i>Chronicle of Houhu Lake</i> <i>Records of Jiankang in the Jingding Reign</i>
		Documents related to the project that connects Xuanwu Lake to the Yangtze River	<i>Chronicle of Jiangning in the Guangxu Reign</i>
	Collected works	Records of the 1849 flood in Nanjing	<i>Memories of Baixia, Records of the Flood in 1849</i>
		The debates of the project of connecting Xuanwu Lake to the Yangtze River	
Archives	Records of the 1849 flood in Nanjing	<i>Factual Records of Emperor Xuanzong of Qing Dynasty, Collected Grand Edicts in the Daoguang Reign of Qing Dynasty</i>	
Compilations	Information of the 1849 severe flood and disaster relief reported by Lu Jianying and Fu Shengxun		
		1849 flood-driven affected areas and disaster relief reported by Fu Shengxun and Xiang Hou	<i>Records of Floods of the Yangtze River Basin and the International Rivers in Southwest Qing Dynasty, A Compendium of Chinese Meteorological Records of the Last 3000 Years</i> <i>A Chronology of Flood, Droughts and Storm Surges Chronology over the Last 2000 Years in Jiangsu Province</i> <i>A Complete Collection of Books on Disaster Relief in China</i>
Maps		Maps of rivers, lakes, city walls, city gates, floodgates, and residential areas in Nanjing	Map of Jiangning Provincial Capital in 1856, Map of Jinling City Made by Jiangnan Military School in 1909, Map of Nanjing City in 1935, Map of Nanjing in 1950
DEM		DEM of Nanjing	Geospatial Data Cloud of Computer Network Information Center of Chinese Academy of Sciences (http://www.gscloud.cn)

rain was abated again in late July and dry-days lasted for 20 days from late July to early August, the inundation was not relieved and even worsened by upstream flows and backwater effects from the downstream. In late August, the flood finally receded in high areas within the city. However, flooding damages were still progressive and serious in low-lying areas until late November.

This study presented a DEM at a vertical resolution of 1 m for Nanjing City using QGIS techniques. A flooding map of the 1849 flood in Nanjing City is shown in Fig. 2, referring to historical maps and records of the damaged areas in historical documents. Figure 2 shows that the inundated area in the city reached nearly 19 km² across low-lying areas of the middle, east, and south of the city, which accounts for ~44% of the total area of the city. Many houses for public officials, soldiers, and citizens were all inundated, collapsed, and damaged in Nanjing City, which caused many social problems such as homelessness and governmental business suspension. For example, some important government offices were flooded, such as Liang

Jiang Governor's Mansion and Jiangning Government Office. Lu Jianying, the Liang Jiang Governor, had to move to Jiming Mountain to work (Yao, 1963). As the Jiangnan Examination Hall was inundated with collapsed walls, Lu Jianying submitted his opinions twice to postpone the Imperial Examinations (Zhonghua Book Company 2008). Normal drills of officers and soldiers could not be conducted due to submerged drill grounds for a long time in Manchu City (Department of Water Resources Management and Department of Science and Technology of Ministry of Water Resources and Hydroelectric Power of the PRC et al., 1991). Submerged wheat and other crops in the field were either rotted or damaged outside Nanjing City. Moreover, there was no place for the harvested wheat to be dried off, resulting in being either germinated or moldy (Zhonghua Book Company 2008). As the functions of levees along the Yangtze River and floodgates in Nanjing City were considerably harmed, more severe flood damages occurred both inside and outside of Nanjing City. The worst flood damage was human life (Department of Water Resources Management and Department of Science and Technology of Ministry of Water Resources and Hydroelectric Power of the PRC et al, 1991). In 1849, many people suffered a survival crisis without residence and food for half a year in Nanjing City.

3.2 Waterlogging in Nanjing City and influence from Xuanwu Lake

As the outlet of drainage in the city is at the Qinhuai River, preserving the water level of the Qinhuai River is critical to avoid flood damages. The mean water level of the Qinhuai River is 6.57 m, which is an elevation lower than residential areas in Nanjing City and higher than the low water level of the Yangtze River. However, during the flood year, the water level of the Qinhuai River reached 9.90 m at the Wuding Floodgate (Nanjing Municipal Compilation Commission of Local Chronicles 1994), which was extremely higher than the elevation of residential areas in the city. Hence, the city has built floodgates since the Ming dynasty to control the waterways of the Qinhuai River through the city. However, the peak flow level in the Yangtze River was much higher than the water level of the Qinhuai River, causing a severe backwater effect that supplementarily increases the water level in upstream areas. For instance, the backwater occurred in the Qinhuai River when a peak flow level in the Yangtze River reached 10.22 m in 1954 (Nanjing Municipal Compilation Commission of Local Chronicles 1994). The 1849 flood in the Yangtze River also caused the backwater effect on the Qinhuai River. Unfortunately, the floodgates were damaged during the flood period, and subsequently, the flood damage in the city was aggravated more.

The 1849 flood in Nanjing was mainly caused by the heavy rainfall in the entire Yangtze River Basin. The 1954 severe flood is the severest one in history since data recorded although flooding events rarely occurred historically in the city. Considering the precipitation during the plum rain season in 1954 was 623.4 mm for 48 days and increased up to 892.6 mm from May to July (Nanjing Municipal Compilation Commission of Local Chronicles 1994), the precipitation from May to July in 1849 should not be less compared with that in 1954.

The floodgates located in the Qinhuai River have usually been closed during the flood season to protect the city from flood damages. However, the water in the city is not drained away when the floodgates are closed. Therefore, the precipitation mainly causes waterlogging in the city. Nanjing City has a drainage area of 43 km² that includes a mountainous area in the west of the city. Rainfall-induced surface runoff flows to the ponds, waterways, and other low-lying areas in the city, which may cause floods in the low-lying residential areas. Assuming that the precipitation in the city in 1849 was the same as that from May to July in 1954, this

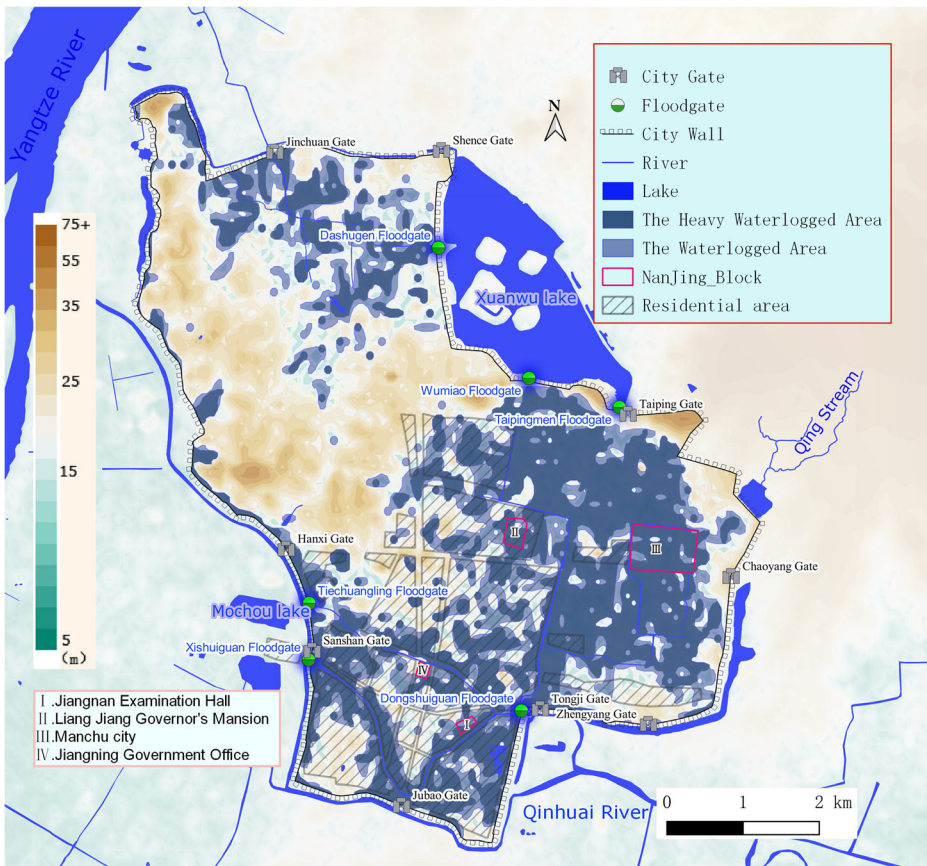


Fig. 2 Flooding map of the 1849 flood in Nanjing City

study evaluated the precipitation of $3.83 \times 10^7 \text{ m}^3$ in the city and calculated the runoff by a simple method with a runoff coefficient. Due to the lack of the runoff coefficient of Nanjing in the flood season, this study employed the runoff coefficient (0.71) of a nearby city, Changzhou (Yan et al., 2017). As a result, this study generated a runoff of $2.72 \times 10^7 \text{ m}^3$, causing serious waterlogging in the low-lying areas of the city.

The waterlogging in Nanjing City was aggravated by Xuanwu Lake that supplies domestic water for residents in the city and has a water level elevation of 11 m, a water surface area of 3.6 km², and a basin area of 26 km². While the water level elevation was then higher than the elevation of most residential areas in the city, the water level elevation of Xuanwu Lake nowadays was lower than the elevation of most areas in the city. In addition, a landscape park has been developed around it. Xuanwu Lake, the pondage less than 3,000,000 m³, had never been dredged throughout the Qing dynasty (Nanjing Municipal Compilation Commission of Local Chronicles 1994) and it had lost the flood control function. As rainstorm-induced floods in the basin may flow into Xuanwu Lake and the city, Xuanwu Lake was the main water system that flows into the city except for the Qinhuai River. Therefore, Xuanwu Lake would become the main source of the external water that causes flooding in the city when the Qinhuai River is closed by the floodgates.

Employing the same precipitation and runoff coefficient, the surface runoff of $1.65 \times 10^7 \text{ m}^3$ from the Xuanwu Lake basin from May to July in 1849 was calculated. In addition, this study evaluated the volume of waterlogging, $4.37 \times 10^7 \text{ m}^3$, and found that the water from Xuanwu Lake accounted for 37.68%. Furthermore, the backwater effect of Xuanwu Lake was superimposed on the internal waters in the city, causing more serious flooding damages. Hence, controlling the water of Xuanwu Lake and discharging directly into the Yangtze River during the flood season was raised as an alternative to relieve the severe waterlogging in Nanjing city.

3.3 Countermeasures for the severe flood

The Qing government adopted a lot of countermeasures, mainly focusing on not only providing food and shelter but also bringing the functions of cities back to normal. Firstly, Lu Jianying (1792–1853) and Fu Shengxun (1793–1865), Governors of Jiangsu, reported the disaster to the Daoguang Emperor to request relief and to exempt or postpone all kinds of taxes. The Daoguang Emperor firstly required the Imperial Household Department to appropriate 1,000,000 taels of silver to the Ministry of Revenue and to the local Governor for relieving the flood in Nanjing and other affected places (Zhonghua Book Company 2008). In October, he also ordered to extend the relief to six subprefectures including Taihu, Jinshan, Jingjiang, Liyang, Shangyuan, and Jiangning in Jiangsu (Shangyuan and Jiangning were then both attached counties in Jiangning Prefecture, government offices of which were located in the now Nanjing City). In early December, he implemented strategies to exempt or postpone the taxes for severely affected feudal lands or slightly affected feudal lands in 57 subprefectures of Jiangsu Province close to the Yangtze River (Department of Water Resources Management and Department of Science and Technology of Ministry of Water Resources and Hydroelectric Power of the PRC et al., 1991). He implemented an additional tax relief policy to postpone the collection of all overdue taxes from 69 subprefectures in Jiangsu Province including Shangyuan and Jiangning (Zhonghua Book Company 2008). Secondly, the relief work was jointly done by impartial and well-off squires and the use of the funds was strictly restricted to prevent local officials from embezzling relief funds and food (Zhonghua Book Company 2008). Thirdly, the work relief policy was promoted. Besides, the farmland was protected with the “Gui Tian method” by building firm walls and should drain the water in the farmland away by water-wheels. Lastly, the Qing government supplied food from Fujian and other provinces to Nanjing. All rice loading boats that sail to disaster-affected areas such as Nanjing were temporarily exempted from the frequent tariff and were allowed to load pisolites to encourage transporting foods to Nanjing (Zhonghua Book Company 2008). Generally, the Qing government played a leading role in relieving the flood, which was effective to a certain extent.

At a non-government level, all social classes also actively responded to the severe flood to mitigate the impacts. While houses and crops were flooded, victims fled to higher places. After the flood subsided, they tried to drain the water away to reduce flood damages and grew crops and vegetables (Zhonghua Book Company 2008). According to historical documents, many elites and rich families responded to the appeal of the government for disaster relief as well as donating money or food to Nanjing City for the 1849 severe flood.

3.4 The debates of the project of connecting Xuanwu Lake to the Yangtze River

Due to the severe flood in 1849, Yang Wending (?–1856), the Financial Commissioner of Jiangning, realized that a channel needs to be built in the northwest of Nanjing City to relieve

the flood, which directly drains the water from Xuanwu Lake to the Yangtze River. Therefore, Yang Wending assigned special personnel to conduct the measurement, piling, and other works outside the city and to prepare for the construction in the early spring of 1850 (Gan, 2007).

While the project that connects Xuanwu Lake to the Yangtze River drew the attention of all social classes in Nanjing, civilians and local elites were all in panic. “三学诸生不期而会者一百余人，奔赴藩署，公呈阻止” (*More than 100 students assembled and marched to the government offices to submit their petition against the project*) (Gan, 2007). Subsequently, some elites and officials opposed the project, such as Mei Zengliang, Chen Zuolin, Gan Xi, Gan Xun, and Wei Yuan. Mei Zengliang (1786–1856) submitted his petition of “为江宁水患上陆制军疏” (*On the Flood in Jiangning to Governor Lu*) to Lu Jianying, pointing out that the proposal of the project that connects Xuanwu Lake to the Yangtze River was absurd because building a channel and draining the water from the lake would “特大龙正脉斫为两段” (*cut the huge Dragon Vein*) (Dragon Vein, terminology of Feng Shui, a geographic form with unexceptionable Feng Shui) that gathers spirit Qi in Feng Shui and consequently brings good fortune to people living nearby Nanjing City (Xia, 2013). Instead, he advocated dredging Xuanwu Lake to drain the water away by waterwheels under floods. Chen Zuolin (1837–1920), then merely 13 years old, studied the *建康实录*, *丹阳图经*, *景定建康志* (*Veritable Records of Jiankang, Illustrations of Danyang and Records of Jiankang in the Jingding Reign*) and wrote “后湖不可通江议” (*On the Disapproval of the Project of Connecting the Houhu Lake to the Yangtze River*). He presented the disadvantages of the project and thought that Xuanwu Lake was the “为胎元之水，气一外泄，则会城之中，上而达官，下而民居，皆有不利” (*amniotic fluid for Nanjing. Once it leaked out, then it would bring misfortune to everyone in the city, including officials and civilians*) (Xia, 2013). He also proposed an alternative that dredges the lake to enhance the embankments. Gan Xi (1798–1853) believed that Xuanwu Lake connected to the Qinhuai River flow into the Yangtze River through the Xishuiguan Floodgate, which is the “通秦淮，出西关，归大江，为钟山随龙养荫真正胎水，断不可旁泻” (*amniotic fluid to nourish the Dragon Vein in the Zhongshan Mountain, and consequently it should not be drained away*) (Gan, 2007). Wei Yuan (1794–1857) is a famous thinker in China who was called “中国睁眼看世界的第一人” (*the first person in China who sees the world outside China as he introduced western thoughts and cultures to China for the first time*) (Chen and Liu, 2011). Hearing about the project, even he thought that it was absurd. He then visited Lu Jianying and tried to persuade him that Xuanwu Lake should not be connected to the Yangtze River (Gan, 2007). The project that connects Xuanwu Lake to the Yangtze River was spread to Beijing after that. As a result, those officials in Beijing who were from Nanjing were horrified that the project may destroy the Feng Shui of the city. Fan Xiaoyun, the Investigating Censor, also prepared to impeach the officials who presided over the project.

Lu Jianying (1792–1853) led some people to survey the Dragon Vein of Nanjing in early March of 1850. They found that the position where Xuanwu Lake was located was “正脉，入城之处，关系全城大局，万万不可挖动，利不可知，害必先见。我等忝居民上，纵不能为地方兴利，岂敢贻害将来” (*the place where the Central Dragon Vein entered the city, which was of great importance to the whole city. The benefits of the project were hard to quantitatively evaluate. However, it was prominent that the consequences of the project were surely serious. We had barely done something for this place, how could we ruin the future*) (Gan, 2007). The project was finally abolished in 1850 with the hindrance of the elites and civilians of the city.

There were many debates about the project that connects Xuanwu Lake to the Yangtze River more than once from the Qing dynasty to the Republic of China, which are shown in Table 2.

Among these debates, those who supported the project such as Cheng Shixuan (1790–1842), Lu Jianying (1792–1853), and Yang Wending (?–1856) were all working in Nanjing but were not born in the place. The opponents of this project, consisting of mainly native civilians and elites of Nanjing, thought that the project may damage the Dragon Vein and then the Feng Shui of Nanjing, consequently bringing misfortune to them in terms of personal safety, finances, and performance in the Imperial Examinations.

4 Discussion

“Feng Shui,” another name of “Geomancy,” focuses on the selection and construction of the living environment (Fan, 1994). “Feng Shui” was recorded in the *Book of Burial* of Guo Pu (276–324) in Jin dynasty for the first time: “葬者，乘生气也。……曰：气乘风则散，界水则止，古人聚之使不散，行之使有止，故谓之风水” (*The buried dead should be embraced by the vital Qi that disperses with wind and gathers with water. Hence, ancient people circulated it and at the same time gathered it to prevent it from dispersing. This is called “Feng Shui”.*) (Guo, 1986). However, the concept of Feng Shui in China could be found in the residence selection of ancient people in the Neolithic Age and in oracle bone inscriptions during the Shang dynasty such as information relevant to the divination for selection of places, which is much earlier than the Jin dynasty. A systematic Feng Shui theory was formed in the Han dynasty (202B.C.–220A.D.) and improved in the Wei, Jin, Southern, and Northern dynasties (220–589A.D.). In the late Tang dynasty, the Feng Shui theory gradually spread to places such as the Korean Peninsula, Japan, and Southeast Asia (Fan, 1994; Yoon 1989).

Feng Shui was widely used not only in daily life but also in the construction of residences, graves, and cities during the historical period. Furthermore, Feng Shui substantially affected many aspects of society nowadays. The divination based on Feng Shui was conducted for orientation selection and construction of residences and graves, in an attempt to bless people living inside of the construction and their offspring (Yoon 1989). The location, planning, design, and construction of public infrastructures (e.g., public housing, gardens, temples, roads, bridges) were determined based on Feng Shui (Li 2012). Feng Shui was also indispensable during the birth of cities and villages. Those capital cities of each dynasty in history, e.g., Xi’an, Beijing, Luoyang, Kaifeng, and Nanjing, were all selected based on Feng Shui, which was conducive to the continuation of the dynasties (Chen, 2003). Public buildings were also influenced by Feng Shui. Production activities such as mining, placing water-powered pestles, sinking wells, and planting trees were also affected to some extent by Feng Shui (Chen, 2002, Huang, 2005, Wang, 2009).

Feng Shui contributed to developing a harmonious and mutually supportive relationship between humans and nature (e.g., surrounding environment, climate, meteorology), subsequently, bringing good fortune to people and their offspring (Dan, 1994). Feng Shui is also characterized as the profit-seeking and harm-avoiding features that are extremely attractive to most people, including the emperors and civilians.

In traditional Chinese society, Feng Shui was often used to improve the performance in the Imperial Examinations which is a unique and important system not only to select officials but also to maintain the traditional Chinese society (He 2000). As the Imperial Examination provided a fair competition to all people depending on only talents and ability from the beginning to the end of the Sui and Tang dynasties (581A.D.–907A.D.), the 21st year of the Guangxu reign in the Qing dynasty (1905), and people could raise their social status and even

Table 2 Chronicle record on debates of the project that connects Xuanwu Lake to the Yangtze River from the Qing dynasty to the Republic of China

Time	Name	Position	Native place	Agreeing the project or not	Note
1832	Unknown	Grand Master Exemplar	Unknown	No	Xuanwu Lake was extremely important to the city. The “ <i>Introduction to the Form and Momentum of Mountains in Jinling</i> ” should be printed to publicize the Feng Shui of Xuanwu Lake.
1841	Cheng Shixuan	Financial Commissioner of Jiangning	Shiqian, Guizhou	Yes	He had prepared in the first place to connect Xuanwu Lake to the Yangtze River under the proposal of some people. However, as being informed by Gan Xi, he abandoned the plan in view of the Dragon Vein of Nanjing.
	Gan Xi	Minister of Ministry of Revenue	Nanjing, Jiangsu	No	He compiled the <i>Studies of Waterways of the Houhu Lake Jinling</i> , including the <i>Introduction to the Form and Momentum of Mountains in Jinling</i> printed in his family, trying to persuade Cheng Shixuan.
1849	Mei Zengliang	Minister of Ministry of Revenue	Nanjing, Jiangsu	No	The project may cut the Dragon Vein of Nanjing.
	Chen Zuolin	No	Nanjing, Jiangsu	No	Xuanwu Lake was the Placenta Water of Nanjing and should not be leaked out.
	Gan Xi	Minister of Ministry of Revenue	Nanjing, Jiangsu	No	Xuanwu Lake was the Placenta Water to nourish the Dragon Vein in the Zhongshan Mountain and should not be drained away.
	Gan Xun	No	Nanjing, Jiangsu	No	He wrote “On Water Conservancy” and “On Form and Momentum of the Houhu Lake (Xuanwu Lake)” and led students to stop the project.
	Fan Xiaoyun	Investigating Censor	Nanjing, Jiangsu	No	He thought that the project was not recommendable and was prepared to impeach officials relevant to the project.
	Wei Yuan	Magistrate of Xinghua County	Shaoyang, Hunan	No	It was absurd to connect Xuanwu Lake to the Yangtze River.
	Lu Jianying	Liang Jiang Governor	Mianyang, Hubei	Yes	Mei Zengliang, Chen Zuolin, Gan Xi, Gan Xun, Wei Yuan, and others tried to persuade that Xuanwu Lake was greatly important to the city and that the project may hurt the Dragon Vein.
	Yang Wending	Financial Commissioner of Jiangning	Dingyuan, Anhui	Yes	Connecting Xuanwu Lake to the Yangtze River was prevented by the elites, civilians, and Lu Jianying.
1851	Unknown	Unknown	Unknown	No	Connecting Xuanwu Lake to the Yangtze River may destroy the Feng Shui of Nanjing.
1931	Wei Daoming	Mayor of Nanjing	Dehua, Jiangxi	Yes	Connecting Xuanwu Lake to the Yangtze River may relieve the waterlogging and floods in Nanjing.

their whole families' status through the Imperial Examinations (Zhang, 1991; He, 2019). The Imperial Examination was a fundamental pathway to ensure the mobility of social classes and social stability in Chinese traditional society (He, 2019). If none of the offspring of the traditional aristocracy passed the Imperial Examinations, it quickly undermined the social status of their families. Most people took into account that better Feng Shui would bring better fortune for the Imperial Examinations in traditional Chinese society. As a result, the Ming and Qing dynasties tried to organize social infrastructures for better Feng Shui in an attempt to pursue good performance of native students in the Imperial Examinations by building Feng Shui towers and water conservancy facilities, reclaiming land from rivers and harbors, relocating and renaming government schools, etc. (Chen, 2002, Huang, 2005, Wang, 2009).

In the late Qing dynasty (1644–1912), Nanjing City was severely flooded many times, creating profound impacts on officials, elites, and civilians in the city, subsequently leading to many debates on the project that connects Xuanwu Lake to the Yangtze River. The failure of the project to be put into practice was originated from the fear of officials, elites, and civilians with regard to disrupting Feng Shui in Nanjing at that time as well as a subtle relationship between local officials, elites, and civilians.

The elites, local intellectuals, had a wide variety of political, economic, and legal privileges that were generally recognized by the government and the public, and they closely engaged in local administrative work and had a strong influence on deciding local policies (Ch'u 2011). The ordinary people were eager to raise their social status through the Imperial Examinations, i.e., having the status of the elites through it (Zhang, 1991). In a word, local people were qualified to be officials and then they were able to maintain their social status at a high level in the government by passing Imperial Examinations. Therefore, the project that connects Xuanwu Lake to the Yangtze River was intensely opposed by the elites and ordinary people in Nanjing City. The elites in Nanjing City believed that building a channel may destroy the Feng Shui of the city, subsequently causing misfortune on the Imperial Examinations to the local society. In other words, they were concerned about the fact that the number of those local students who pass the Imperial Examinations may be greatly lessened, which means that the number of officials from Nanjing may be decreased and consequently weakening the power of local elites. To maintain the status they had achieved, the families of the elites were necessary to ensure that their offspring could pass the Imperial Examinations continuously. That is, the families of the elites attached great importance to the family inheritance in traditional China. Moreover, the elites did not want to face this situation even if it could only possibly happen. As students and ordinary people were also eager to raise the status of themselves and their families through the Imperial Examinations, they were afraid that the possibility of passing the Imperial Examinations would be lessened by the alteration of Feng Shui. Therefore, the elites smoothly led local students and civilians into preventing the project from being carried out.

Officials from other places were also persuaded by the local elites. On the one hand, the development of Nanjing City might be affected by concerns that Feng Shui was destroyed by the project. The local development was one of the standards for officials to assess their performance, and consequently, it was highly related to their promotion. Therefore, the destruction of Feng Shui would likely affect their careers. On the other hand, officials from other places such as Cheng Shixuan (1790–1842), Lu Jianying (1792–1853), and Yang Wending (?–1856) were usually tired of local affairs and thus might have little knowledge about the place. In contrast, however, local elites, especially those who had been officials, knew the place in detail. Moreover, most of the elites had experiences in administration and could advise on or even participate in public works, local defense, and other complex affairs

(T'ung-tsu Ch'u 2011). Therefore, the local elites were essential for successfully implementing the order of officials in Nanjing with governance. Furthermore, if officials carried out the project without the consent of local elites, the local elites might provoke those officials in the capital behind and put their careers at risk. Therefore, the disapproval from relevant officials in the project that connects Xuanwu Lake to the Yangtze River was not only a concession to the local elites but also the result of considering their interests.

The concept of "Feng Shui," as a cultural factor, influences social behaviors through social choices to avoid misfortune. In this aspect, there is no difference between the Feng Shui in China and the cultural taboos of traditional African cultures. However, it can also be concluded that the institutional culture, namely the Imperial Examinations system in this study, is the main factor behind the role of Feng Shui in the project that connects Xuanwu Lake to the Yangtze River. The Imperial Examinations were then very important to improve and maintain social status. Hence, any changes that may induce a decrease in the number of local students who pass the Imperial Examinations may be strongly opposed by the local elites and civilians. In such a complicated traditional society with developed institutional systems, cultural concepts play an important role in social adaptations to climate change, which needs to be usually implemented by institutions.

In addition, there were many cultural factors in complicated traditional China. Most people were superstitious about Feng Shui while it was still regarded as a folk culture that is independent of the orthodox Confucianism culture and is opposed by Confucians (Li and Wen, 2007). As the so-called verification of the Feng Shui theory was then mostly based on stories and superstition, it was no accident that the project that connects Xuanwu Lake to the Yangtze River was kept discussing during the Qing dynasty when the traditional culture was dominating. However, the Nanjing National Government put the project into practice in 1931, only 80 years later since it had been proposed, indicating that a cultural concept is not unbreakable with the change of corresponding social systems.

In 1931, a severe flood, once-in-a-century, stroke the middle and lower reaches of the Yangtze River. Nanjing City also suffered from severe flood damages again. The project that connects Xuanwu Lake to the Yangtze River was raised again and implemented later. There are many factors that attribute to the success of the project after more than 80 years since it had been proposed. Firstly, the Imperial Examinations were revoked. In the meantime, the feudal monarchy has been destroyed in China after the Revolution of 1911. Under the New Culture Movement from 1910s to 1920s that science and democracy were strongly promoted, an advanced social education model was increasingly spread with "popular education" and "civilian education" as the main body. As a result, the society embraced a new phase that was different from that of the last century (Office of Nanjing Municipal Committee of the Compilation of Local Chronicles 2011). Secondly, the project that connects Xuanwu Lake to the Yangtze River was supported by the Nanjing National Government. In 1928, Nanjing was selected as the capital of the Nanjing National Government. Moreover, many senior officials were adapted to Western cultures from studying abroad. For example, Liu Jiwen, Wei Daoming, and Ma Chaojun who served as the mayor of Nanjing, studied in Europe, the USA, and Japan, respectively. As they also valued the great importance of science, the project was greatly supported by the central government and the municipal government. Thirdly, the project was supported to improve waterways in Nanjing as part of the Capital Plan that was designed to transform Nanjing into a modern city (Office of Nanjing Municipal Committee of the Compilation of Local Chronicles 2011). Fourthly, an advance in construction technologies contributed significantly with regard to accurately evaluating the consequences of the project by precise engineering surveying and

planning to ensure that it could discharge water during the flood season and maintain its normal water level during the rest of the time (Nanjing Municipal Government 1932).

5 Conclusion

In 1849, the severe flood in the Yangtze River Basin caused serious impacts on socio-economic components in Nanjing such as human lives, agricultural products, urban systems, and infrastructures. The Qing government implemented proactive policies to mitigate the impacts of the flood by granting relief funds, exempting taxes and tariffs for some places and boats, adopting work relief, enhancing a food supply channel, and appealing for donations. Non-governmental forces also took part in mitigating flood damages actively. The severe flood prompted a series of debates on the project that connects Xuanwu Lake to the Yangtze River, in an attempt to fundamentally reduce floods in Nanjing. However, the local elites and civilians opposed and stopped the project based on a concept of Feng Shui, profit-seeking, and harm-avoiding features, that has a wide influence on all social classes. In other words, they were worried that the project may change the Feng Shui, consequently bringing misfortune for local students in the Imperial Examinations and the development of the city and their families.

In complicated traditional China, traditional cultural concepts were also important to social adaptations to climate change. However, the concept of Feng Shui is not the same as that of the cultural factors of indigenous Africans such as beliefs, taboos, ethnic groups, and gender. As the former needs to be bound with specific institutional factors, the deep influence of developed institutions on people may affect a decision-making process. In this sense, the institutional culture may be fundamental to determine social adaptations to climate change in a complicated society. However, the role of cultural concepts is also of great importance.

From the 1849 severe flood, it is found that culture is dynamic in a complicated social background and is continuously changed along with the influence of institutional changes, educational development, the guidance of the media guidance, etc. Besides, culture is always evolving while helping or restraining social adaptations to climate change. It is indispensable to build social adaptations by better understanding a complicated cultural system and its possible roles in determining social adaptations to climate change as well as the influencing pathways and mechanisms.

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