

# **Study on the flood prevention countermeasures about historical and cultural city in the middle and lower reaches of the Yangtze River**

## **—Taking Nanchang City in Jiangxi province as the example**

黃 凌誌<sup>1</sup> · 賀 旺<sup>2</sup> · 劉 弘濤<sup>3</sup>

Lingzhi Huang<sup>1</sup>, Wang He<sup>2</sup> and Hongtao Liu<sup>3</sup>

<sup>1</sup> Postgraduate, Southwest University of Science and Technology, School of Civil Engineering and Architecture  
(Qinglong's Middle Road 59, Mianyang City, Sichuan 621000, China)

<sup>2</sup> Engineering, Southwest University of Science and Technology, School of Civil Engineering and Architecture  
(Qinglong's Middle Road 59, Mianyang City, Sichuan 621000, China)

<sup>3</sup> Associate Professor, Southwest Jiaotong University, School of Architecture  
(Southwest Jiaotong University West section, High-tech Zone Chengdu, Sichuan 611756, China)

The middle and lower reaches of the Yangtze River is a flood prone area, and along the Yangtze River Valley has many historical and cultural city, the occurrence of floods not only to the region caused huge economic losses, but also damage to the city's material and cultural heritage. Based on a large number of historical data and research basis, this paper analyzes the types and damage of floods and disasters in Nanchang City of Jiangxi Province, and puts forward the countermeasures and measures to prevent floods and disasters. At the same time, there will provide reference for the flood control measures of the historical and cultural cities in the middle and lower reaches of the Yangtze River.

**Keyword:** *Floods, Disasters, Jiangxi province, Nanchang, Defense*

## **1 Basic overview**

### **(1) Location Overview**

Nanchang, also known as Yuzhang or Hongcheng, is the capital city of Jiangxi Province. Nanchang, also known as Yuzhang or Hongcheng, is the capital city of Jiangxi Province. Nanchang is located in the central part of Jiangxi Province, Gan River, Fu River downstream, near the Poyang Lake. Nanchang is not only a national historical city, but also a revolutionary hero city. Nanchang City, which a total area of 7432 square kilometers and 510.09 million population (2013). It is a 2200 years of history of the world's historical and cultural city that also is before the Southern Tang Dynasty capital. Nanchang terrain to plain, southeast flat, northwest hilly ups and downs, about 112.1 km north-south, east-west width of 107.6 km, is a real water city, with unusually rich water resources. (Fig.1)



Fig.1 position of Nanchang City in Jiangxi province

## (2) Historic evolution

More than 6000 years ago, when Nanchang has built a number of the original settlement. And 3000 years ago, from the south of Qingyun area to the north of Aixi River, which gradually formed the ancient Nanchang resident community.

In 202 BC, the Han emperor Liu Bang ordered Guan Ying stationed in Nanchang area, known as "Guan Ying build the city", which is the beginning of the city of Nanchang. Emperor Gaozu six years (201 BC), there sets the Nanchang county to attach Guo county, and belonging to Yangzhou, so that the name of Nanchang originated from here.

In 1926, the Northern Expeditionary Army captured Nanchang, who began to set up a city of Nanchang, by the provincial management directly. After the Northern Expedition in 1926, Chiang Kai-shek had designated the capital of the Republic of China in Nanchang, which has often become the military and political center of China.

On May 22, 1949, Nanchang by the government of the People's Republic of China to take over, which it has become the Municipalities of Jiangxi Province, and Jiangxi province people's government of the provincial-level base, after has become the capital city of Jiangxi province.

## (3) Historical and Cultural Heritage overview

Nanchang has rich historical and cultural heritage. There has been found the ancient cultural sites more than 70 and a large number of cultural relics unearthed in the Neolithic Age to the Shang and Zhou Dynasties. There has majestic You Min Temple that has built in the Southern Dynasties days (502-519), and prestigious Tengwang Pavilion by which Tang Taizong's brother Li Yuanying was built in Ren Hongzhou governor. In addition, there has Wanshou Palace that has been built in the two-Jin Dynasty, and the Feiyin tower of the Ming Dynasty other places of historic interests. Nanchang left a lot of revolutionary sites ruins, including eight-one Nanchang Uprising headquarters site, Ye Ting headquarters site and the New Fourth Army headquarters site and so on. In 1986, the State Council of the People's Republic of China named Nanchang as a national historical and cultural city. (Fig. 2, Fig. 3)



Fig. 2 You Min Temple



Fig. 3 Tengwang Pavilion

#### (4) Drainage distribution

There are main drainage distribution that have Poyang Lake, Gan River and Fu River in the distribution of Nanchang city. In addition, it has distributed to the East Lake, West Lake, Castle Lake, Ai Lake, Elephant Lake, Yao Lake and many other lakes distribution in the center of city. Among them, Gan River, Fu River, Yudai River, Jin River, Liao River vertical and horizontal throughout the entire of Nanchang City. There are hundreds of large and small water forms such as Poyang Lake, Junshan Lake, Jinxi Lake and Qinglan Lake in each county outside the city. Nanchang's lake water area of 1239 square kilometers, and natural lake shoreline up to 260 km.

According to research statistics, Nanchang City, the total land area of 7402.36 square kilometers, of which the water area of 2204.37 square kilometers, accounting for 29.78% of all areas, the water surface area of urban area for 27.3%. (Fig. 4)



Fig. 4 The water distribution of Nanchang City map



It can be seen from Fig. 4 that the distribution of water in Nanchang is almost all over the whole city, and the development of the city is influenced by the natural factors. Therefore, the defense of flood disaster is very important for the protection and development of the historical and cultural city.

## 2 Type

### (1) Season type

Nanchang City, Jiangxi Province flood disaster from the seasonal point of view, through which the seasonal classification of floods and statistics can be seen that spring water (that is, every year 3 to 5 months of floods) occurred a total of 5 times, and the frequency of 19.23%. Summer water (6 to 8 months of floods) occurred a total of 18 times, and the frequency of 69.23%. Other types of floods (such as autumn water, winter water, summer and autumn water, autumn and winter water, winter and spring water, etc.) are less frequent. The final analysis shows that the largest flood types in Nanchang, Jiangxi Province is the summer water, followed by spring water, again spring and summer water. We can see that the spring and summer season is a high flood season, so we need take early defensive measures. (Table. 1, Table. 2)

Table. 1 The flood disaster situation of major year in Nanchang City, Jiangxi Province

Years	Major flood time	Flood disaster level
1955	In the middle of June to late June	Area flood and Partial big flood
1957	Late April	Area flood
1958	Early May	A wide range of flood and Partial big flood
1962	In the middle of June to late June	A wide range of flood and Partial big flood
1964	In the middle of June to late June	A wide range of flood and Partial big flood
1967	In the middle of June	A wide range of flood and Partial big flood
1969	Late June	A wide range of flood and Big flood
1973	Late June	A wide range of flood Area flood
1975	In the middle of August	A wide range of flood and Partial big flood
1977	In the middle of June	Area flood and Partial big flood
1983	In the middle of July	Area flood and Big flood
1993	Early July	A wide range of flood and Partial big flood
1994	In the middle of June	A wide range of flood and Partial big flood
1998	In the middle of June to late June, Late July	A wide range of flood and large floods
1999	Mid to late April, Mid to late June	Area flood
2000	In the middle of June	Area flood
2002	In the middle of June to late June	A wide range of flood and Big flood
2003	late June	Area flood and Big flood
2004	In the middle of June	Area flood
2005	In the middle of June to late June	Area flood and Big flood
2006	Early April to the middle of April	Area flood and Big flood
2008	Late May	Area flood
2010	Early March, mid to late June, mid to late July	A wide range of flood and Big flood
2012	In the middle of May	Area flood and Big flood
2014	Late May, mid to late June, In the middle of July to late July	A wide range of flood and Big flood
2016	Mid to late June	A wide range of flood and Big flood

Table. 2 The flood disaster situation of major year in Nanchang City, Jiangxi Province

Name	Spring water (March to May)	Spring and summer water	Summer water (June to August)	Other	Total
Frequency	5	3	18	0	26
Percentage	0.1923	0.1154	0.6923	0.0000	1.0000



## (2) Month type

According to the distribution type of flood season in Nanchang City. In the single months of floods, with which the largest frequency of floods in June, accounting for 53.57%, followed by the percentage of 10.71% in April, again in May and July occurred in the frequency of 7.14%. In the double months of continuous floods, which the frequency of June to July is 2 times than the frequency of May to June, at 7.14%. According to the distribution type of flood season in Nanchang City. In the months of continuous floods, which mainly in May to July this time period, at 3.57%. It can be seen that Jiangxi flood disaster defense focus should be in June and followed by July (single month plus double month of continuous disaster), meanwhile, This two months the number of flood accounted for total of floods more than 2/3. Therefore, All localities should take effective measures to be taken seriously. (Table. 3)

Table. 3 Statistics of floods by month

Name	March	April	May	June	July	August	May to June	June to July	May to July	总计
Frequency	1	3	2	15	2	1	1	2	1	28
Percentage	0.0357	0.1071	0.0714	0.5357	0.0714	0.0357	0.0357	0.0714	0.0357	1.0000

## 3 Economic losses condition

According to the research can be learned, the direct economic losses caused by the floods in Nanchang, Jiangxi Province were generally below 400 million yuan when from 1955 to 1983. From 1993 onwards, the economic losses caused by floods were over 400 million yuan. Especially in recent years (2008-2016), the flood losses caused by flood losses increased year by year, which reaching 815.23 billion yuan. With the slowdown in the process of urbanization, the historical and cultural city of economic development and cultural heritage protection has been unable to withstand the impact of floods, so that we should be more attention to the urban flood prevention work. (Table. 4, Fig.5)

Table. 4 Statistics on direct economic losses caused by floods from 1955 to 2016

Years	Direct economic losses (100 million)	Years	Direct economic losses (100 million)
1955	1.973	1998	30.265
1957	2.055	1999	33.287
1958	2.058	2000	15.781
1962	2.505	2002	11.104
1964	2.296	2003	11.872
1967	2.937	2004	8.562
1969	2.956	2005	9.321
1973	3.629	2006	8.113
1975	3.108	2008	2.391
1977	2.989	2010	13.112
1983	3.812	2012	20.731
1993	8.726	2014	35.712
1994	9.921	2016	81.523

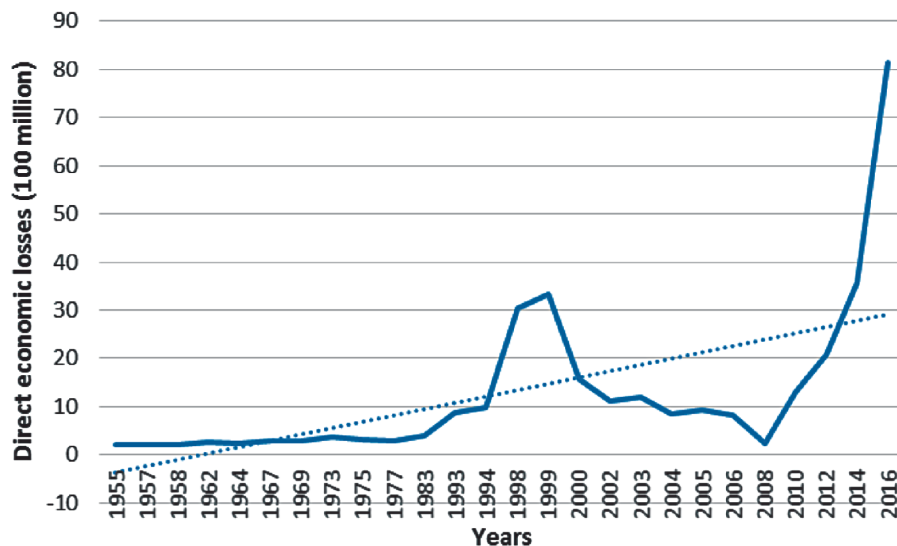


Fig. 5 Economic Loss Trends from Flood Disaster in Nanchang City, Jiangxi Province map

## 4 Flood control measures

### (1) Strengthen water conservancy construction

From 1955 to 1957, water conservancy construction belongs to the recovery phase, which is a focus on building dam and resume production. It mainly for flood control and drainage. From 1958 to 1979, water conservancy construction in the development stage. It has been implementation of a mountain, water, forest and farmland road comprehensive planning, and comprehensive treatment. From 1980 to 1990, water conservancy construction was in the reform stage, which had three salient features.

- Water conservancy construction focused on disaster prevention and treatment of existing engineering hazards, reinforcement of existing projects and related facilities.
- Water conservancy work into the new stage of water control and management of water.
- Water conservancy investment reduction, and construction stagnation.

Since 1991, with the continuous improvement of the establishment of socio-economic system, which water conservancy construction has entered the stage of consolidated and continue to improve. At present, there are still many problems in Nanchang, which are reflected in the following aspects. For example, the water conservancy facilities aging failure, dangerous risks and flood control standards are low. Therefore, we have to strengthen the improvement of water conservancy construction at this stage. There are require the following 4 points:

- Repair, rebuild reservoirs, ditches and dams.
- Reinforcement, increase the existing embankment and improve the water conservancy facilities flood control standards.
- To improve farmland irrigation conditions and increase farmland area.
- Increasing investment in water conservancy construction.

### (2) Planting flood control vegetation

At present, there will construct of sand dam, valley and bamboo ditch and other soil and water conservation measures to deal with the problem that serious soil erosion about mountain and slope. Although soil and water conservation and engineering measures in the Nanchang watershed are indispensable, we must be combined with biological measures. Making use of engineering to protect biological, on the contrary, Biological replacement engineering. Although the biological measures slow effect, it is less investment,

effective and effective long life. In addition, it can complement engineering measures to a certain extent.

On the other hand, it should use biological measures to prevent soil erosion, not a simple barren hills green, nor is it simply closed forest, but the basin of all the forest resources for a comprehensive and systematic management. Measures not only build soil and water conservation forest, and create a timber stands, economic forests and firewood forests and so on, so that the ecological economic benefits can be achieved. In addition, there are cultivating forest resources while to protect forest resources, which especially the natural forest. In the construction of soil and water conservation forest, which formation of multi-tree species and multi-level ideal vegetation, in order to facilitate the forest to slow down the flood, water conservation, to maintain water and soil functions.

### (3) Strengthen the comprehensive management of river basin

Table. 5 Distribution of soil and water loss area of two major river systems in Nanchang City

Name	Soil and Water Loss Area of whole basin (10,000 hm <sup>2</sup> )			Soil and water loss area in upper and middle reaches (10,000 hm <sup>2</sup> )		
	Total	Low level	Medium level or more	Total	Low level	Medium level or more
<b>Gan River Basin</b>	165.72	57.98	107.74	142.67	48.10	94.51
<b>Poyang Lake area</b>	48.96	17.40	31.56	48.96	17.40	31.56
<b>Total</b>	214.68	75.38	31.56	191.63	65.50	126.07

The Gan River and Poyang Lake water systems run through various areas of Nanchang. Because of affecting by floods, the soil erosion is more and more serious in the Gan River basin. The form of the disaster is mainly in the form of water invasion. Other area existed gravity erosion and wind erosion and so on. According to the research, the total area of soil erosion in the Gan River is 1.6572 million hm<sup>2</sup>, accounting for 77.19% of the whole basin. The area of soil and water loss in these two water systems is mainly distributed in the middle and upper reaches of the urban area, so that the problem is more serious. We should put flood governance focus on the upper reaches of the region. (Table. 5)

On the one hand, soil erosion not only accelerate the lake blockage and reduce the capacity of flood storage but also aggravate the flood disaster. On the other hand, it will reduce water conservancy and shipping efficiency, loss of land resources, destruction of ecological balance, and restricting social and economic development. In order to prevent the floods caused by the Gan River Basin and the Poyang Lake Basin, which we must adhere to the combination of water control and sand control and strengthen the comprehensive management of soil and water loss in the whole basin. Finally, we will build the ecological barrier of flood control safety system.

### (4) Strengthen flood control non - engineering measures, the establishment of integrated flood control management system

a) Improve flood control awareness and disaster prevention and mitigation level of the whole people

Strengthen the flood prevention and mitigation propaganda, raise the flood awareness of the whole people. First of all, we need strengthen the promotion of China's current water resources, so that the whole society fully aware of the devastating floods on the city. At the same time, a clear flood prevention and mitigation is a social act, which all people have the responsibility to maintain our home.

Increasing the investment in flood control, and establish of multi-channel, multi-level and diversified water investment system. Governments at all levels should pay attention to speed up the progress of flood control construction, which increase investment in water conservancy construction. At the same time, Government need actively broaden the water resources to raise channels, and attracting a wide range of social funds to solve the problem of insufficient water conservancy construction funds for the construction of modern flood



control system to provide adequate funding.

It need to vigorously develop education, which is effective disaster reduction and disaster prevention and implementation of the basic protection of sustainable development. We should combine ecological environment education, disaster prevention and disaster prevention education with local social and economic development to improve the quality of the whole people and knowledge of environmental protection.

b) Formulate and improve the laws and regulations for flood prevention and control

It is the important one of content that do the job of flood prevention is strengthen the construction of flood control laws. We should adjust the environmental legal and economic legal relations between the lake area and the river basin from the perspective of coordinated development of economic construction and ecological environment, and formulate regulations on the protection and management of river waters.

c) Strengthen scientific research, which increase the role of science and technology in flood prevention and relief

The middle and lower reaches of the Yangtze River Basin is a large watershed system. The Yangtze River flood disaster prevention and remediation should be in accordance with the entire river basin system coordination and coordination, which the principle of comprehensive rectification to unified planning and implementation.

Construction of "digital river basin" to enhance disaster early warning and disaster prevention capacity. In the information network, communication technology and "3S" technology support, which can be timely processing, analysis, display and transmission of water, disaster information, feedback, communication of different channels of information related to decision analysis. Finally, It forms an integrated can run of the flood control information system, so as to improve the response rate of flood disasters, decision-making timeliness and scientific nature.

**Acknowledgment:** We would like to thank the various people who provided useful advices and helpful assistance during the whole writing process. Special thanks to the Jiangxi Provincial Water Conservancy Bureau and the Meteorological Bureau to provide the relevant data.

## References

- 1) Guoqing Huang: The Regularity for Temporal and Spatial Distribution of Flood Disaster in Jiangxi Province, *J. Disaster science*, Vol.14, 1999.
- 2) Genmu Chen: Reflections on the Flood Disaster in Our Province this year, *J. Journal of Jiangxi Agricultural University*, Vol. 20, 1998.
- 3) Shi Deming: A New Technique of Soil and Water Conservation for the Development and Utilization of Hillside Land—An Introduction to Hillside Ditches and Its Application Prospect, *J. Bulletin of Soil and Water Conservation*, Vol. 01,1997.
- 4) Rui Nie: The Impact of Urban Space on Flood Disaster, Risk Assessment and Disaster Mitigation Strategies - A Case Study of Tokyo, Japan, *J. Urban Planning Forum*, Vol. 06,pp.79-85,2012.
- 5) Guoqing Huang, Haiyan Chen: Agricultural Natural Disasters in Jiangxi Province in Recent Years and Its Countermeasures, *J. Disaster science*, Vol. 02, 2005.
- 6) Shuangna Jiao: Study on Flood Control Strategy of Poyang Lake Area, *D. Huazhong University of Science and Technology*, 2013
- 7) Fengsheng Wu: Study on Countermeasures of Flood Prevention and Disaster Prevention in the Yangtze River Basin, *J. Disaster science*, Vol. 02, pp.34-338, 2013.7.
- 8) Jufang Hu, Chaomei Zhang and Jing Peng: The main characteristics of Variation of meteorological disasters in Jiangxi Province's analysis, *J. Meteorology and Disaster Reduction Research*, Vol.04, pp37-42, 2014.09.