Lessons Learned on Land Management Policy from the 1998 Changjiang River Flood

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ABSTRACT: The 1998 flood had smaller peak discharges than of the 1954 flood (largest flood in the 20th century) at most gauging stations in the middle and lower reaches, but resulted in higher peak stages. One of the reasons of this higher water stages is the decrease in the surface area and storage capacity of natural lakes due to the excess impoldering agricultural land and sedimentation. However, there is social difficulty in retarding flood waters in polders around natural lakes because it would damage settlements and agricultural land use in these areas. As a response, the government of China took national program called ‘single retreat’ and ‘double retreat’. ‘Single retreat’ is to relocate residents alone, while ‘double retreat’ is to relocate both residents and agricultural lands. This program comes with compensation scheme of local residents. By examining the management of polders around Dongting Lake as a case study, we explore the possibility of transferring Chinese experience to other countries.

1 Introduction

Flood plain of the Changjiang River is characterized by a high population density and extremely accumulated property especially in cities such as Wuhan, Nanjing, and Shanghai. Thus, one of the most important subjects of the Government of China concerning the Changjiang River basin is the construction of a sustainable flood control system in the area.

After the flood of 1998, the Government of China reviewed its flood prevention policy and proclaimed the so-called 32-character-policy. In this policy, there are three land management regulations, i.e.1) enclosing mountains and planting trees, 2) transforming arable lands into forests, 3) converting polders into lakes and using lakes as retarding basins. In this paper, we would like to examine the management of polders around Dongting Lake as a case study. We also attempt to explore the possibility of transferring this Chinese experience to other countries by analyzing similarities and differences of landuses and other societal systems among related countries.

2 Flood control system and the 1998 Flood

2.1 Flood control system in the Changjiang River

The Changjiang River is one of the largest rivers in the world with a mainstream length of 6,300km and a catchment area of 1.8×10^6 km^2, about 1/5 of the China's land area. China can be divided into three areas according to its topography (Li et al., 2001), that is: 1)Tibet plateau , 2)Yungui plateau, and 3)hilly terrain and lowland area. With regard to the Changjiang River basin, the area corresponding to 1) or 2) is called upper reach, and the area corresponding to 3) is called middle and lower reach. Average annual precipitation in the basin is 1,067mm. Precipitation in the south-east part of the basin is largest, and the north-west part is smallest.

The middle and lower area of the river includes important abovementioned cities with a large population and cultivated land, therefore, social and economic development of the nation would be damaged if the areas were flooded. Among the historical floods that occurred in the 20th century, the 1954 flood is the largest. Thus, the highest flood stages in that flood became the design standard for flood prevention systems. In the 1954 flood, return periods at Yichang, Chenglingji (confluence of the Changjiang River and Dongting Lake), and Hankou are 80, 180, and 200 years respectively (Wang et al., 2004). On the contrary, the current discharge capacity in each point only corresponds to the floods of about 10-20 year return period. Thus, the peak discharges of many historic floods were much larger than the current discharge capacities. Because of this property, floods can not be regulated only by embankments and other measurements such as retarding basin are needed for flood prevention. **Figure 1** shows the retarding basin along the middle reach of the river. There are 6 retarding basins in the area, namely Jingjiang, Dongting, Honghu, Wuhan, Poyang and Huayang. Their storage capacities are 5.4, 16.0, 16.0, 6.8, 2.5 and 2.5×10^9 m^3 (Wang et al., 2004), respectively. Each retarding basin is composed of many small impoldered agricultural lands and settlements. Dongting and Poyang lakes are two of the largest fresh lakes in the basin, connected with the river system. Thus, these two lakes play important role in the regulation of floods.

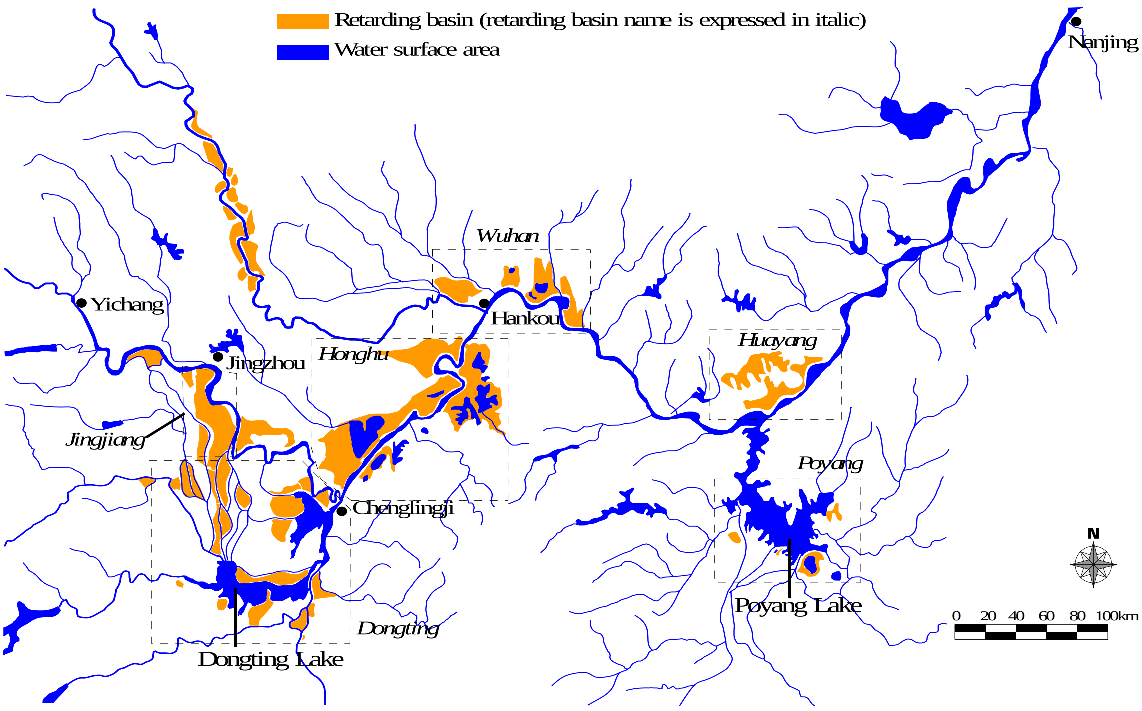

Figure 1. Retarding basins in the middle area of the Changjiang River basin
(Changjiang Water Resources Commission Ministry of Water Resources, 2000)

2.2 Characteristics of the 1998 flood

The 1998 flood had smaller peak discharges than of the 1954 flood at most gauging stations in the middle and lower reaches, but resulted in higher peak stages. The main causes of this higher peak stages can be analyzed from the following three view points.

1) Flood diversion and levee breach

The flood volume that was diverted into retarding basins and flowed into the landsides due to levee breaches was 102.3×10^9 m^3 in 1954, whereas it was 1.0×10^9 m^3 in 1998, only about 10% of that in 1954 (Wang et al., 2004).

2) Change in the surface area and storage capacity of natural lakes

The surface area and storage capacity of the natural lakes has become smaller and smaller because of sedimentation and impoldering agricultural land.

3) Impact of water logging

In 1954, few pumping stations were available for stormwater drainage from the landside back into the river during the flood, while the stormwater of 22.1×10^9 m^3 during the 1998 flood was pumped back into the river (Wang et al., 2004).

3 Flood prevention policy and law

3.1 Regulation of retarding basins and polders before 1998 flood

In the late 1980s, the Government of China implemented the policy to prohibit impoldering agricultural land in the Changjiang River basin (Zhao et al., 2004). In January 1998 (before the 1998 flood occurred), the Government of China established the first law for flood prevention. The law stipulates the regulation of retarding basins and polders among other regulations. In short, the law bans making new polders; prohibits construction of facilities without evacuation equipment; promotes relocating residents of retarding basins to safer places; and gives central government authority to make decision whether or not to use retarding basins. However, punishment system is not fully formulated in the law, thus, the law fails to regulate illegal activities.

3.2 Flood prevention policy after the 1998 flood

After the 1998 flood, the Government of China has realized that what is important in flood mitigation is not to control but to manage. Based on this understanding, the following so-called 32-character-policy was formulated immediately after the flood. The 32-character-policy consists of 8 items. Each item is expressed in 4 Chinese characters. Thus, this is called as 32 (4x8)-character-policy. Contents of these 8 items are as follows: 1) enclosing mountains and planting trees, 2) transforming agricultural lands into forests, 3) demolishing dykes of polders to channel flood water, 4) transforming impoldered agricultural lands into lakes, 5) supplying laid-off laborers for rehabilitation, 6) relocating residents to form new township, 7) reinforcing key levee and, 8) dredging river beds. Except for 5), 7), 8), policies are related to landuse management. Since 3), 4), 6) are closely related, they are always executed simultaneously in any impoldered land management project. In the next section, we would like to explain how the Government of China executed the policy related to managing polders.

3.3 Converting polders into lakes and rivers from 1998 to 2003

The Government of China implemented a 10-year lake restoration project in the Changjiang River (Zhao et al., 2004). In practice, the government took two ways of converting polders into lakes. These are called 'single retreat ' and 'double retreat'. 'Single retreat' is referred to relocating residents. And agricultural lands in the polders are remained to be used. On the other hand, 'double retreat' is referred to relocating both residents and agricultural lands to safer places. Up to now, around Dongting Lake, Poyang Lake and the Changjiang River, 2,900 km^2 of land was returned to lakes and rivers and the flood storage capacity increased up to 13 billion m^3 (Cheng, 2004). The government of China plans to relocate all the people lived in this area. When relocating residents or agricultural lands to safer places, compensation for residents is made. Total financial input during 1998 to 2003 amounted to over 10 billion RMB (Cheng, 2004)

4 Polders around Dongting Lake

4.1 Decrease of water surface area in Dongting Lake

Figure 2 shows the change of water surface area and storage capacity in Dongting Lake. From 1949 to 1971, the decrease of water surface area in Dongting Lake was drastic. The surface area shrunk by about 1,530km^2. The main reason of this drastic decrease is attributed to the agricultural policy of the Government of China. The government tried to increase the arable land to feed its increasing population. In fact, 15 state farms occupying 1,214 km^2 area were impoldered from 1950 to 1964. Another important aspect extracted from **Figure 2** is that after the late 1970s, high decreasing ratio was remarkably calmed down. Zhao and Fang (2004a) showed that after the late 1970s agricultural lands have been converted into wetlands and forests by analyzing topographical maps and satellite imageries. Reasons of this trend can be attributed to two factors (Zhao et al., 2004b): 1) The government policy, 2) the return of inundated lands to the lake by local people for they are unwilling to repair dyke breaches by floods. Accelerated impoldering lands practice before the late 1970s is the important factor of decrease in water surface area of the lake. In addition to this, sediment load is another important factor of water surface area decrease.

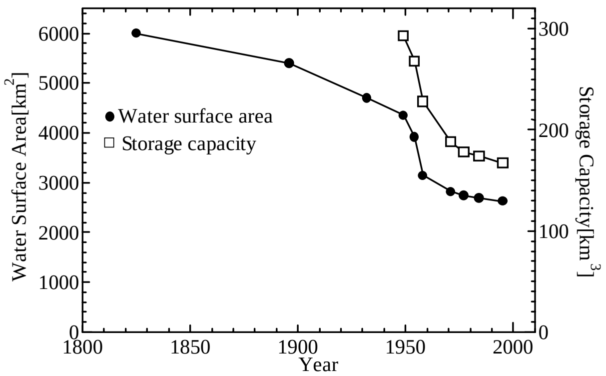

Figure 2. Change of water surface area and storage capacity in Dongting Lake(Dou and Jiang, 2000)

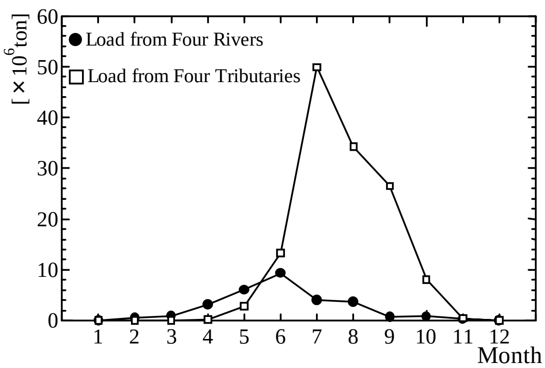

Figure 3. Sediment load from Four Rivers and Four Tributaries to Dongting Lake(Dou and Jiang, 2000)

Water of Dongting Lake drains into the Changjiang River through one tributary which has an exit at the northeast of the lake. At the same time, the lake is fed by the four tributaries (collectively known as the Four Tributaries) of the Changjiang River which flow into the lake from the northwest. In addition to this, there are four rivers (collectively known as the Four Rivers) which flow into the lake at the south and southwest of the lake. **Figure 3** shows the monthly sediment load (averaged over 30 years from 1950) of Four Rivers and Four Tributaries to Dongting Lake. It shows clear that most part of sediment in Dongting Lake is transported from Changjiang River. Total sediment load from the Changjiang River per year is 135×10^6 ton, and this amount is about 83% of total sediment load of Dongting Lake per year (Dou and Jiang, 2000). Moreover, the amount of sediment load from the Changjiang River is accelerated by height of dykes. The government ranks dykes according to height of extra banking and width of levee crown. The current dyke between Songzi and Chenglingji section of left bank is classified as rank 1 dyke (height of extra banking is 2m; width of levee crown is 8-12m). On the other hand, the dyke in the same section of the right bank is classified as rank 2 dyke (height of extra banking is 1.5m; width of levee crown is 6-8m). Thus, the sediment load of the Changjiang River during the flood season tends to be conveyed through Four Tributaries to the Dongting Lake.

4.2 Conversion of polders into Dongting Lake after 1998 flood

The retarding basin of Dongting Lake can be divided into 24 areas as shown in **Figure 4**. These areas were established after the 1954 flood. Total population in the areas in 1987 was about 1.37×10^6(Hong, 1997). As shown in **Table 1,** frequencies of flood disasters in the Dongting Lake region between 1525 and 1998 are tremendously increasing with time (Based on Li et al., 1999). Especially, frequency from 1990 to 1998 is very high. On the contrary, there are a few areas where both pump and gate are constructed. Thus, flood prevention facilities in the retarding basin are inadequate and polders around Dongting Lake are more vulnerable to floods than ever. After the 1998 flood, according to the ten year lake restoration project of the government, the government plans to double the surface area of the lake by 2010. In this process, all the people who live in the retarding basin are planed to be relocated. From 1998 to 1999, 337×10^3 people were already relocated.

Though this is not the case in Dongting Lake region, Cheng(2004) reported the result of a specific survey on Poyang Lake in 2003 The result revealed some primary issues that have emerged from the process of returning polders to lakes and relocating people to townships. These include lack

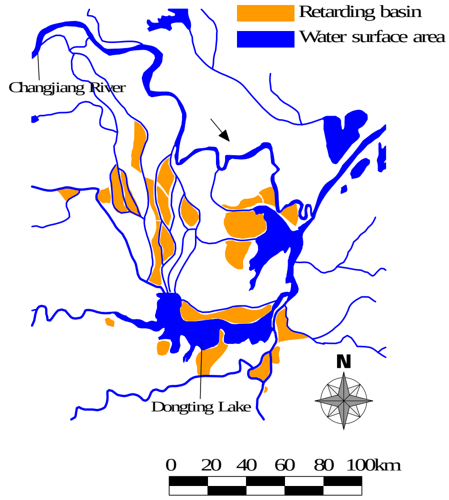

Figure 4. Retarding basin of Dongting Lake (Changjiang Water Resources Commission Ministry of Water Resources, 2000)

Table 1. Frequencies of flood disasters in the Dongting Lake polders between 1525 and 1998 (Li et al., 1999)

Periods	Total years	Average interval between floods (yr)
1525-1851	327	20
1852-1949	98	5
1950-1989	40	4
1990-1998	9	1.5

of necessary evacuation facilities in the polders returned to lakes; maintenance of dikes around the polders has been weakened; the shortage of drainage capacity of the polders is serious; the impacts on transportation are obvious; and compensation scheme is still in under examination process and not fully established.

5 Discussion

In this paper, we traced the change in the process of flood prevention policy in China with a special focus on management of impoldered lands around Dongting Lake. Around the Dongting Lake region, after the late 1970s decreasing rate of water surface area was dropped down. Increasing flood damage in polders is assumed to be the main reason of this trend. Under the circumstances, the 1998 flood was the turning point in the policy of the Government of China. If there had not been catastrophic damage especially during the period of 1990-1998, this large scale relocation program would not have been started. In executing the relocation of people, the key point for success of relocation is how to offer a satisfying compensation scheme. Especially for farmers who experience ‘double retreat’, their satisfaction does not only depend on the amount of compensation but on the development of social infrastructure. Relocation just begun, thus, we would like to examine more samples to understand how and why relocation works or fails. Eventually, we would like to explore ways to apply learned lessons to other countries.

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