

Outlook and Thinking Changes in Chinese Flood Dispatching

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Flood dispatching, in this article, means the process of artificially changing the natural distribution states of a river flood by using structural flood-control measures, so as to reduce the entire flood damages of the river. It refers to the flood dispatching process over a whole river basin, not a single flood-control work. A flood dispatching possesses significant importance to the flood-damage reduction of a river. In the past 50 odd years, it has been a very important method for reducing flood damages during large flood events over large and important rivers in China.

1. Background Environment of Flood Dispatching in China

Large rivers in China are rain-fed rivers, therefore their floods are concentrated in time and usually with high peaks and huge volumes. The total value of the maximum 4-month rainfall amounts to 50%-80% of the annual value, while the amount of the maximum 1-month rainfall consists of 15%-30% of the yearly rainfall in most part of China. High intensity and large-scale rainfalls often occur in the relatively developed and populous eastern half of China. The high rainfall records of different duration in China are very close to that of the world records. Meanwhile, the southeastern coast areas of China are often visited by typhoons, which often bring about heavy rainfalls and cause flood disasters.

Flood disasters happened frequently and caused many casualties and damages throughout Chinese history. From 206 B. C. to 1949 A. D., there happened 1029 disastrous floods in China, averagely 1 time in every 2 years. After the year of 1949, approximately 9.3 million hectares of farmland were affected by floods each year, in which 4.6 million hectares were inundated. Averagely, 5,200 odd people died due to floods yearly, in which 2/3 were in hilly areas while the other 1/3 were in plain areas. In 1942, the Yellow River breached its southern bank and drowned 0.34 out of 0.37 million people at the city of Kaifeng, Henan province. In 1931, another disastrous flood occurred in the Yangtze River valley, the dykes along the main trunk of the river were breached 300 odd points and nearly all the cities along the main trunk were inundated. Not only 3.3 million hectares of farmland were affected, but also 145,000 people were drowned this year as well. In 1998, large floods visited the Yangtze, the Xijiang and the Songhua Rivers respectively; 13.78 million hectares of farmland were affected and caused a direct damage value of \$3 million.

China has performed large-scale river treatment during the past 50 odd years, so as to control the flood disasters. Above all, comprehensive river treatment plans were made in the 1950s, and they were improved and revised several times later on. Secondly, huge amounts of flood control works were built up according to the plans. There are about 8,600 reservoirs, 260,000 km dykes and 98 flood diversion and detention areas recently in China. Thirdly, the flood control standards of large rivers have been obviously enhanced. A relatively complete structural flood-control system has been built up over each large river, and its flood control standard has been raised to withstand a 20-50 year flood when the flood diversion and detention areas are used. Flood control standards for the small and medium sized rivers have also enhanced accordingly.

However, flood disasters cannot be eliminated completely merely by means of structural flood-control works. The flood control standard of the existing structural flood-control works in China is still very low compared to that in the developed countries. Therefore, flood dispatching, which means using the structural flood-control system of a river properly to minimize flood damages, is indispensable and a very important task in China.

2. Traditional Thinking Methods of Flood Dispatching in China

Large rivers in China have performed comprehensive flood-control treatments under the guidance of their respective plans since 1949, according to the principle of "considering both release and storage and putting release at the priority". A structural flood-control system has been established on each large river by means of dyke construction, channel regulation, reservoir building, flood diversion and detention areas, as well as soil and water conservation. The purpose of a river treatment is to control or limit the flooding areas of the maximum actual flood that happened after 1949, and drain its floodwater smoothly to the sea, so as to reduce the overall

flood damages of the river.

Since many years ago, flood dispatching of a river has been controlling or limiting its inundation areas by using every kinds of methods and means, and release its water to the sea as quickly as possible and as more as possible. It has been a well-recognized rule that making benefits must obey damage reduction in flood dispatching of a river. Each large river has made its own flood dispatching schemes and applied many concrete measures based on its local conditions. The schemes and measures differ from river to river. However, the main principles of flood dispatching over different large rivers may converge to 6 points as bellow:

(1). Control the reservoir water level during flood seasons and lower it further more before a flood comes according to flood forecasting, so as to empty more room of the reservoir beforehand for floodwater detention.

(2). Make a full use of the releasing capacity of a river channel, and sending floods to the sea. Use diversion channels or floodways to increase the releasing capacity of the main channel at proper locations or when meet with available conditions alongside the river.

(3). Break through a part or all the local polders in between the 2 dykes of a river to increase its releasing capacity, when the river channel is insufficient to carry the floodwater of the river.

(4). Use upstream reservoirs to detain floodwater at proper times, so that the flood-burden downstream can be reduced and flood damages can be mitigated in the lower part areas.

(5). Divert proper amount of flood discharges at proper moment from the river channel by using flood diversion and detention areas that locate outside the 2 dykes of a river but directly attach to the river channel.

(6). When very necessary, abandon or actively use some relatively less important areas to divert floods, so as to minimize the overall flood damages in the river valley.

All the structural flood-control works of a river should be protected according to local conditions by well-organized social people and by using pre-prepared flood-fighting materials through out the whole process of flooding and flood fighting.

3. New Thoughts of Flood Dispatching in China

Even though flood disasters are severe in China, the water resources are scarce in the country. The average annual occupation of water per person is merely 2,400 m³, about 1/4 the value of the world average. Precipitation distribution is very uneven both timely and spatially. The maximum 4-month rainfall amounts to 60%-80% of the annual total in most parts of China. While the annual precipitation in the eastern half of China overpasses that greatly in the western half of the country. There are 9 provinces and municipalities or autonomous regions possess an average annual water amount of less than 500 m³ per person. The water shortage is obvious and it has become a major component that resists the progress of society and local economy. Further more, more than 300 cities are facing the problem of water shortage among the 600 odd cities in China, and about 1/3 of them are serious in need of water.

Water shortage has appeared more and more obvious in most parts of China along with the social and economic development in the country. Therefore, regulating the water quantity difference between the rich and the deficient water seasons is not a pressing research topic, but has become an important realistic issue. It directly connects to the social and economic development of the country.

The issue of making use of the flood resources has been attracting more and more attention of many experts and scholars since the 1990s in China.

In 1996, a rainfall flood happened in the upstream area of Daqing River, Haihe River basin. The river system was very dry before the flood, due to no other obvious flooding events had ever happened for as long as 33 years. Therefore, floodwater flew very slowly in the river channel and much of it infiltrated into the ground. This caused an increase of local ground water level by several meters, and improved the local conditions of water supply and environment. This event also pushed the consideration of and discussion on making use of floodwater resources a large step forward in China.

Under the guidance of a new theory on water and its utilization and management, which was proposed by the Ministry of Water Resources, China, considerable changes have been made in flood dispatching in recent years. They are symbolized in the following 5 aspects.

(1). For the construction of flood dispatching infrastructures, river treatment has begun to change from human invading into flood passages to the behaviors of living with floods. Several local polders in between the 2 dykes of the main trunk of the Huai River have been destroyed, so as to broaden its flood passage way. Many small-sized and human-occupied polders along the river channel of the Yangtze River and in the directly attached Dongting Lake and Hongze Lake areas have been emptied and retreated for floodwater detention, so that the flood stages along the main trunk of the Yangtze may be reduced to some extent.

(2). For the practicing period of flood dispatching, it has begun to change from merely performing in the flood season to the whole year. Therefore, flood dispatching may perhaps finally become water dispatching. Through the practice of river-wide water management and dispatching, the Lower Reach of the Yellow River hasn't dried up for 3 successive years. However, before the practice, it usually runs out of water and the dry up has attracted worldwide attention.

(3). For the way of flood dispatching, it has begun to change from merely damage reduction to the combining damage reduction and water resources utilization as well. In the Songhua River basin, a practice of transferring water from rivers to the Jalong wetlands was performed during flood seasons, so as to increase the biological and environmental water uses. In the Taihu Lake area, clean water was transferred from the Yangtze River to the lake and some of its downstream waterways for increasing usable water quantity and improving local water quality and environments.

(4). For the spatial arrangement of flood dispatching, more and more energy have been gathered to cope with the integrated water dispatching basin-wide and region-wide, which possesses water from different river systems. Water transfer from one river system to another has been performed successfully for 2 successive years in the Xinjiang Uygur Autonomous Region. In the Heihe River valley, usable water of the river has been divided successfully between the Gansu Province and the Inner Mongolia Autonomous Region. Before the integrated water dispatching process in the way of basin-wide combine with region-wide, many problems had been existed for many years.

(5). For the flood dispatching schemes of large rivers in China, the authority in charge has begun to consider changing some parts of the existing schemes, so as to make better use of the flood resources. Several flood-dispatching schemes of some rivers have scheduled to revise after this flood season, and the revised schemes will make floodwater utilization a little bit favorable. After their approval, the amended schemes will become legal rules in the practices of floodwater utilization.

The water dispatching activities in the past 2 years around the Taihu Lake area may reflect some thinking changes in flood dispatching in China. The Taihu Lake area is high in its surroundings but low in its middle part, high in the western half but low in the eastern half, with a 2,400 km² natural lake in between the western part and the eastern part. The natural lake receives floodwater from the western part and drains or supplies water to the eastern part. Many waterways cut through the Taihu Lake area, and a waterway network in this area is therefore formed. Due to the releasing capacity of the waterways that drain water out of the basin is small, the water stage of the lake cannot be lowered easily when it has been raised. Flood disaster and water logging happens when meet with downpours at times of high lake water levels. The traditional flood dispatching method is to maintain a low water level of the lake and drain the water from the lake as quickly as possible according to the water stages in the downstream waterways. Only the flood damage mitigation is considered then. In the past 2 years, schemes on water resources utilization were proposed and tested because the water quality in the Taihu Lake area was becoming poor and poor along with the quick economic development in the area. There are 3 main new improvements in flood dispatching. First, lower the water level of the natural lake at the beginning of flood season and raise it gradually afterwards for water resources utilization. This was done after having analyzed the historical flooding patterns within the area. This arrangement will do no large harm to the flood control security of this area. Second, divert clean water from the Yangtze River in dry seasons to the lake and its downstream waterways, so as to form frequent water flow cycles to improve the local water quality and environment. Third, enhance the flood-forecasting accuracy and divert the clean water from the Yangtze River during flood seasons at times when the water stages in the Taihu Lake area are relatively low both in the lake itself and its downstream waterways. This water-dispatching test has achieved positive results and accumulated some good experiences.

4. Outlook of Flood Dispatching trends in China

As have been said before, the per capita occupation of water resources in China is very small, and the water resources distributed unevenly both in space and in time. Therefore, from a long point of view, the flood dispatching in China will possibly have 6 main changes in the future.

(1). The traditional flood dispatching that merely focuses on damage mitigation during flood seasons will possibly go to the direction of whole year water dispatching, putting more attention to the water resources utilization. The future flood dispatching will consider both floods and droughts, both regional and basin-wide, both upstream and downstream, both left bank and right bank, as well as different water functions as livelihood water, biological water and production water. Any water use will be coped with other uses harmoniously.

(2). In the areas with proper local conditions, cross water system flood dispatching will be taken into more and more consideration. This kind flood dispatching not only takes care of conveying floods smoothly to the sea and damage reduction, but also water resources utilization and distribution as well.

(3). The measures of floodwater interception, detention, storage and infiltration into the ground will possibly occupy more and more spaces in the process of flood dispatching in the future. Detain the floodwater in some areas within the river basin for a longer time and infiltrate more water into the ground to increase the usable water quantity and overall percentage are perhaps of increasingly importance.

(4). Based on the accuracy enhancement and leading time prolongation of flood forecasting, the real time flood dispatching will probably become more and more popular in the future. The flood dispatching component depending on pre-determined schemes would perhaps be reduced in actual practices, even though this kind of schemes is usually indispensable.

(5). The basin wide flood dispatching of a river will be reinforced in the future while that based on administrative regions will be reduced. Therefore, river basin committees will become increasingly important in flood dispatching, and the existing State Flood Control and Drought Relief Headquarters will also possibly play more important roles in the future.

(6). Multi-administrative layer consultations on flood dispatching or water dispatching will become more and more frequent, significant and important. Therefore, a nation wide modern information system for flood dispatching that connects administrative regions, provinces, river-basin committees, as well as the State Flood Control and Drought Relief Headquarters, is necessary and in a state of increasingly pressing need. Therefore, It needs to be constructed quickly.

5. Concluding Remarks

River wide flood dispatching is a heavy task and of great importance in China. In recent years, flood dispatching has begun to change towards the direction of living with floods, whole year water dispatching and water resources utilization. Due to the new development situation in China, the flood dispatching of rivers may possibly have some considerable changes in the future. The flood dispatching for merely damage mitigation during flood seasons will change towards the direction of whole year water dispatching. In the areas that have proper local conditions, a cross water system flood dispatching or trans-administrative region flood dispatching will probably be taken into more and more consideration. The interception, detention, storage and infiltration measures will possibly play an increasingly important role in future flood dispatching. Based on the accuracy enhancement and leading time prolongation of flood forecasting, the real time flood dispatching will perhaps become increasingly popular.