



# CHINA: FLOOD MANAGEMENT

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**Abstract.** Information is provided about the approach and experience on flood management in China, which is supported by a series of laws and regulations for the water sector. There has been the recognition during recent years of the need for, and the evolution of the practices towards an integrated flood management (IFM). Of particular interest is the information on: (i) the integrated strategy applied to cope with the inappropriate land use due to population growth; (ii) on public participation and community involvement; and (iii) on the institutional system in the water sector. The study also contains practices/lessons with potential to be transferred/applied to other regions.

## 1. Location

China has frequently been hit by floods and suffered from flood disasters. The critical issue is that about 8% of the land area located in the mid-and downstream parts of the seven major rivers of the country, namely: Yangtze, Yellow, Soughua, Liaohe, Haihe, Huaihe and Pearl River Basin, are prone to floods. These areas are distributed over the eastern and southern part of China. However, in these areas live 50% of the total population of the country, and they contribute over two-thirds of the total agricultural and industrial product value.

## 2. Nature of floods

The vast area of East China and most of South China are dominated by the Eastern Asia monsoon (oceanic air current during summer and continental current during winter), resulting in dry winters and wet summers. The floods produced by storm rainfall in the summer with large coverage and high concentration mainly cause flood disasters in the plain areas of the seven major rivers, despite the fact that isolated local storms frequently produce flash floods, land-slides and even dam failures in mountainous regions. In addition, ice jams during the spring season in the upper reaches of some of the rivers often result in disastrous flood in their middle and downstream reaches. On the other hand, China's coasts with a total length of 18,000 km can be affected by storm surge, tides and tsunamis; these can result in serious consequences when some of these events occur concurrently with river floods.

According to the historical record, 1092 large flood disaster events occurred since 206 BC in China during the period of 2155 years, averaging once in every two years. At the beginning of the twentieth century, the major rivers in China were struck by a number of disastrous floods. However, after 1949 the losses due to flooding were less compared with those before that date because of flood control projects put in place and efforts made in flood preparedness. On the average, about 7.8 million ha, which accounts for about 7.8% of China's total farmland, was affected annually by floods during the period 1950-1990.

The historical floods and flood disasters have been recorded, documented and are preserved in the archives of government. These descriptive records normally included the highest water level of the rivers, the coverage of flood-affected areas, the water depth, the death toll, the estimated number of houses damaged, etc. The coverage of the flooded area was considered as the major indicator identifying the degree of disaster for different flood events.

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### 3. Flood management and mitigation strategies

The integrated approach to flood management in China is comprehensive and complex. This is due to the fact that China has a huge population and its limited flood prone areas in the middle and down stream reaches of the seven major rivers are densely inhabited. For years the low-lying depressions, lakes and the flood plains were reclaimed by the settlers due to the pressure of population growth of adjacent areas. The inappropriate land use in these areas resulted in significant reduction of storage and retention capacity of the river basins and consequently greatly increased the flood flows in the channels.

The overall *flood management strategy* in China comprises the following: (i) storing the flood-water in up stream areas to the extent possible; (ii) protecting the flood prone areas against ordinary flood in middle and down stream reaches of major rivers; (iii) making joint use of the levees and storage and detention basins for handling the extraordinary floods; and (iv) flood preparedness and flood fighting before and during flood season relying on the well organized emergency management system.

The *flood mitigation strategies* are grouped under three main areas: soil and water conservation, building of flood control systems and flood proofing. During the past 50 years important efforts have also been made in *soil and water conservation*, particularly in up and mid-stream mountainous regions. Policies and guidelines have been developed to deal with this issue, for example, zoning and slope surface and gully control. As regards *flood control systems*, some 85,000 reservoirs of different sizes have been constructed in upstream reaches of rivers, most of them built mainly for flood control integrated with irrigation and power generation. In addition to the above, a *levee system* totalling 250,000 km in middle and downstream reaches of rivers has been constructed to control the ordinary floods (10~20 years return period), so as to protect 34 million ha of farmland and 400 million people. Historically levees have been the mainstay of the flood control system, while lakes and low valleys, which total about 100 along the major rivers, regulate the excessive flood volumes of extraordinary events.

Also as an important measure to mitigate flood disasters, there are also a number of large *pumping systems* in China. These have made significant contribution in alleviation of flood disasters in areas where natural drainage is impossible in flood seasons. In cases they also are used to withdraw the surface water to irrigate the land during dry season.

In view of the frequent flood disasters in China's history, emphasis was placed on flood control in the design and operation of all the water projects. Therefore, in practice the flood water level of the reservoirs is maintained at the flood control level throughout the flood season in order to ensure the safety of the hydraulic structure. However, since early 1980s water shortage has become a major issue in China's development process, and there has been a strong appeal from the users, especially the hydro-power generation and irrigation sectors, to change the current operational practice, i.e. to vary the flood control level during the flood season, specifically to raise the water level in the later period of flood season. A research program was initiated in 2002 to provide applicable methods in design and operation of reservoirs for this purpose.

China has heavily relied upon *flood-proofing* led by the *Flood Proofing and Drought Defying Headquarters* (FPDDHQ) at different levels in fighting against flood. This mechanism has ensured the successful mobilization of all the necessary resources and sound operation of the flood control system throughout the country.

It should also be pointed out that the hydrological information and flood forecasting system has played vital role in timely transmitting the information among the FPDDHQ at different levels and to the public. As of 1992, there were 3,172 hydrological stations (measurement of rainfall, water level and discharge), 1,149 gauge stations and 15,368 rain gauges, which constitute the hydrological



network and also the flooding monitoring system over China. Part of the above stations (8,525) are mandated to report/release hydrological information during flood period regarding the hydrological elements and the time interval, as stipulated on the basis of the requirement of flood forecasting for the river system.

In the 1990s large floods frequently hit China. After a review of past flood management strategies, Government and the public came to deeply realize that flood management has to be closely integrated with the land use plan, while taking into full account the population issue in the flood prone areas; furthermore, that floods are a natural phenomenon which cannot be eliminated nor be totally brought under control. This resulted in the modification of the flood management strategies so as to face the new challenge. An integrated national flood control plan has been formulated and is being reviewed by State Council for approval.

In the past water resources development projects and the flood control programmes were mainly funded by the central government. However, since the 1980s a new approach in the fund raising has been promoted in order to secure stable resources for these activities, trying to mobilise funds from multiple sources through loans, bonds, stocks and foundations; investment is also encouraged from enterprises, private sector, foreign investors and the peasants in the form of labour contribution.

#### **4. Flood and water management instruments**

A series of Laws and Regulations in the water sector have been enacted since the 1980s. The major ones include the "*Water Law*" (1988) that was revised in 2002, the "*Law of Flood Control*" (1997), the "*Law of Soil and Water Conservation*" (1991) and administrative regulations like the "*Regulation of Flood Proofing*", "*Regulation of River Course Management*" and "*Guide to Safety Building of Flood Storage and Detention Basins*" etc.

The promulgation of the *Water Law* laid down the foundation of legislation in the water sector with relevant rules and regulations. The revised *Water Law*, promulgated in August 2002, complements and stresses in particular the integrated planning of water resources, and that it should be an integral part of the national economic plan. In development of water resources environment protection is emphasized, which includes water quality control. The unified management of a river basin has been added so that the legal position of river basin organization is identified. Finally, the treatment of water dispute has been clarified including consultation, mediation and lawsuit.

The *Law of Flood Control (1997)* stipulates among others that: (i) every unit and individual has the obligation to protect the flood project and to participate flood fighting; the governments at different levels are responsible for organization of flood fighting and relief work after flood disasters; (ii) flood control plans should be integrated in basin plans and coordinated with the land-use plans, and the local interests should be subject to the interests of the whole basin, hence the flood control and management should be exercised on the basis of coordination and cooperation among all the parties concerned; (iii) in flood prone areas, including the area to be protected, the storage and detention basin and the flood affected area without protection should be clearly identified and delineated; and (iv) relevant policies and management rules should be formulated and implemented as soon as the flood plan is approved.

The *Law of Soil and Water Conservation (1991)* states among others that the protection of soil and water loss is the first priority of conservation work, which involves the forestation, prohibition of cultivation on steep slopes, rational lumbering and restoration of vegetative cover after completion of any infrastructure project.



## 5. Institutions responsible for flood management

The *Ministry of Water Resources (MWR)* discharges the responsibility of a unified management of water resources of the country. There are seven major *River Basin Commissions*, which are the arms of the MWR to perform the function of water administration in the river basins. They play an important role in a unified management of water resources of the basins, co-ordinating flood and drought protection, mediation of water disputes, etc. As for the water affairs within a province it is the responsibility of the provincial governments.

The institutional system in the water sector has been established from the *MWR* as the highest level down to the *water resources station* that refers to the grass root level (township) water administration. The MWR is widely distributed in rural areas playing an important role linking the rural community with the government. The station not only acts as a technical body but also as the media for consultation with the rural people on local water issues.

The *Water Resources Bureaux* are the water administration departments of the local government, which assume the responsibility of planning, development and management of water resources within their jurisdiction under the direct supervision of the local government. The *local water resources management agencies* comprise four levels, i.e. the provincial, prefecture, county and the village (town). They are responsible for local water administrative management within their respective jurisdictions.

The "*Flood Proofing and Drought Defying Headquarters*" (*FPDDHQ*) mechanism ensures the mobilisation of all the necessary resources and sound operation of the flood control systems throughout the country. The major responsibilities of FPDDHQ are: (i) establishment of the flood forecasting and warning system; (ii) formulation of flood operation schemes and conduction of real time operations; (iii) mobilization of all parties concerned with the participation of armed forces and people to fight against flood; and (iv) preparation and supply of materials including the transportation facilities needed for flood fighting.

During flood events, many governmental agencies are involved and share a responsibility in accordance to their mandate. The co-ordination of operations during the flood period is handled by the FPDDHQ.

Flood management operational schemes are planned and agreed upon by all the parties concerned through a long process of negotiation and discussion; and then approved by government at different levels depending upon the size and importance of the project. There is a mechanism for conflict resolution through negotiation, with government at higher-level ruling on the conflict in case agreement cannot be reached.

Women play an active part in political and socio-economic activities in all fields of the country. The village governing organization, an autonomous body at grass root level, is legally represented by women predominately taking care of matters relating to the interests and welfare of women and children. However, they have been involved in all the social and economic activities.

## 6. Policy

The water legislation in China has laid down the legal foundation for integrated water resources management and flood management; the relevant terms include:

- Water development plans should be formulated on the basis of integration of all the factors emphasizing on multipurpose use and the coordination of the water use in livelihood, development and environment;



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- Water resources development programs should be integrated into the national and social development plan;
  - The water management system is based on the integration of river basin management and that of the administrative regions (mainly provinces); and
  - Construction of any building, infrastructure, etc. or any activity within river channel management areas affecting flood discharge capacity in flood passage is prohibited.

The central government has laid down specific policies for implementation of the above-mentioned laws, comprising:

- Restoration of reclaimed slope area, lake area and the flood prone areas to natural forest and lakes with government subsidy;
- Relocation of people of these reclaimed areas and economic compensation and tax exemption for the settlers; and
- Restraining the economic development and control of the population growth in flood prone areas, especially in frequently flooded areas.

Specific policies to cope with soil and water loss in mountainous and hilly areas include:

- Integrated regulation and management of small catchments;
- Establishment of a contract system for regulation and management of small catchment in soil eroded areas;
- Reinforcement of prevention of soil erosion; and
- Establishment of a market oriented mechanism in soil and water conservation.

## **7. Main lessons learned**

- The reclamation and use of lakes, flood plains and slope land in up-stream areas have reduced the storage/discharge capacity of floodwater in these areas. The flood control plans were difficult to put into practice and the conflicts between the local interest and overall river basin management led to inefficient flood operation during the flood periods.
- Appropriate policies including economic ones were not emphasized in flood management before the 1998 large flood event. Local governments and people were often reluctant to follow the planned activities in flood management.