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CASE STUDY

CHINA: *FLOOD MANAGEMENT*

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Zhang Hai-lun[1]

Introduction

China has been frequently hit by big floods and suffered from flood disasters. The critical issue is that about 8% of the land area located in the middle and down stream of the seven major rivers are prone to floods, where is inhabited 50% of total population and contributes over 2/3 of total agricultural and industrial product value.

1. Geographic features

1.1 Climate

The vast area of the East China and most part of the South China are dominated by the Eastern Asia monsoon, which are affected by the oceanic air current in summer and winter are controlled mainly by the continental air current in winter. These phenomena result in dry winter and wet summer. The annual areal distribution of precipitation is extremely uneven and descends from southeast to northwest. In southeastern coastal areas and some regions of southwest China the mean annual precipitation depth is higher than 2,000 mm. In south of the middle and lower reaches of the Yangtze River, it is over 1,000 mm. In the region of Qinling and Huaihe River Basin, it is around 800 mm. For vast area of northwest and Inner Mongolia the annual precipitation drops to less than 400 mm.

1.2 Topography

The terrain of China is high-elevated in the west and of low altitude in the east. The highest area is Qinghai-Tibet Plateau with elevation higher than 4,000 m down to the coastal plain areas being below 50 m. The mountainous area accounts for 33% of the total Chinese territory, the plateau, hilly area, inter-mountain basins account for 26%, 10% and 19% of the total respectively, and the plain area is only 12%.

1.3 Rivers

China has about 50,000 rivers with the area being larger than 100 km^2, among which more than 1,500 rivers cover an area of larger than 1,000 km^2. Most rivers are distributed over the eastern and southern part of China. The total basin area of the river flowing into the sea accounts for 2/3 of the total area of Chinese territory, and the remaining 1/3 belongs to the inland river basins.

Taking into account the flood issues and social and economic importance, the following seven river basins are considered as major ones, namely: Yangtze, Yellow, Soughua, Liaohe, Haihe, Huaihe and Pearl River Basin. The middle and down stream of major rivers and coastal areas are plains with fluvial deposit and shallow ground water aquifer.

1.4 Soil

Out of the total land area of 9.6 million km^2 of China, the non-usable land including Rocky Mountains, petrified soils, waste land in high altitude and frigid temperature, Gobi deserts and glaciers account for about 38%. The black soil is distributed in northeast plain with high proportion of humus. The yermosol and xerosols are widely distributed in remote north and northwest provinces and autonomous regions with dry climate.

2 Flood and flood disasters

2.1 Type of flood

[1] Institute of Hydrology and Water Resources, Nanjing Hydraulic Research Institute, Nanjing, China

The flood caused by storm rainfall with large coverage and high concentration predominates the flood disasters in plain area of the seven major rivers of China, despite the fact that isolated local storm frequently produces flash floods, land slides and even dam failures in mountainous regions.

Snow melt and glacier floods in spring season occur in western mountainous regions of the country. Due to its slow melting process, snowmelt in general does not cause significant threat to the downstream of these small rivers. However, the ice jams in spring season in the upper reaches of the Yellow River and Songhua River often results in disastrous flood to the middle and down stream of the two rivers.

China has long coastal lines, with the total length of 18,000 km which are affected by storm surge, astronomical tide tsunamis as well as the river floods which can result in serious consequences as some of these harmful events occur concurrently.

2.2 Historical floods

The magnitude of the maximum floods varies widely, based on the recorded and investigated historical flood data of 6,000 river reaches of the country, the noticeable events are given in Table 1.

Table1 The observed/investigated maximum flood discharge for major rivers in China

River	Station	area (km^2)	Investigated		observed	
			discharge	Year	Discharge	Year
Nenjiang	Jiangqiao	177300	15600	1932	10600	1969
Second Songhuajiang	Jilin	44100	12900	1909	7720	1953
Hunhe	Shenyang	7920	11900	1888	5550	1935
Taizihe	Benxi	4190	10200	1888	14300	1960
Liaohe	Tieling	120760	8740	1886	14200	1951
Dalinghe	Fuxinbao	2932	16200	1930	4660	1959
Dalinghe	Balinghe	17690	30400	1949	15000	1962
Luanhe	Luanxian	44100	35000	1886	34000	1962
Yongdinhe	Guantin	43400	9400	1801	4000	1939
Jumahe	Qianhekou	4740	18500	1801	9920	1963
Hutuohe	Huangbizhuang	23270	20000-27500	1794	18100	1956
Zhanghe	Guantai	17800	16000	1569	9200	1956
Yellow	Lanzhou	222550	8500	1904	5900	1946
Yellow	Shanxian	687900	36000	1843	22000	1933
Wudinhe	Suide	28720	11500	1919	4980	1966
Weihe	Xianyang	46860	11600	1898	7220	1954
Jinghe	Zhangjiashan	43220	18800	18XX	9200	1933
Beiluohe	Zhuangtou	25150	10700	1855	4420	1940
Yihe	Longmen	5320	20000	233	7180	1937
Huaihe	Changtaiguan	3090	12400	1848	7570	1968
Yihe	Linyi	10320	30000	1730	15400	1957
Yangtze	Lizhuang	639200	65600	1520	48200	1955
Yangtze	Cuntan	866600	100000	1870	65300	1968
Yangtze	Yichang	1005500	105000	1870	71100	1896
Minijiang	Gaochang	135400	51000	1917	34100	1961
Wujiang	Gongtan	58350	24700	1830	17400	1964
Jialingjian	Beibei	156100	57300	1870	37100	1974
Lishui	Shanjiangkou	15240	31100	1935	15900	1950
Yuanjiang	Yuanling	78600	40200	1649	27300	1943
Zishui	Taojiang	26700	21500	1926	15300	1955

Xiangjiang	Xiangtan	81640	21900	1926	20300	1968
Hanjiang	Huangjiagang	95200	61000	1583	27500	1958
Gangjiang	Waizhou	80950	24700	1924	20900	1962
Qiantangjian	Lucibu	31490	26500	1901	29000	1955
Qujiang	Weiren	13500	30400	1912	23000	1952
Minijiang	Zhuqi	54500	29400	1900	29400	1968
Dongjiang	Boluo	25320	10300	1940	12000	1959
Beijiang	Hdengshi	34000	21000	1915	18000	1982
Xijiang	Wuzhou	329000			54500	1915

2.3 Flood disasters

According to the historical record, 1092 big flood disaster events occurred since 206 B.C. in China in the period of 2155 years, averaging once in every two years. Beginning from the twentieth century, major rivers in China were struck by a number of serious disastrous floods.

After 1949 considerable number of big floods occurred in large rivers such as the Yangtze, Yellow, Huaihe, and Haihe rivers, yet the losses were far less compared with those before 1949 because of the role of the available flood control projects and efforts made in flood preparedness.

The average annual flood affected agriculture land during 1950-1990 was about 7.8 million ha, which accounts for about 7.8% of the China's total farmland. Most of these areas are located in the downstream reaches of the Yellow River, Huaihe River and Haihe River that were severely affected by flood disasters.

The historical floods and flood disasters were recorded and documented by the government at different levels, which were well preserved in the archives of the government. These records were descriptive, which 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 house damage, etc. The coverage of the flooded area was considered as the major indicator identifying the degree of disasters for different flood events.

After 1949, the FFDDHQ requested the local government at different levels to report to the central government each year the flood disaster information including the flood affected area, flood disastrous area (30% of crop yield loss due to flood), death toll and the number of house damage. All these information were processed and coordinated with the Department of Interior and Department of Statistics at different levels and finally issued by the National Bureau of Statistics.

Since each flood disaster event is associated with a specific flood of a given basin, so that the frequency of flood was adopted to identify the frequency of the associated flood disaster.

3. Flood management strategies

3.1 Flood management strategies

The integrated approach to flood management in China is comprehensive and complex. While analyzing the flood management strategies one has to consider the basic fact, that is China has its huge population and is densely inhabited in limited flood prone areas in middle and down stream of seven major rivers. Despite the fact that China is short of water especially in north part of the country, however the conflict between the flood and inhabitants in these areas has been increasingly acute. This is partly due to rapid population growth during long historical period and partly due to the problems in flood management.

For years the depressions, lakes and the flood plains were reclaimed by the settlers due to the

pressure of population growth of adjacent areas. According to statistics of five provinces along middle and downstream of Yangtze River, 1100 lakes with different sizes were eliminated in the past 40 years. For other rivers like Huaihe River many depressions and lakes along the main stream were also reclaimed and inhabited. The inappropriate land use in these areas has resulted in significant reduction of storage and detention capacity of the river basins and consequently greatly increased the flood flows in the channels. The strategy of flood management in China comprises the following.

- Storing the flood water in up stream areas to the extent possible
- Protecting the flood prone areas against ordinary flood in middle and down stream of major rivers
- Joint use of the levees and storage and detention basins in middle stream for handling the extraordinary floods
- Preparedness and flood fighting before and during flood season relying on the well organized emergency management system.

3.2 Flood mitigation strategies

- Soil and water conservation

The government emphasizes the soil and water conservation in up and middle stream mountainous regions especially for the Yellow and Yangtze River. The government has financially supported local people and has developed policies and guidelines to deal with this issue, for example, zoning and slope surface and gully control. (The 1998 decision on extending land tenure to farmers for another 30 years may yield significant effects.)

1) The upper and middle stream of Yellow River has long been seriously suffered from soil erosion, the area of which covers 430,000 km^2 (67% of total area of upper and middle stream) and bring about 1.6 billion ton of sediment each year to down stream of the River. Since early 1980s the issue of soil erosion of Yangtze River has also aroused great concern of the public and government.

During the past 50 years strenuous efforts have been made in soil and water conservation, the specific policies coping with soil and water loss in mountainous and hilly areas include:

- Integrated regulation and management of small catchments

Integrated planning for small catchment in soil eroded areas has to be formulated and rational utilization of land resources on the basis of the integrated planning is implemented to promote the development of agriculture, forestry and animal husbandry in a coordinate way. The integrated plan has to take all necessary measures in coping with the soil erosion including engineering measures, plantation, and agricultural measures.

- Establishment of contract system for regulation and management of small catchment in soil eroded areas

Started from early 1980s the contract system was initiated and implemented in rural areas of China, the same system was applied in regulation and management of small catchment, this is a break through in catchment regulation and management. 3.5 million families in Yellow River Basin were contracted with the local governments and the project for regulation and management of 2000 small catchments in Yangtze River were implemented.

- Reinforcement of prevention of soil erosion

Great importance is attached to the prevention of soil erosion in management of small catchment, a monitoring system was established to closely monitor deforestation and any other activities which may ruin vegetative cover.

- Establishment of market oriented mechanism in soil and water conservation

Special fund was established for supporting the contractors in the regulation and management of small catchment. Various economic measures were taken such as interest-free loans, distribution of premium to encourage those who make significant contribution to small

catchment regulation and management. Multi-channel fund raising system was promoted, the use of loan from the World Bank since 1993 was the first time in China securing the foreign investment in soil and water conservation program while in the past governmental subsidy was the only source in this endeavor.

- Building of flood control system

So far 85,000 reservoirs of different sizes have been constructed in upstream of rivers, most of them are built mainly for flood control integrated with irrigation and power generation.

In order to optimize the use of water resources, there is a trend to vary the flood control level during the flood reason based on the study of flood characteristics in different time period during the flood reason and the improvement of medium and long term hydrological forecasting. The normal maximum level is an important element in design and operation of reservoir which needs to be approved and has to be strictly observed during the flood season in order to ensure that the storage between the normal maximum level and the maximum controlled level is reserved for storage of floods. However due to the different hydrological characteristics of floods and the conflicting demands in different time periods during the flood season, maintaining same normal maximum level may not be possible. For example in Zhe Jiang Province in south east coast of China the flood in flood season is clearly affected by plum rain in the early stage and the typhoon in the later stage. The Province strongly requested the Ministry of Water Resources to approve the application of varying normal maximum levels during the flood season for operation of reservoirs. The purpose is to try to store more floodwater for use in the coming dry season. The government has approved the suggestion made by Zhe Jiang Province and other large reservoirs like Dan Jiang Kuo in Han Jiang River- a large tributary of Yangtze River) on a case by case basis to operate the reservoir in a varied normal maximum level in flood season. A research program on this subject matter was initiated to assess the whole situation and to review the necessity for revision of the regulation.

In view of the frequent flood disasters in China's history, emphasis was placed on the flood control in design and operation of all the water projects. Most reservoirs in China were built in 1950s and 1960s, the hydrological design of the reservoirs was cited from former U.S.S.R and in practice the flood water level of the reservoirs maintained at the flood control level through out the flood season in order to ensure the safety of the hydraulic structure.

However the practice of the operation has shown that the characteristics of flood varies with different time periods during the flood season which usually lasts from four to six months for different rivers of China. In 1979 the Regulation of Flood Design was adopted and issued by the Ministry of Water Resources which was the first unified regulation in water sector, it specified that design flood could include vary according to different flood characteristics during the flood season, but most reservoirs still strictly follow same flood control level in the flood season as designed. As a result the reservoirs were difficult to restore the water level to normal (effective storage) by the end of flood season. Since early 1980s water shortage has become a major issue of China in its development process. There were strong appeal to change the current operational practice from the users especially the hydro-power generation and irrigation sector, 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.

The change of design and operational rule for different reservoirs has been proposed and approved by FFDDHQ on a case by case basis. There is a common understanding to vary the flood level during the flood season so as to make full use of flood water resources. A research program supported by the FFDDHQ was initiated in 2002 to justify the change and to provide applicable methods in design and operation of reservoirs for this purpose. 12 large reservoirs were selected as pilot reservoirs, it is expected that the research will be completed within two years and the output of the research will lead to wider use of varied flood control level in both

design and operation of reservoirs.

Levee system totaling 250,000 km in middle and downstream of rivers have been constructed to control the ordinary floods (10~20 years return period protecting 34 million ha of farmland and 400 million people

Historically levees are the mainstay of the flood control system while lakes and depressions totaling 100 along the major rivers regulate the excessive flood dealing with extraordinary floods.

- Flood-proofing

China has heavily relied upon flood-proofing led by 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 net work equipped with efficient facilities has played vital role in timely to transmit the information among the FPDDHQ at different levels and to the public.

3.4 Modification of flood management strategies

As discussed in section 3.1 that the flood water level is increasingly high in middle and downstream of the major rivers due to inappropriate reclamation of the lakes and depressions and migration of massive settlers. The land/space used for flood regulation has changed for agricultural use and human settlement. The occupied land was generally enclosed by levees and hence protected. With the rapid economic development these controlled flood storage and detention basins were also developed with even more rapid step due to the favorable policy laid down by the government.

In 1990s big floods frequently hit many major rivers in China, strenuous efforts were made in flood proofing via mobilizing hundreds of thousands of people to fight against flood along several thousands km long levees.

Having reviewed 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 and that flood is a natural phenomenon which can not be eliminated and also can not be totally under control.

The following conclusions were made in modification of flood management strategies in facing the new challenge.

- Enough space has to be retained for storing excessive flood water.
- Restriction of land use for agriculture or other development purposes has to be strictly abide by in lake shore areas, depressions, low lying areas and by pass channels.
- Part of settler in storage and detention basins should be moved out in a planned way and favorable policy should be adopted to encourage the settlers migrating out of these basins. This action should be integrated with the development program of small towns in rural areas.
- In case of big flood part of formland could be flooded as planned while people's life be secured.
- Part of cultivated land in slope land in mountainous areas should be changed to foster saplings for restoration of forest.

All the above strategies have legal, institutional and financial implications, and an integrated flood plan is being formulated to match for the modified flood management strategies.

In the ‘Law of Flood Control’ (1997), chapter II ’Flood Control Planning’ and chapter IV

'Management in Flood Protection Area and Flood Control Projects' clearly stated that flood control plan should be integrated in and coordinated with the land use plan. In flood prone area including the area to be protected, the storage and detention basin and the flood affected area without protection should be clearly identified and delineated. Relevant policies and management rules should be formulated and implemented for these three areas as soon as the flood plan is approved.

A national flood control plan and that for seven major river basins, and that for all provinces/autonomous regions were formulated and are being reviewed by State Council for approval.

Strenuous efforts were made after 1998 floods. Substantial fund was generated both from central and local government for reinforcement the levees and for building the flood storage and detention basins. The "Regulation of Compensation on Flood Operation in Flood Storage and Retardation Areas": was approved by the State Council in May2000 in order to provide favorable policies to secure the livelihood and for the restoration of agricultural productions for the people living in these areas. It was reported that for the four provinces in the middle and down stream of the Yangtze River 870,000 people were resettled, 1/3 to 1/2 of polders located in lake shore areas and depressions were discarded before 1999 flood season, which resulted in safe release of 1999 in the middle stream of Yangtze River compared with the situation in 1998.

4. Flood and Water Management Instruments

4.1 Information / data collection and transmission system

Hydrological information and flood forecasting are the basis of flood fighting. 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 under the administration of MWR. 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.

4.2 Fund raising

One of the big issues in water sector as the same for other sectors is short of funds in construction of new projects in renewal and rehabilitation of available projects and is even short of funds for operation and maintenance. The capital investment in water sector has long been kept in a very low level, i.e. 2-3% of the total capital investment of the central government Since 1980s a new approach in fund raising system has been promoted in all economic sectors in order to secure the stable funding sources. In the past the flood control program and other resources development programs were mainly funded by the central government the new system also emphasizes the contribution from the government at all levels. In addition, the new system tries to mobilize the fund from multiple sources through loans, bonds, stocks and foundations in addition to governmental appropriation. The new system encourages the investment from enterprises, private sector, foreign investors and the peasants in the form of labor contribution.

In view of the fact that flood control project is social benefited, nearly all flood projects have been funded by government in the past, especially the central government. The new system includes:

- The central and local governments (mainly the provincial governments) share the investments via appropriation for major projects of seven major river basins (referring to those cross provincial ones) with a specified ratio according to the size of the projects and the division of respective rights and responsibilities. As for those projects the impact of which is within one province are mainly funded by local governments.
- In the 1990s the special fund for flood control was established for local governments to

fund the local flood projects.

- Since1992 a special funding system is established in a number of administrative regions that is the fund is also generated from beneficiaries. A substantial funding contribution for construction of the dyke of the Huang Pu River was raised from the riparian enterprises. About 400 million Yuan were generated in Huaihe River Basin within 6 years.

4.3 Effective use of floodwaters and floodplains

The operation and maintenance of flood control works is complicated by the fact that flood events are of random occurrence. As such various flood control facilities are operated infrequently. For example, part of flood storage of a reservoir may not be used in most years, the flood diversion channels and detention basins may be used only once in a decade. On the other hand many floodplains, lake shore areas, low lying areas, depressions along both sides of main stream and that in the neighborhood of confluence areas were frequently flooded due to both the high water level of the main stream and the flood water produced by local storm.

These features mean that there is a need to promote a special management method in order to optimize the use of flood storage and detention basins and multi-purpose use of reservoirs.

There is a trend to vary the flood level of the reservoirs during the flood season in order to make full use of flood water as for the effective use of floodplains as discussed in section 3.4 program on migration of settlers in flood storage and detention basins as well as in flood plains is being implemented.

Historically (before 1949) the flood plains, lake shore areas, low lying areas, depressions along both sides of main streams and that in the neighborhood of confluence areas were used as the regulator of floods, where were frequently inundated. However since 1950 under the pressure of population growth and the process of economic development these areas have been gradually reclaimed and settled.

The flood control system for major rivers with reservoirs in upstream and levee system in middle and down stream could control ordinary flood (10-20 years return period), while the extra-ordinary floods can be managed by using the flood storage and detention basins. These areas are frequently flooded by local rain and the floods from tributaries, which are difficult to be drained out because of the high water level and long duration of flood in main stream.
It should be pointed out that the basic course of the issue lies in the population growth, the inappropriate land use in these areas has resulted in reduction of the space which was in the past occupied by floods. An integrated strategy has been applied to cope with this issue, which includes the following:

- Development policy applicable to these areas

The policy encouraging the local inhabitants to migrate out of these areas was formulated, which is integrated with the policy for developing the small towns and that of urbanization. The policy also includes moving the house out and remaining the reclaimed land in flood affected areas so that the life and personal property can be protected.

- Structure change in agriculture sector

Development of policy guidance and technical assistance to farmers to develop aquatic plant; to change the dry farming to rice growing; to change the crops, the harvest season of which could shift out of the flood season.

- Engineering measures

Polder building

It is the usual practice to build polders in these areas, however it requires high quality of dikes and needs considerable resources for flood proofing during the long period of flood season,

unlike the delta areas the more polders are built the higher flood level will be in the river net system, which usually leads to more difficulties in flood protection.

Building pumping station
This is also an important measure to mitigate flood disaster in these areas, there are an number of big pumping systems in China which have played a vital role in flood mitigation. The most famous one is the Jiangtu Pumping Station with the capacity of 400 cms located in Jiangsu Province in down stream of Huaihe River, which could pump the flood water out (covering 10000 km^3) and also could withdraw the surface water to irrigate the land during dry season. Another example is the pumping station system in middle stream of Yangtze River, the total installed capacity reaches as much as 700,000 k.w.(the confluence area of Yangtze River and its major tributary Han Jiang River). The pumping system has made significant contribution in alleviation of flood disasters in this area where natural drainage is impossible in flood season due to high water level with long duration in the mainstream of Yangtze River. As for those areas where are in small size and relatively poor, it is difficult to mobilize enough fund for construction of pumping system and the cost of operation and maintenance.

4.4 Law enforcement
The law of Flood Control was adopted on 9 Aug. 1997 and enforced on 1 Jan. 1998. The law has specific elements on river management, rules and regulations of flood proofing, river management and the Guideline on Safety Building of Flood Storage and Detention Basins. Local governments sometimes face the dilemma of either protecting the interests of local people or enforcing the flood control plan that may lead to the inundation of lands in detention/storage basins or flood by pass passages. The latter is likely to meet strong opposition from people living in these areas. The issue is usually solved on a case by case basis with the intervention of government at higher levels.

It should be pointed out that the operational scheme of flood in most cases (all the cases for the seven major rivers) are planned and agreed upon by all the parties concerned through a long process of negotiation and discussion and finally approved by the government at different levels depending upon the size and importance of the project. The problem lies in the operation. Disputes often arise due to land reclamation and other human activities like building of infrastructures that greatly affected the discharge capacity of the rivers so that there is difficulty for implementation of the operation scheme in flood prone areas, the usual approach for the solution of the disputes is as follows:

- Negotiation among the parties concerned i.e., the representatives of local governments and communities as the flood forecast indicates that certain measure has to be taken.
- To persuade the relevant parties to take immediate action, who will be affected by the flood if the approved operational plan is to be implemented.
- The government at higher level will rule the dispute in case agreement cannot be reached, some times the case will be referred to State Council for final decision.

The whole procedure was processed in a very efficient way during the flood season under the national flood fighting and drought defying system.

5 Policy

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

The essential points of the Water Law (1998)

- The water law identifies the ownership of water, which comprises three points: First, water resources are state owned, which is mainly realized in overall management and allocation of water by the state. The water in the ponds and reservoirs under the jurisdiction of the collective/economic organizations is collectively owned. Thirdly the state protects the legitimate right and interests of the collectives, economic entities and individuals in developing and utilizing water resources.
- With regard to water resources development and utilization emphasis is placed on the integrated planning and management of water resources, thereby the legal position of planning is clarified.
- Separate provisions have been made for flood control, water supply, irrigation, drainage, hydropower, navigation and fishery, so that the activities of each sector are protected and also constrained by the law so as to have a coordinated development in order to play multiple functions and yield comprehensive benefits.
- Prevention of water pollution and soil erosion is mentioned in principle since the state issued relevant laws in these two aspects.
- The water management is an important part of the Water Law which involves the planning, water allocation, water drawing permission etc.
- The principles of flood control and flood fighting are also put forward, which includes reinforcement of leadership, obligation of governments and people in flood fighting, and other important issues.
- As for the management system the state exercises the unified management with the involvement of local government at different levels and different sectors, the Ministry of Water Resources is appointed as the Water Administration Department of the central government in water management for the whole country.

The promulgation of the Water Law has laid down a solid foundation of legislation in water sector thereafter relevant rules and regulations have been formulated and approved.
Not long after the promulgation of the Water Law China entered a period of rapid economic development and system reform. In the implementation of the Law a number of problems arose:

- The urban expansion together with industrial and agricultural development resulted in serious environment deterioration and water shortage.
- The diversified interests for different economic sectors make water resources management more complicated. The integrated planning and management of water resources becomes a critical issue and needs to be reinforced.

The revised Water Law was promulgated in Aug.2002,which keeps the main structure of the Water Law and to amend, complement and stress some important provisions according the new development briefly described as the following:

- Integrated water resources planning is emphasized, the integration refers to that among different sectors and different administrative regions to meet the growing demand of water resources. It is also stressed that the water resources planning should be an integral part of the national economic plan.
- In development of water resources environment protection is emphasized, which includes water quality control and water source (all natural water bodies) protection.
- Rational water allocation and water saving are highlighted, water saving becomes the national policy.
- Unified management of a river basin is added so that the legal position of river basin organization is identified.
- Treatment of water dispute is clarified including consultation, mediation and lawsuit, which will be conducive for implementation.

The Water Law has greatly promoted the improvement of development and management of water resources, the major achievements can be summarized below:

- Institutional building

The execution team of law enforcement has been established for all water administrative department (water resources bureau) at all levels.

- Planning

The integrated water resources planing was initiated last year and is being conducted in order to implement all the principles laid down in the Water Law.

- Water management

Unified management of water resources especially for the river basin management is being reinforced, one of the examples is that the 'dry up' of the Yellow River is improved as the Yellow River Commission exercised its function of overall management.

- Water saving

Since the water saving has been emphasized and relevant economic policies have been applied, which leads to the slow/zero growth of water use for many provinces of China in recent 10 years.

Essential points of the Law of Flood Control (1997)

- Principles

1) The law stipulates that 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. 2) Flood control plan should be integrated in basin plan 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.

- Planning

1) The flood control plan should be brought within the national economic and social development plan. 2) The flood plan must conform to the economic and social development plan of an administrative region and the flood plan of a region should integrated into that of the river basin it located. 3) The system of reserved zone for flood control is legally established, any development projects being irrelevant to flood control are not permitted to be built in the reserved zone designated in the flood control plan.

- Regulation and protection of rivers and lakes

The Law laid down the principle of flood regulation that flood water should be regulated by making full use of the capacity of the river system including reservoirs, depressions and lakes, the system should be strengthened and the reclamation in lake areas is prohibited. The local government should organize the residents living in occupied lake shore areas and flood passages moving out and be resettled in a planned way.

- Management of flood prone areas

Flood prone area refers to those areas being subject to flooding, which includes the flood plain, flood storage and retardation basin and the flood protected area. The Law stipulates that the government should organize all the relevant parties to formulate the program of safety building for these areas/basins. Any project in the flood prone area which is irrelevant to flood protection is requested to make the impact assessment prior to its submission for approval.

- Flood fighting

The Law stipulates that the head of the government at all levels are responsible for flood fighting, exerting unified management and coordinating the activities of relevant parties in flood period. The Flood Fighting and Drought Defying Headquarters (FFDDHQS) at different levels are entitled to issue the flood warning and to take emergent measures during flood period.

- Fund raising

The Law laid down the principles and policies of fund raising including joint fund raising from the government and beneficiaries, cost sharing between the central and local governments (mainly the provincial governments) and the labor contribution in rural areas. As for cities, oil fields, railways, mines, large enterprises, etc. the investment of flood control should be derived from themselves.
The Law finally stipulates the legal liability for those who violate the Law.

The governmental appropriation after 1998 floods has significantly increased so that the levees along the major rivers has been greatly consolidated. The implementation of flood control policy has been speeded up including the safety building in the flood storage and retardation areas, the resettlement and new township building in flood prone areas. (also referring to 2) Modification of flood management strategies).

Essential points of the Law of Soil and Water Conservation (1991)

- Every unit (institution, economic entity etc.) and person has the liability to protect the land and water resources, and to prosecute those who violate the said Law.
- The protection of soil and water loss is the first priority of the work of soil and water conservation which involves the afforestation, prohibition of cultivation on steep slop, rational lumbering and restoration of vegetative cover after completion of any infrastructure project. Monitoring and supervision for implement of the Law is emphasized.
- The water administrative department at different level is designated to assume the leading responsibility of soil and water conservation.
- The integrated management of small catchments is emphasized in soil and water conservation, to this end the land use plan should be formulated prior to the planning of soil and water conservation. The construction and management of the soil and water conservation works are contracted with individuals and collective economic entities and their interests are protected
- Multi-channel fund raising system is stipulated in order to speed up the implementation of soil and water conservation program.
  860,000km2 out of 3.56 million km2 total soil eroded land in China has been regulated in past 50 years, which resulted in noticeable outcome and the reduction of annually300 million tons of soil generated from the middle stream of Yellow River in recent years is an example. As an integral part of social and economic development plan a nation wide program on the soil and water conservation was initiated to meet the challenge of sustainable development in 21 century.

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

- The water development plan 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.
- The water resources development program 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).
- Construction of any object (building, infrastructures etc.) or any activity within river channel management area affecting flood discharge capacity in flood passage is prohibited.
- Polder building in lake area/river course is also prohibited, the reclaimed area should be restored to its natural state.

The central government has laid down specific policies for implementation of the above mentioned laws. After 1998 big floods in Yangtze River and Songhua River, the government has stepped up the implementation process.

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

6. Institutional Arrangement for Flood Management

6.1 Ministry of water resources (MWR)

The MWR is designated as the Department of Water Administration of the State and discharges the responsibility of unified management of water resources.

6.2 The river basin commission

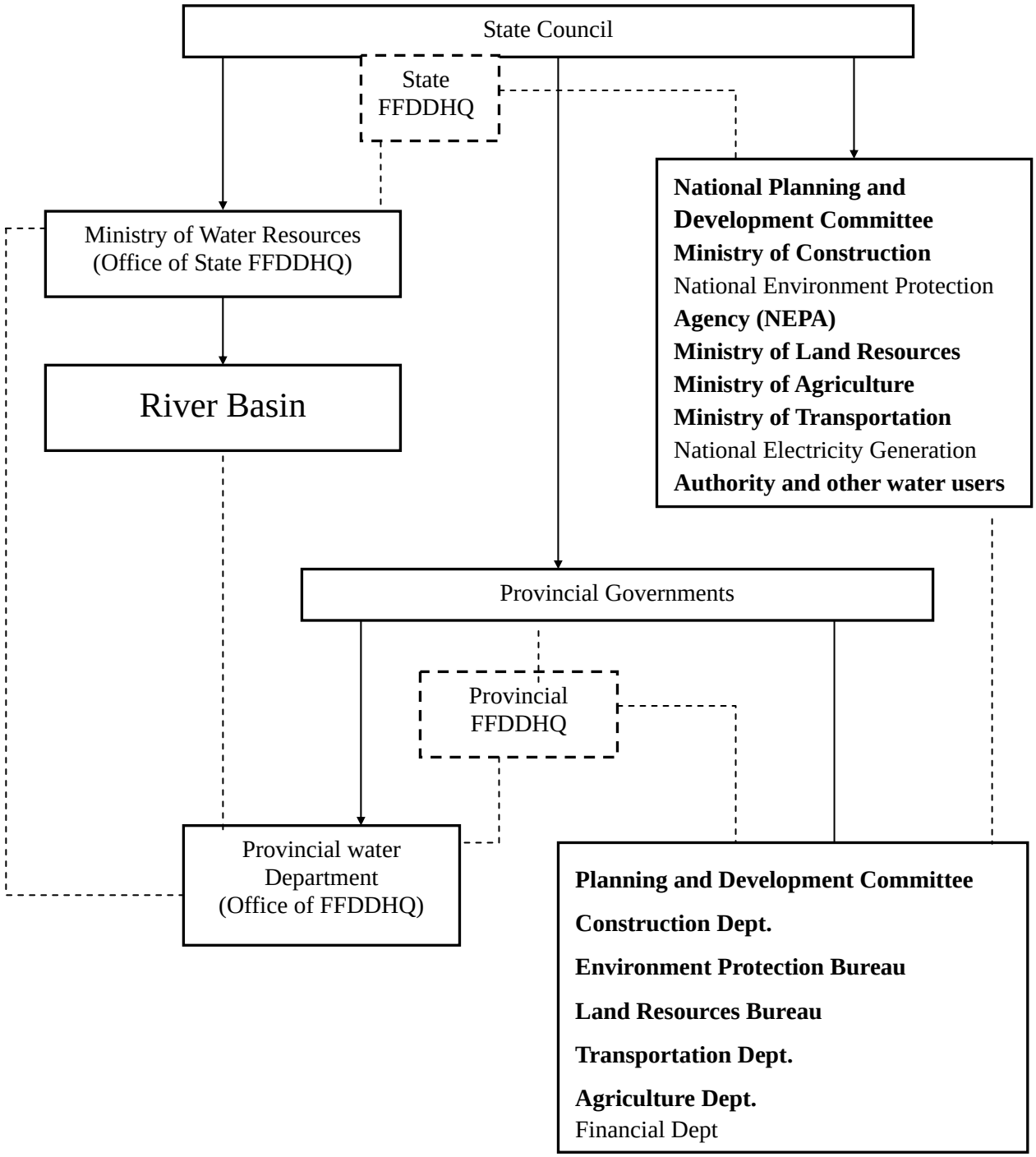
There are seven major River Basin Commissions which are arms of the MWR to perform the function of water administration in the river basins. The river basin commission of the seven major basins have played important role in unified management of water resources of the basin including rivers, lakes, estuaries, tidal flats and management of key river reaches as authorized by the central government; co-ordinating flood and drought defying; mediation of water disputes, etc.

The river basin commission is the field office of the Ministry of Water Resources assuming the responsibility of basin planning, coordination of water resources development and integrated management including flood control in a basin, mediation of water disputes, direct management of important projects dealing with two provinces. As for the water affairs within a province it is the responsibility of the provincial government.

The Water Resources Bureau at different levels are the water administration department of the local government at different levels which assume the responsibility of planning, development and management of water resources within its jurisdiction under the direct supervision of the local government at the same level.

The organization chart of Huaihe River Commission is given below. The structure of other river basin commissions is more or less the same.

Organization Chart Relating River Basin Management



6.3 The local water resources management agency

The local water resources management comprises four levels i.e. the provincial, prefecture, country and the village (town). They are responsible for local water administrative management within their respective jurisdictions.

6.4 Flood proofing and drought defying headquarters(FFDDHQ)

The Water Resources Bureau at different level is the office of FFDDHQS of the same level, the latter is headed by the leader of the local government (vice governor of the province or the mayor of a city as designated by the local administrative authority) with the involvement of representatives from the relevant departments even the army and armed police, usually the director of the water resources department at the same level is the deputy director of FFDDHQS at the same level, who engages in the routing work during the flood period. This mechanism has proved to be powerful and effective in flood proofing, which is conducive to mobilize all the necessary resources in a short time period to fight against flood and is also efficient to coordinate the flood fighting activities among relevant departments in emergent cases.

FFDDHQ have been established for the government at county level and above, the member of the headquarters include all the relevant departments at the same level led by the head of local governments. As for the FFDDHQ of the central government, it is headed by a vice premier designated by the State Council with the executive office in the MWR. The FFDDHQ is mandated during the flood season to assume the full responsibility of flood proofing by all means as stipulated by the laws and governmental regulations. (Rules and Regulations of Flood Proofing for the People's Republic of China, June 1991). The major responsibilities of FFDDHQ are:

- establishment of flood forecasting and warning system
- formulation of flood operation scheme and conduct real time operation
- mobilization of all parties concerned with the participation of armed forces and people to fight against flood.
- preparation and supply of materials including the transportation facilities needed for flood fighting.

Many governmental agencies have been involved in flood proofing during the flood season, each shares its responsibility according to its mandate, the major ones include:

- Information center (Bureau of Hydrology) of the MWR

hydrological data collection, transmission and flood forecasting

- Bureau of Meteorology

provision of weather forecast especially the severe weather conditions

- Ministry of Information Industry

provision of electronic communication facilities as the first priority in flood season for transmission of flood information

- Ministry of Communication and Ministry of Railway

transportation of material needed for flood proofing is the prior responsibility of the two ministries

- Ministry of Sanitation

responsible for epidemic disease prevention induced by flooding

- Army has often been mobilized to join in flood proofing in emergent cases to deal with difficult task

As for the relief operation it is the responsibility of the Ministry of Interior.

The powerful leadership of the FPPDHQ at different levels has enabled the large river basins being refrained from the catastrophic disasters in recent 50 years despite the fact that the highest floods have been recorded in these rivers in this time period.

- Mainly the local government takes over the sectorial coordination for an administrative region. The water resources plan is integrated into the overall plan of an administrative region like a province. The local planning and development department is in charge of the coordination with the involvement of all departments concerned in the same region. As for a river basin the river basin commission is entitled on behalf of the Ministry of Water Resources to take over the formulation of a basin plan with the involvement of relevant provinces (the bureau of water resources is the executive body within its jurisdiction) via. repeated consultation and finally reach an agreed plan, sometimes the mediation of the central government is needed.
- The implementation of the plan for a given region is mainly the responsibility of the local government as the basin plan is approved.
- The coordination of flood operation during the flood period is handled by the FFDDHQS as discussed above. The water resources protection agency for seven large river basins supervised by both the Ministry of Water Resources and the National Environmental Agency is established to jointly monitor the quality of the water bodies of the basin.

6.5 Public participation and community involvement

- The Law of Flood Control in its general provision laid down the legal liability of public participation and inter-sector coordination in planning and implementation of flood control projects, in flood proofing during flood period and in the operation of post flood relief.
- The Law also emphasizes that the flood control plan should be integrated with overall river basin plan and coordinated with land use planning. The flood planning should be coordinated by water department at different levels with the participation of all parties concerned, that means flood plan should be well coordinated with the sectoral plans. This was the usual practice in the past and was also the approach followed by the current national flood control planning.
- For those plans/projects of vital importance, consultation was held and advice was sought as the practice of the Three Gorge Project, the conclusions and suggestions made by independent top level experts at different fields formed the basis for decision making of the government. The project was also discussed and approved at the National People's Conference.
- Flood fighting organized by FFDDHQ at different levels has been strongly supported and actively participated by the people in flood prone areas. Hundreds of thousands of people were organized in their residential areas to monitor the flood and to examine any weak points/sections for the protective projects especially the long levees which are the mainstay of flood control system protecting the flood prone areas. The flood fighting team is organized on a community/village basis, each one is responsible for protection of one section of levees.

It should be mentioned that drought relief team has been organized at the grass root level(below county),which is a technical team to assist formers to take emergent actions coping with drought. It is a non-governmental and non-profitable organization participated by the experienced personnel including farmers, and are funded partly by government and partly by beneficiaries. This approach is more effective and efficient in drought management since quick action could be taken by the team who are well prepared and equipped.

The institutional system in water sector has been established from the Ministry of Water Resources as the highest level down to the water resources station that refers to the glass root level (township) water administration. The Ministry of Water Resources is at the central level

and the local water administration includes provincial, prefecture, county and township levels. The Ministry of Water Resources is widely distributed in rural areas as the field arm of water administration playing an important role linking the rural community with the government. The station not only acts as a technical body but also acts as the media for consultation with the rural people on local water issues.

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. It is should be mentioned here that madam Qian Zhen Yin was appointed as the minister of the Ministry of Water Resources and remained in her post for over 30 years.

7. Lessons Learned

7.1 Integration of land use with flood management

The reclamation of lakes, flood plains and slope land in up stream areas has reduced the storage/discharge capacity of floodwater in these areas. The flood control plan was difficult to be put into practice and the conflict between the local interest and overall river basin management led to inefficient flood operation during the flood period.

Due to the population pressure and the rapid economic development the activities of reclamation in flood plain (lake shore areas, flood storage an retardation basins and even flood channels) have been frequent. The local resident and local government during a number of years built the flood control works to protect themselves in flood plains. During the flood time the protection of these flood control works led to negative effect on the overall flood operation, for example the protection of polder in lake shore areas and depressions gave rise in the higher water level in rivers, which significantly resisted the discharging of flood waters in many important river reaches, this is the root cause for water dispute in flood operation within a river basin or between two administrative regions.

The Law of Flood Control clearly classifies the flood prone area into flood plain flood storage and detention basin and flood protective area, which will be legalized as soon as the flood plan is approved.

7.2 Appropriate policies in flood management

Appropriate policies including economic ones were not emphasized in flood management before the 1998 big flood event. The local government and people were often reluctantly to follow the planned activities in flood management.

As discussed in section 5 the implementation of the policies being conducive to flood management has been reinforced.

The on going project regarding the national flood plan stresses the importance of flood risk management on the basis of delineated flood plains, flood storage and detention basins and flood protective areas. The flood insurance is proposed to be a mighty economic tool in flood management. The flood insurance was initiated and encouraged by the Chinese government, several pilot projects were implemented in An Hui Province of Huaihe River Basin. However the projects were not very successful, this is mainly due to the fact that the poor rural people in floodprone areas were reluctant to pay the premium and they traditionally rely on relief from the government after flood disasters.