

# Action towards Typhoon-related Disasters Reduction in China

## 1. Introduction

In the east part of the continent of China, it is close to the seas of Bohai, Huanghai and Donghai. And, there is wide sea area in the south part of the continent. The continent of China extends about 44 degrees of latitude. The coastline is more than 18900 kilometers. China is one of countries that have the most serious influence by the tropic cyclone and is the region with a high frequency of typhoon in the world. The statistics data shows that there are more than 80 typhoons happened on the global tropical ocean every year. In which, three fourth happens on the tropical ocean in the Northern Hemisphere and there are almost 27~28 tropical cyclone happened in the northwest Pacific Ocean which closes to China and south China sea every year, which is about 38 percents of the total of typhoons in the world. It is the first one among 8 typhoon regions in the world. There are almost 20 typhoons that can bring impact and can cause disaster to China and about 7 of them landed in China per year, which is four times of American's, double of Japan's. The maximum number of landing typhoon in China is up to 12 a year in 1971 and the minimum is 3 at least such as in 1951, 1952 and 1998 (see figure 1).

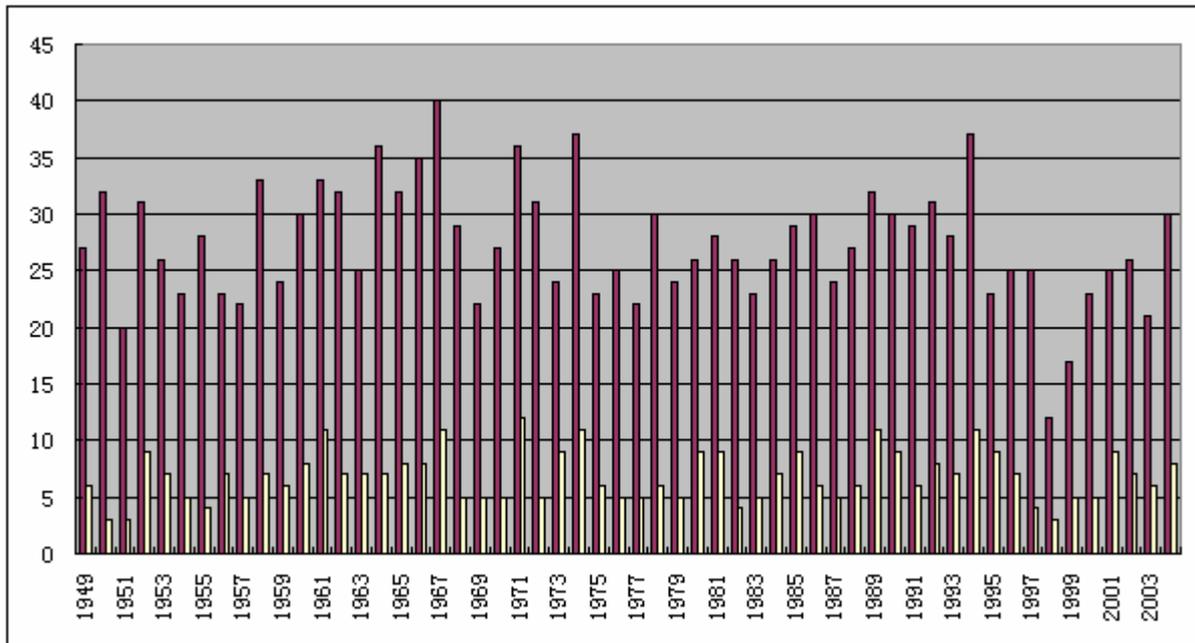


Fig 1. The number of typhoon generated in the Pacific and landed in China

In China, the east coastal regions are mostly developed economic zone. The landing of tropical cyclone causes the severe threat to the social-economic development and the safety of people's life and property in these regions. And, some tropical cyclone may go to the inland and produce the heavy rainstorm and catastrophic flood and cause the enormous disaster. The famous '75.8' big flood is one of them. With the developing of socio-economic, the typhoon is becoming the disaster that causes influence increasing most rapidly to economy and society in all natural disaster in China.

## 2. The impacts of typhoon-related disasters to social-economic development

According to the statistics from the data since 1950's, there are 27 provinces influenced by typhoon in the total of 31 provinces and municipalities and autonomous regions in China. Only Qinghai, Gansu, Tibet and Xinjiang are not involved in. About continent area of 477,000 km<sup>2</sup> and almost 230 million people which is about 18% of the national total population are directly influenced by typhoon. It relates up to 4,800 billion RMB Yuan that is about 41% of the national gross domestic product. With the faster developing of socio-economic in the coastal regions, the direct economic losses caused by the typhoon will be more and more.

According to the incomplete statistics, on average, there are about 600 persons died because of the typhoon every year in the mainland of China. In recent years, the typhoon disaster appears the following obvious trends:

(1)The total life losses caused by the typhoon-related disaster is decreasing year by year. For example, there were 969 people died because of the typhoon disaster every year in 1950's, down to 415 people in the 1990's. In 2004, the typhoon disaster caused 196 people died totally and 154 people lost their life up to now in 2005.

(2)The death by the single typhoon disaster is obviously decreasing. Comparing the 14th typhoon 'Rananim' in 2004 with the 12th typhoon in 1956, the intensity, the duration and the affected range are almost the same, but there were 4,945 people died during the 12th typhoon in 1956 and 179 people died during 14th typhoon 'Rananim' in 2004. In 2005, there are 17 people died in the typhoon 'Matsa' and 124 people died in the typhoon 'Talim'.

(3)The proportion of the death caused by typhoon to the total death caused by flood is increasing. The proportion was 8 percent in 1970s and rose to 10 percent in the 1980s. In 1990s, the proportion was up to 11% and 19 percent in 2004.

(4)The economic losses present the trend of increasing obviously. China was not able to count the direct flood economic losses until the 1980s. In 1990s, the direct economic losses caused by the typhoon disaster accounted for 21% of the total direct flood economic losses. The percentage rose to 37% in 2004 and above 35% in 2005 up to now.

In China, typhoon often causes other natural disasters such as flash flood, debris and mudflow, sediment disaster, dam-break and etc. and results a large amount of casualties. For instance, in 1975, the 3rd typhoon went up to the north of China after landed on August 3 and influenced the upstream of Huaihe river Basin where occurred extra rainstorm. The maximum rainfall for three days reached 1605.3 mm at Linzhuang, Henan province and 1060.3 mm for 24 hours. This caused the extremely great flood in Hongru River and Shaying River. 2 large-scale reservoirs and 60 medium and small-scale reservoirs were broke. It is estimated that around 29 counties and towns, 11 million people and 1.1 million hectares farmland were hit by flood and rainstorm. In which, 7 towns in the low reaches of the rivers were destroyed completely. 26,000 people lost their life. The 14th typhoon in 2004 caused some severe flash floods and outsize mud-flow which killed 41 people accounting for about 22.6% of the total amount death caused by the typhoon.

Since 2004, there are four typhoons that caused the severe impacts to China, such as the typhoon 'Rananim' in 2004, the typhoon 'Haitang', 'Matsa' and 'Talim' in 2005.

In 2004, Rananim was the most notable one because of its exceptional intensity, long duration and large affected scope. Almost 7 Provinces experienced the influence caused by Rananim. From August 11 to 14, the area of rainfall over 100 mm was over 140000 km<sup>2</sup>. The maximum rainfall for three days was 916 mm, the maximum rainfall for 24 hours was 874.7

mm, the maximum rainfall for one day was 873 mm and the maximum rainfall for 12 hours was 661.8 mm. The return period of maximum rainfall for one hour caused by Rananim in Zhejiang province reached 50 years, the return period for 12 hours, 24 hours and one day reached 100 years and the return period for three days reached 70 years.

Rananim is the strongest typhoon landed in China since 1956 with the largest wind speed of 58.7m/s and caused the extra rainfall in some areas. The heavy rainfall and big flood caused serious calamity with 179 people died and the direct economic losses of 18 billion RMB Yuan.

In 2005, the typhoon Haitang landed in Fujian province of China on July 19 with the lowest air pressure of 975 and the largest wind speed of 33 m/s at the center. This typhoon has great intensity and strange track. It weakened quickly after landing. Fujian and Zhejiang Provinces experienced the influence caused by Haitang. The maximum rainfall for three days is 585.5 mm.

This typhoon caused big casualties and serious economic losses in some areas of Zhejiang and Fujian provinces. It is estimated that around 8.48 million people affected, 5 people died, 6 people missed, 12000 houses collapsed resulting direct economic loss of 8.1 billion RMB Yuan.

The Typhoon Matsa landed in Zhengjiang Province of China in the early morning on August 6, 2005. After landing, Matsa went to north and crossed Zhemin Basin, Taihu lake, Yangtze River, Huaihe River, Haihe River and Liaohe River. 10 Provinces were affected directly. It disappeared in 4 days later. The Typhoon Matsa is arrestive because of its great intensity, plentiful rainfall, long duration and large affected scope. The mean area precipitation in Zhejiang province's was about 130 mm, more than 200 mm in Shanghai and 100~200mm in other area.

This typhoon caused big casualties and serious economic loss in some areas such as Fujian, zhejiang, Jiangsu, shanghai, Anhu and Shandong and etc. According to the incomplete statistics, the stricken crop areas by Matsa were more than 1.1 million hectares, around 1.63 million people were affected and 17 people died. The total direct economic losses caused by Matsa reached 14.2 billion RMB Yuan.

The typhoon 'Talim' landed on September 1, 2005 and hit 6 provinces. About 20 million people were influenced. Almost 2 million people were evacuated and 124 people lost their life and 31 missing. The direct economic losses reached 15 billion RMB yuan.

However, the tropical cyclone brings no all disaster. The heavy rainfall caused by typhoon can increase the reservoir's storage, mitigate the situation of water resource scarcity and bring a great benefit to the agriculture, aquatic products, navigation, urban water supply and tourist industry. In 2004, the agriculture of China appeared the good situation. Both the grain production and peasants' income increased. According to the analysis of relevant experts, the positive impacts of good climate to agriculture and farmer accounted for 30 percent in the increased income. The typhoon 'Ranaim', 'Haitang' and 'Matsa' brought not only disaster to Beijing, Hebei, Hunan, Hubei, Jiangxi and Hainan but also water resources. Data show that reservoirs in the areas affected by the above-mentioned three typhoons have gained water about 2.0 billion, 1.2 billion and 1.8 billion cubic meters.

### **3. Disaster risk management for socio-development**

In long-term work of typhoon defending, China has accumulated abundant practical experience in prevention, reduction, mitigation and management of the typhoon disaster.

### 1) Establish Typhoon Defense Organizations at Different Administrative Levels

The work of Typhoon Defense belongs to the issues of flood control and water management in China. The Organizations have been separately set up at state, province, region and county levels. They are responsible for water management and construction management of engineering works. The water administrative organization at the state level is the Ministry of Water Resources (MWR). Under the Ministry of Water Resources, seven water resources commissions were separately established in the Seven Large River basins. Each of them is in charge of one river basin's water planning and water management. The provincial, regional and county level water management organizations perform their respective responsibilities under the leadership of their one-step-high water management organization as well as the government at the same administrative level. Management organizations are also established at the important engineering works for flood control, and they are responsible for every day management of the engineering projects (See figure 2).

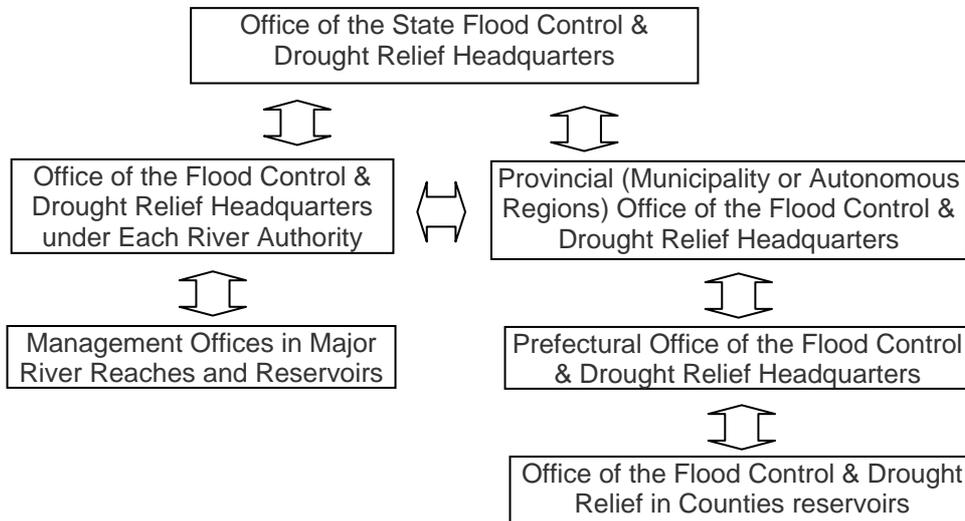


Fig 2. The organization structure of typhoon defense

The state, provinces, municipalities, and related regions and counties have also established flood control organizations respectively, so as to perform centralized arrangement of food fighting activities. Each organization of each level is composed of the executives from different departments of their respective governments on the same administrative level. Each organization's routine job office is put inside the water administrative organization of the same level. The State Flood Control and Drought Relief Headquarters (SFCDRH) is the highest flood control organization in China. It is composed of the vice ministers from the related ministries and one executive member from the troops. Each organization has one member in the SFCDRH. One vice premier from the state council, the central government of China, behaves as general commander of the SFCDRH. The minister of the Ministry of Water Resources is the deputy commander of the SFCDRH. The routine job office of the SFCDRH is called the Office of State Flood Control and Drought Relief Headquarters (OSFCDRH), which is put inside the Ministry of Water Resources. Those administrative regions above the county level also established flood control

organizations at their respective levels, if they have flood control problems. And the composition of any level flood control organizations is just like the SFCDRH. The Yangtze River and the Yellow River have established their respective river basin organizations for flood control. Each member of the river flood control organization is either a governor of the related provinces or a general director from the water resources commission of the river. The commander of the river flood control organization is the chief governor of one province designated by the central government. And the deputy commander is the highest executive of the water resources management organization in the river. The routine job office of a river flood control organization is inside the water resources management organization in the same river.

This is guaranteed defending the typhoon disaster effectively by an organization.

## **2) Implement the Responsibility System**

The leadership of the government at different level in coastal areas pay much attention to the work of the typhoon defense. All provinces and cities set up the supervision mechanism of responsibility system. The Chief Governor is Responsible for Flood Fighting. This is the obligation and duty entrusted to the chief governors at different levels by the laws and regulations of China. The chief governor may let one deputy governor to do the practical jobs of flood control, but it is his duty to take the over all responsibility for flood control within his administrative region, either responsible for the flood fighting activities in flood seasons or responsible for the flood fighting preparedness in low water seasons. This measure has strengthened the work of typhoons defense effectively.

## **3) Give the First Priority to People's Life Protecting**

All the arrangements and all the concrete actions for flood control must take ensuring the people's life into consideration. It is one important principle that we have to stick to in flood fighting activities in China.

China regards the casualty reduction as the primary thing in the work of typhoon defense. The idea 'people are the first' has run through the work of typhoon defense. In order to reduce casualty furthest, some effective measure has been taken in the practice when the typhoon appears such as the whole province should be mobilized, the whole people should be in action, the precautions should be in all round and doing should be in the best and etc. These measures are very sturdy and effective. For example, the typhoon 'Matsa' in 2005 hit 10 provinces directly and crosses 5 river basins. 1.6 million people were evacuated, 57200 ships were called back to the harbor shelter. This strong typhoon only caused 17 deaths.

## **4) Perfect the preconcerted scheme of typhoon defense**

In order to make the responsibility, task and procedure of typhoon defense standardization gradually, a series of prevention schemes of typhoon defense is established according to the different characteristic of typhoon disaster, threatening range and actuality of defense structures in the different coastal region based on the principle of 'defense first and combination defense and avoiding'. The statistics data shows that there are 341 counties (cities) that have finished the prevention schemes establishment and amending, accounting for 68% of in the total 489 counties (cities) influenced directly by the typhoon.

The preconcerted schemes include:

(1) The social and economic emergency counterplan;

- (2) The counterplan on the flood, typhoon and droughts disaster and water structures emergency;
- (3) The counterplan of the enormous natural disaster salvation;
- (4) The emergency counterplan for the sudden sediment disaster;
- (5) The regulation to governments in coastal regions for typhoon defending;
- (6) The emergency counterplan for the medical departments to rescue typhoon casualties;
- (7) The counterplan for the traffic department in the emergency of typhoon;
- (8) The counterplan of electric power facilities;
- (9) The counterplan for countryside in case of typhoon;
- (10) The counterplan for sediment and mud-flow disaster during typhoon;
- (11) The water-supply system,
- (12) The counterplan for the rescue system at sea and etc.

The implementing of the preconcerted scheme has enabled the work of typhoons defense standardization and well-regulating, which reflects the government's effective management.

#### **5) Accelerate the sea wall up to standard and improve the standard of typhoon defense.**

The coastline of mainland in China is about 18900 km, in which about 14000 km has sea walls which protect about 59 million people, 3 million hectares of cultivated land. The gross national product is 1,320 billion RMB Yuan in the protection zone. At present, there are about 6600 km sea walls up to the construction standard, which is 47.9% of the total length of all sea wall. The sea wall has offered an important measures and played an important role in defending the disaster of typhoon and tide.

#### **6) Strengthen the non-structure measures**

In the coastal region, the non-structure measures have been strengthened such as typhoon monitoring, early-warning and prediction, communication, computer network and the decision-making supporting system and etc.. The no-structure measures gain valuable time for the scientific decision and organizing of mass evacuation and have created the obvious benefit. At present, the cities and counties along the coast influenced by typhoon have already installed the satellites nephogram receiving system. The large and medium cities in the coastal region have founded the typhoon and rainstorm early-warning signals issuing system according to international consuetude, which can effectively guide the mass to avoid disasters.

#### **7) Strengthen the disseminating**

In recent years, China applies itself to help public to promote the capacity of avoiding disaster and the consciousness of typhoon defense by safe knowledge of defend typhoon and relevant regulations have be propagated through disseminating the concerned knowledge and laws and regulations. Before the typhoon landing, the mass can get the detail information about typhoon via various kinds of channels, such as broadcast, TV, newspapers and periodicals, Internet and short information of mobile phone and etc., which can play an important role on reducing casualties.

#### **8) Enhance co-operation between departments**

In the work of typhoon defending, the government departments have strengthened effective management. They have not only the individual responsibility but also the close and smooth cooperation. The Departments, such as flood control, meteorological, ocean and etc. monitor and predict the trends of typhoon nearly and study the precautionary measures early. According to the typhoon warning issued by the meteorological department, the province and city, county will start the preconcerted scheme of typhoon defense and enter the combat-ready state in all-round ways.

The Departments of Water Resources organize specialists and local people to inspect the water constructions such as seawall, reservoir and etc..

The Department of Land & Resources watch the sediment disaster and issue warning in the area impacted by typhoon possibly.

The Departments of Ocean and Traffic organize the sea-ships back to the harbor shelter for avoiding typhoon. In the area hit by typhoon, any sailing and navigating is forbidden, all constructing are stopped and the high way is closed.

The Department of Urban Construction has responsibility for fixating the altitude facilities such as billboards.

The Departments of Civil Affairs start the preconcerted scheme of succor in time. All kinds of rescue material are dispatched to the place where the disaster occurred.

Soldiers, policemen and reservists are put into flood fighting and support local government for disaster reduction and mitigation.

#### **9) Plan the flood-control and drought-relief as a whole**

China government adheres to develop flood-control and drought-relief simultaneously and plan the disaster reduction and the benefit promoting as a whole. By dispatching scientifically the flood water as a resources, a good results has been achieved. For an example, according to the prediction, the coastal sluices were regulated to discharge and drainage in time before the typhoon 'Rananim' landing in 2004, so that the inundated area was reduced about 100 km<sup>2</sup>, the water depth in inundated area was reduced about 25~30 cm and the duration of inundation was shorted about 50~80 hours. After the typhoon landing, the reservoirs in the influenced area played full role to store flood water. The total water volume stored in reservoirs during 'Rananim' reached about 1.5 billion m<sup>3</sup>. It not only had lightened the pressure of flood control in the downstream of the reservoirs, but also had offered the water resources for the drought relief occurred after typhoon.

#### **4. Conclusions and recommendations**

(1) China is the country with high frequency of typhoon disaster that brings the huge impacts to the national economy, social development and people's lives. With the rapid developing of socio-economic, the influence of typhoon is becoming greater and greater. The typhoon disaster will be one of the most important natural disasters need to be prevented, mitigated and reduced in the future in China.

(2) The early warning, the preventable scheme perfecting, scientific dispatching and effective management of government are effective measures for prevention, mitigation and reduction the typhoon disaster.

(3) Because the population in China is concentrated in the eastern part where is very prone to the influence of typhoon. To reduce casualties as much as possible will be main work of typhoon defense in China.

(4) The typhoon can bring not only the disaster, but also the water resources to people. So, the typhoon is a challenge, and also is an opportunity. How to scientifically and effectively use the flood created by typhoon as a kind of water resource will be a subject need to research.