

FACTOR ANALYSIS OF DISASTER LOSSES: CHINA CASE STUDY

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1. Introduction

As reported by the Ministry of Civil Affairs, China, the central government agency responsible for disaster management and mitigation (Jia, 2005) for the past 15 years, about 370 million people annually have been affected by various kinds of natural hazards, and thousands have lost their lives in China. Moreover, over the same period of time, about 4 million buildings and 500 million hectares of crops were destroyed, with direct economic losses of more than 120 billion US dollars each year on average (Figure 1). In the 1990s, disaster losses increased by 40% compared with the 1980s. Among all kinds of natural hazards that occurred, losses caused by floods, droughts and earthquakes were 80 to 90% of the losses, which was about 3 to 6% of GDP.

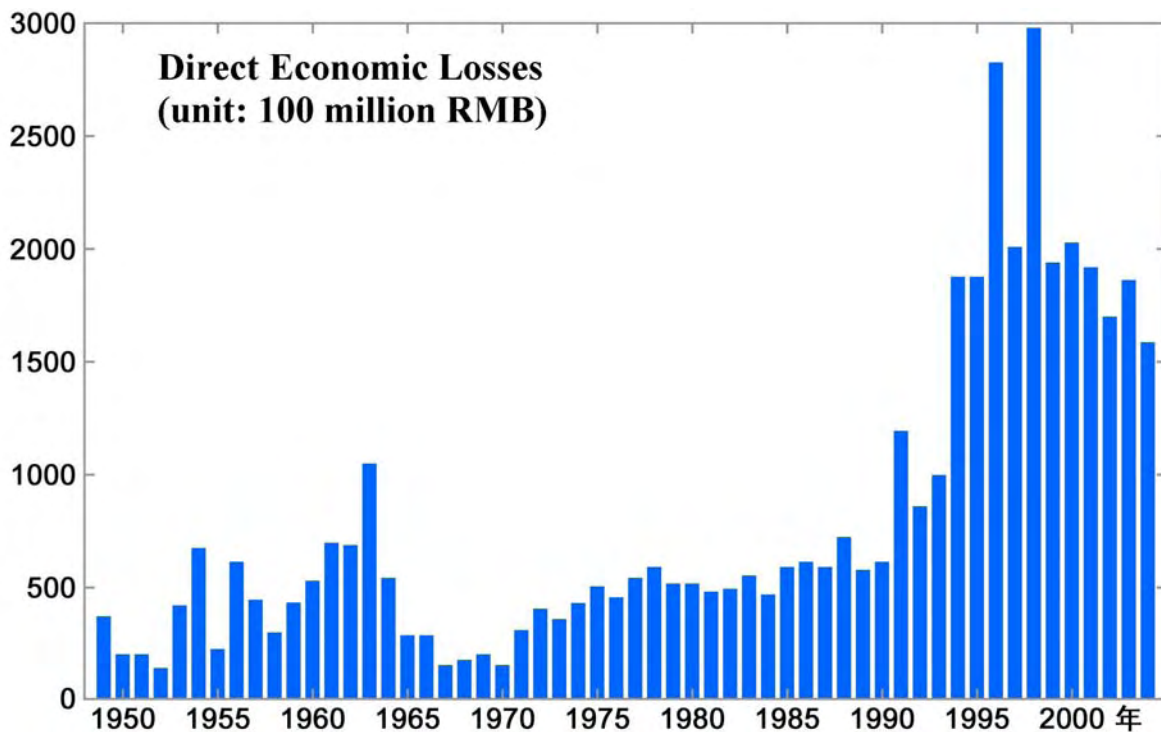


Figure 1. Direct Economic Losses Due to All Natural Hazards in China (Source: China National Disaster Research Group, 2000; China National Climate Center, 2005)

Floods and storms have been recognized as major hazards in China for more than 3,000 years, since agriculture always plays a dominant role in China's economy and society. For example, as historical records show, the Yellow river in northern China has flooded more than 1,500 times during the past 2,000 years and affected more than 250,000 square kilometers. Figures 2a, 2b, 2c and 2d show the time series of direct economic losses, populations affected, the area of affected crops, and the buildings that were destroyed by major floods and storms in China from 1990 to 2005.

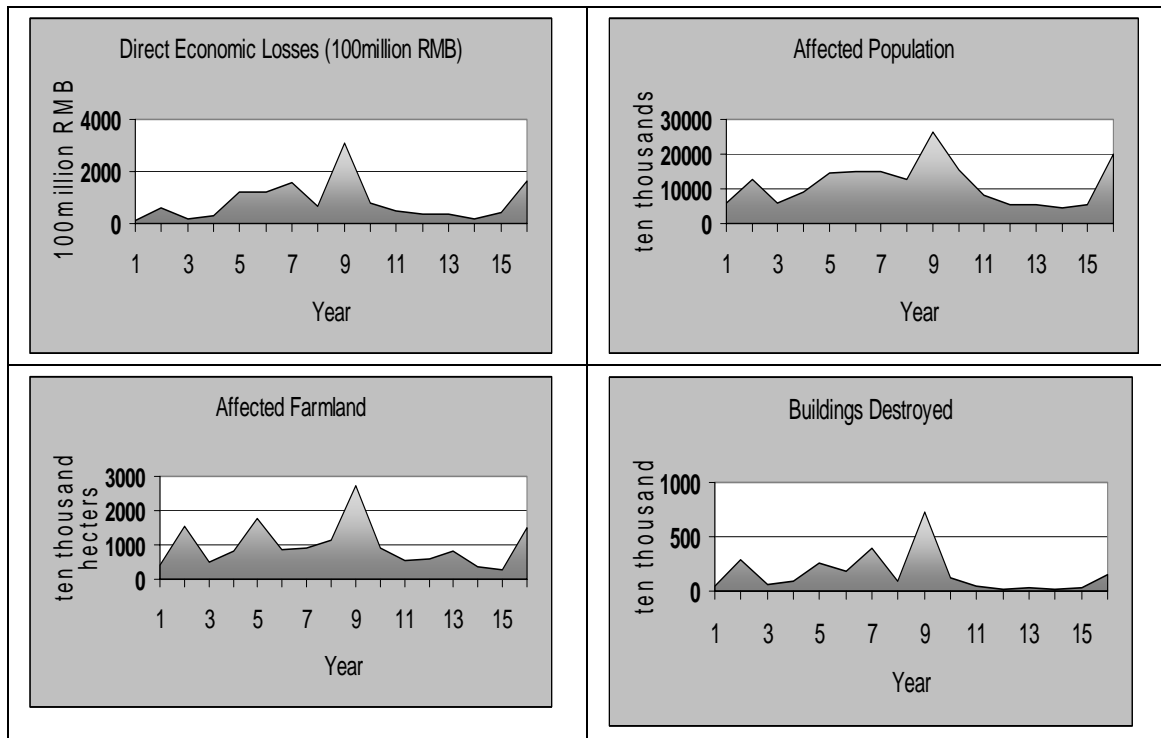


Figure 2. Time series of a) direct economic losses; b) affected population; c) affected farmland; d) number of buildings destroyed. (Source: Guo et al., 2005 and Ministry of Water Resources, 2006)

China’s complex geological topography and various climatic conditions render the country extremely vulnerable to hydrological hazards, including floods and storms. In general, the topography of China can be divided into three distinct steps: from the high mountains in the west, to many hills and flat valleys in the middle of the country, and ending in fertile deltas and vast flat alluvial plains in the east (Figure 3a). Most major rivers which originate from the high mountains in the west flow eastward, accelerating from the first step to the second step. The water then suddenly slows down when it enters the third step before flowing into the ocean.

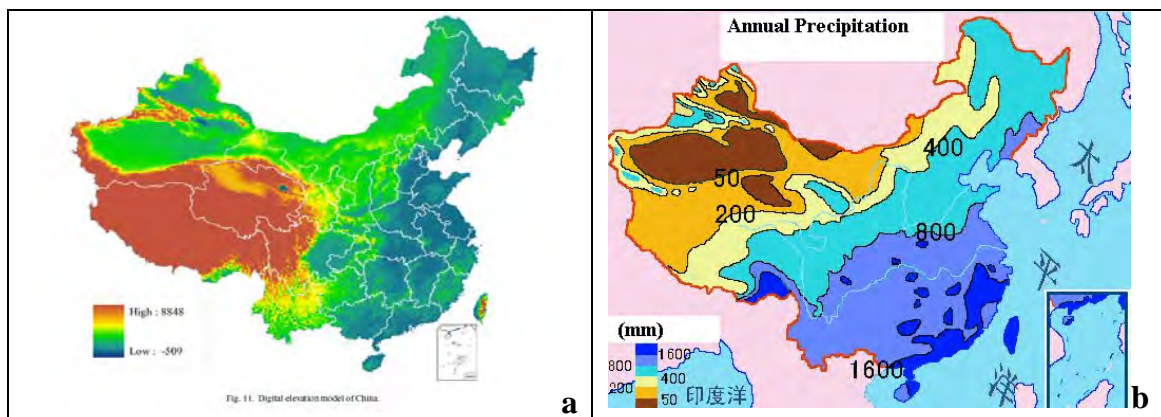


Figure 3 a) Topography of China; **b)** Annual Precipitation Distribution in China

Although China’s territory covers many different climate zones defined as torrid, subtropical, warm-temperate and temperate, most portions of the east and middle regions in China are governed by the monsoon climate, which brings significant spatial and temporal variations in rainfall patterns which peak in summer and are concentrated along the Yangtze river basin (Figure 3b).

2. Factors causing increased losses due to floods and storms

China has had the largest population and the fastest economic growth rate in the world for the past twenty-five years. It is not surprising that the major factors related to increased losses caused by floods and storms, as in other developed and developing countries around the world, can be traced to the increase in both population and wealth, as pointed out by Pielke Jr. and Landsea (1998) and others (e.g., Loster, 1999).

a. Population Increase

The population of mainland China surpassed 1.3 billion on Jan. 6, 2005, according to China's National Statistics Bureau (NSB) (Xinhua News, 2005). The increase in population, as shown in Figure 4, is not evenly distributed around the country. Most of the increase has occurred in eastern China partly due to migration from rural to urban areas, which also has experienced the fastest economic development

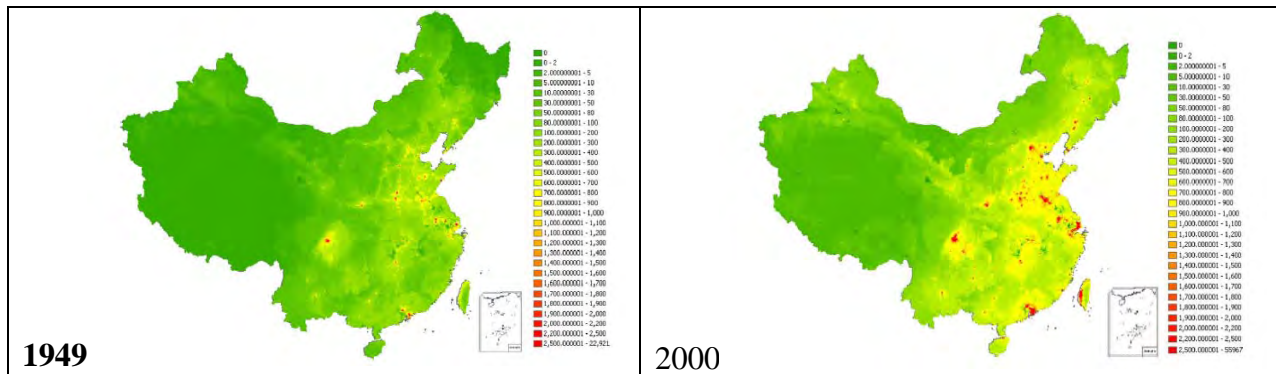


Figure 4. The population distribution of China in 1949 (left) and 2000 (right) in unit of persons per square kilometer. (Source: Tian et.al., 2004)

b. Wealth Increase

China has achieved remarkable progress in economic development since its reform and opening policy adapted in 1979. According to the statistics, the average growth rate of Chinese GDP was as high as 8.2% from 1979-2005 (National Statistic Bureau, 2005). China has become the world's fifth-largest economy in terms of GDP and has moved to the rank of a middle-income country, according to GDP per capita measures (exceeding \$1,000 US dollars in 2003). It is a miracle that China has kept a high economic record for such a long time. With such high growth in the economy, the Chinese people have also become richer. For example, the number of wealthy people, each with more than \$1 million US dollars in assets, has increased more than 12% every year (Merrylin Group, 2004). Meanwhile, a sizeable middle class is starting to emerge. The income increase in urban areas has kept a similar tempo with the growth of the national economy, with an increase in average employee salary of 16-33% in the past five years.

Although further studies need to be carried out in order to determine a reliable trend in China's flood and storm damage, based on a normalization of the damages that takes inflation into account, as well as changes in population and wealth, the increase of population and wealth obviously plays an important role in the increasing trend of losses. The other factors which have been considered in China, however, are highly dependent on the differing interests of numerous government agencies.

Factor 1: Weak Capacity in Hydrological Management (emphasized by Ministry of Water Resources)

For more than 50 years, China has built and reinforced over 270,000 km dikes of various standards, constructed more than 10,000 km of sea dikes, built 85,000 reservoirs of large, medium and small size with the total storage of 518.4 billion m³, and developed 97 flood detention and storage zones for major rivers, including the Yangtze river, Yellow river, Huai river and Hai river with a total area of 30,000 km² and total volume of 107.8 billion m³.

However, not only most projects along the major rivers were constructed with only a standard of withstanding the worst flood that might be expected over a ten to twenty year period but also after many years of mismanagement and overuse, it is estimated that at least 40% of these hydrological engineering projects are presently in various degrees of malfunction. As pointed out by the Ministry of Water Resources,

“The changes of flood control situation in China are mainly indicated as (a) the decline of the flood carrying capacities in river courses and flood detention capacities in wetlands which caused the flood stages higher and higher at the same discharge; (b) Flood-protected areas rely more on dikes for their safety that aggravate hardships in flood fighting; (c) inundated areas caused by river outflows have decreased, but that caused by local rainstorms increased; (d) the densities of inhabitants and properties in flood prone areas increased sharply, which have aggrandized flood damages and emerged the scarcity of flood-protected level in urban areas; (e) casualties in flood plains decreased, but the rate of casualties caused by torrents and mud-rock flows in gullies and valleys, and storm surges along coastlands increased; (f) the conflicts among different regions during flood control operations aggravated and hardness in harmonizing enlarged; (g) the management and maintenance of the flood control engineering system becomes more important, and demands on information system and decision-support system increased, and so on.” (Cheng Xiaotao, Ministry of Water Resources, 2005)

Since more than 70% of total national fixed assets, 44% of the total population, one-third of the farmland, several hundred cities, and a huge number of heavy industrial facilities and infrastructures are downstream of many rivers, the potential for increased losses caused by floods and storms is very high without appropriate prevention and mitigation management plans.

Factor 2 Environmental Degradation (emphasized by National Environmental Protection Bureau)

During the past 25 years, with increasing economic development but protection of the natural environment lagging behind, 70% of the rivers in China are now polluted. The major pollution sources come from municipal and industrial waste water and overuse of pesticides in agriculture. For example, in 2004, among a total of 661 cities, only 55% of them have waste water processing facilities and among these facilities, the efficient treatment rate is only 45.7%. As a result, when even small-scale floods and storms occur, polluted water from upstream flows downstream and can cause considerable damage to the agriculture and tourism businesses, as well as short-term and long-term impacts on the health of human beings and ecosystems.

The areas of land degradation, which leads to soil erosion in many river basins, are also increasing. Currently, more than 37% of the total land surface in mainland China suffers various kinds of land degradation problems, of which about 50% is directly caused by floods and storms (National Environmental Protection Bureau, 2005). Moreover, with the national policy of speeding up urbanization, many wetlands and lakes which used to be buffer zones for floods have been transferred to industrial use or replaced by apartment buildings. For example, in Shanghai more than 25% of water surface has been lost due to urban development (People’s Daily, 2003). As a result, in combination with increasing sediment deposition due to the soil erosion and land reclamation, many lakes and reservoirs have lost their capacities to hold floodwaters (Shankman and Liang, 2003).

Factor 3 Climate Change (emphasized by China Meteorological Administration)

Although northern China is still suffering from a long-lasting period of droughts starting in the 1980s, there is a trend toward an increase in annual precipitation in southern China, as shown in Figure 5 (Zhai and Wang, China National Climate Center, 2003). For the future, an increase of precipitation in China is also predicted by the IPCC based on different scenarios (IPCC, 2003). More precipitation in China usually means more floods and more frequent storms.

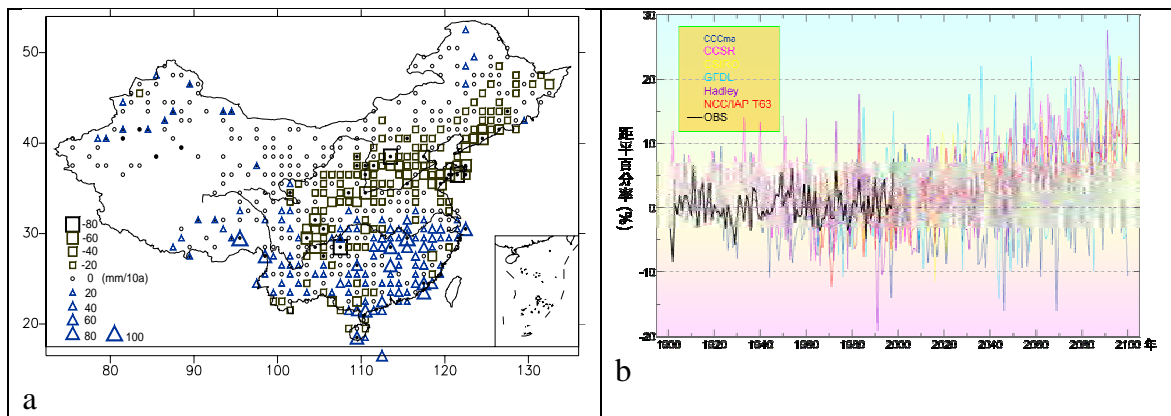


Figure 5. a) The trend of annual precipitation over China in the last 50 years (Zhai and Wang, China National Climate Center, 2003); **b)** IPCC prediction based on different scenarios (IPCC, 2003)

Factor 4 Political Game (stated by overseas scholars)

“A man who wishes to run the country well should give priority to flood control” is a saying handed down from generation to generation in the Chinese nation. Leaders, on the other hand, have often used flood disasters as an opportunity to show the people how powerful they are and to test how much control they can gain by moving resources around. As pointed out by overseas Chinese scholars, a large amount of the losses during the Great Yangtze River Floods in 1998 was mainly due to wrong decisions made by the leaders from the central government, who wanted to use the opportunity to test both the loyalty of the military and the strength of their power (Wang, 2005).

3. Implications for Research and Policy

For researchers:

First, many floods and storms should not only be categorized based on physical characteristics, such as wind speed and pressure as in the case of typhoons, but the social and economic impacts should also be considered. For example, in the Korean cases of Super-typhoons Rusa and Maemi, we found that “the significant differences in their physical characteristics led to different damages to the society” (Ye, 2005).

Second, a reliable, up-to-date monitoring, early warning and assessment system is needed. Again, in our Korea super-typhoon case study, it was found that the government agencies used either averaged data or out-of-date information when they dealt with these extreme events.

Third, since it is impossible for scientists to single out factors responsible for increases in flood and storm losses, future research on these issues should not only include the scientific community in different disciplines but also, and even more importantly, government decision makers, city managers, community organizations, planners, and insurance companies.

For policy makers:

First, as we discussed above, it is clear that different government agencies have their own needs and different working priorities when dealing with flood and storm disasters. Therefore, improving capacity of communication and sharing information among these government agencies is a must, at least in China’s case.

Second, a third party, for example, insurance companies, should play an important role in government assessments when decisions on hydro-meteorological issues are being made, such as major river diversions and other mega-scale hydrological engineering projects.

Third, floods and storms are repeating natural events. Humans dealt with these natural hazards even before the dawn of

civilization. Looking back into the history of other countries, one can easily find many similar lessons that have been learned and so many social, economic and political solutions that have been identified. The question is, as Glantz asked in his UN 16-country study on the impacts of El Nino, "Why are many of those solutions known by governments, researchers, and individuals learned but not yet applied?" (Glantz, 2001)

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