

## **Natural Disaster Prevention and Mitigation System Based on Disaster Investigation and Assessment**

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### **Abstract**

Disaster investigation and assessment is an important path to systematically sort out the current level of disaster management system. By analysing the successful investigation and assessment cases of major meteorological disasters in China, this paper establishes the index system of disaster investigation and assessment, improves the prevention capability of urban typhoon and rainstorm emergency response, and constructs comprehensive typhoon and rainstorm prevention and mitigation system. The paper provides a reference for checking the deficiencies of disaster prevention and mitigation system, identifying and solving problems in a timely manner, and improving the ability of natural disaster prevention and mitigation of the community.

**Keywords:** natural disaster, prevention and mitigation, investigation and assessment, index system, meteorological disasters, typhoon, rainstorm

### **Introduction**

China is a country frequently impacted by multiple natural hazards. Natural disasters in China are dominated by floods and typhoons. According to the 2018 China natural disasters statistics, floods and typhoon disasters are mainly occurred during the flood season. The losses caused by floods (including geological disasters) and typhoon disasters account for 70%-80% of the total natural disaster losses throughout the year (Liu and Wei, 2019). It is necessary to establish an effective and scientific natural disaster prevention and mitigation system to improve the capability of natural disaster response in the whole society. Disaster investigation and assessment work should not only focus on disaster fatalities and damage, but also focus on cause analysis, emergency response analysis and disaster prevention analysis (Yan and Shang, 2019).

### **Thesis**

On March 17th 2018, Ministry of Emergency Management (MEM) is founded to integrate scattered disaster-relief resources to cope with the country's frequent natural disasters and accidents. After the establishment of MEM, it took over disaster management powers and resources previously spread over 13 other ministerial departments. The MEM proposes to establish and improve the mechanism of natural disaster investigation and assessment system (Qiu and Rao, 2018). Through the investigation and assessment of natural disasters, we can comprehensively and objectively evaluate and test the operation effect of the current system, we can also systematically sort out and analyse the problems and shortcomings. Thus, to provide scientific and informational basis for the development of work plans.

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## Application

### Case analysis of disaster investigation and assessment

In 2017 Typhoon Hato direct hit Macao, China and in 2018 Typhoon Mangkhut made landfall in Guangdong, China which both cause large impact. Throughout the study and analyse of these two natural disaster investigation and assessment, we can find many common problems which will provide experience and data for future works.

### Typhoon Hato Disaster Investigation and Assessment in Macao: Construction of a Modernized Disaster Prevention and Mitigation System

On August 23, 2017, typhoon Hato direct hit Macao, which killed 10 people and injured 244 people in Macao. The direct economic loss was 8.31 billion Macao Pataca and the indirect economic loss was 3.16 billion Macao Pataca. Right after the disaster, the team of experts from Tsinghua University, Northern University of Technology and the National Disaster Reduction Centre of the Ministry of Civil Affairs carried out disaster investigation and assessment in Macao (Shan et al.,2018).

On the basis of a careful summary of the characteristics of Typhoon Hato, the experiences and lessons learned from the disaster, drawing lessons from advanced experiences and concepts both domestic and international, strengthening top-level design, optimizing emergency management system, implementing key projects for disaster prevention and mitigation as planned, and establish and improve public safety with Macao. The risk-competitive coordination mechanism of Guangdong, Hong Kong and Macao has gradually formed a government-led, society-wide participation, covering the entire process of public safety emergency management, and a comprehensive emergency response system.

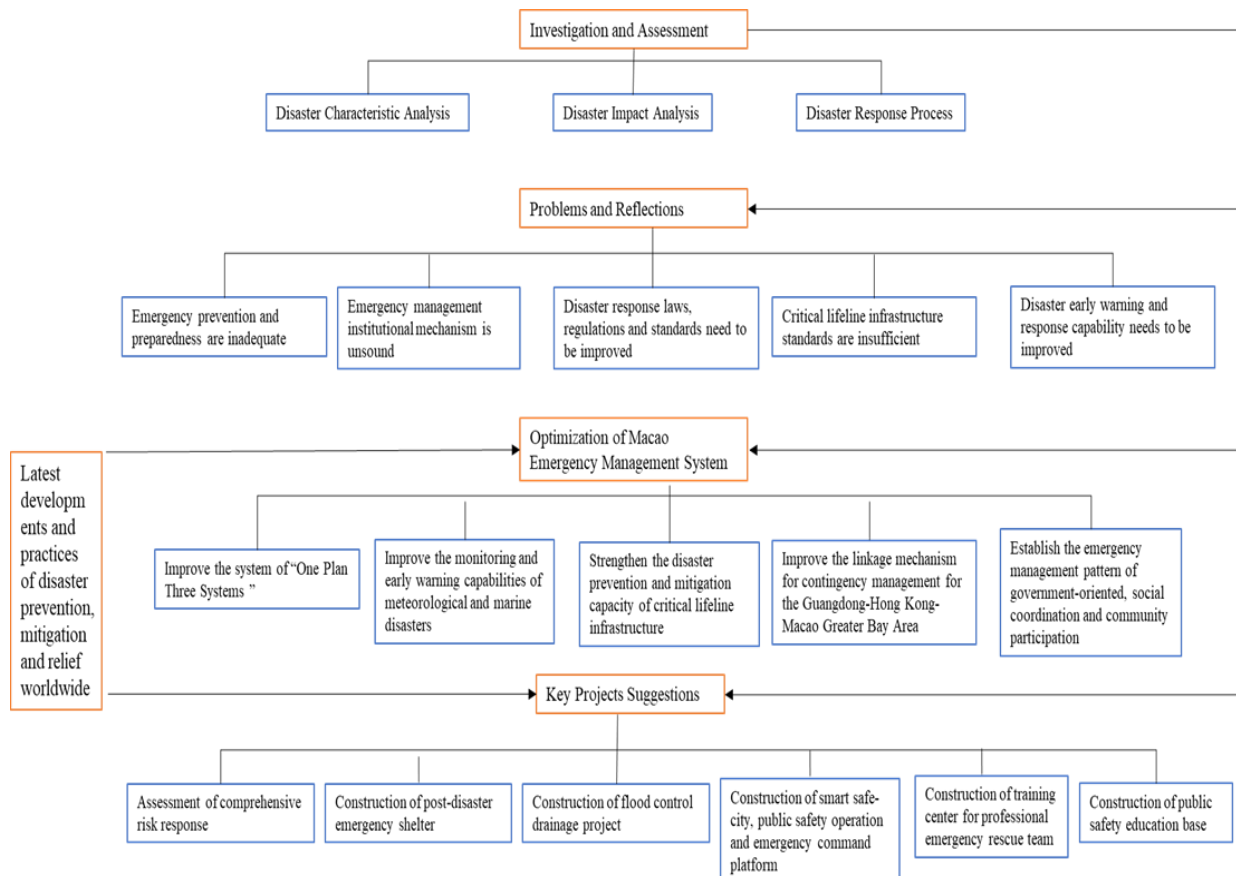


Figure 1: The structure of Typhoon Hato investigation and assessment report

### Typhoon Mangkhut disaster investigation and assessment promotes Shenzhen's comprehensive improvement of typhoon prevention ability

On September 16, 2018, super typhoon Mangkhut made landfall in Haiyan Town, Taishan, Guangdong, China. The typhoon eye was only 125 kilometres away from Shenzhen. Mangkhut was the strongest typhoon to affect Shenzhen after Ellen since 1983. It had the characteristics of high intensity, wide range, long duration and extremely damage, which has caused serious losses in Shenzhen. The whole disaster emergency management process provided valuable experience, effective data support and typical cases for improving urban natural disaster prevention, mitigation and relief capabilities.

Day after the disaster, Shenzhen Flood Control and Drought Relief Headquarter proposed to carry out typhoon Mangkhut investigation and assessment. Shenzhen Urban Public Safety and Technology Institute worked as a third party to set up a professional project team to start disaster investigation and assessment work (Xi, et al.,2019). This work included gathering disaster information and news through internet, collecting first-hand disaster prevention and mitigation related materials from government departments and local companies, taking typhoon aftermath photos on site, conducting interview with forefront response teams and releasing online typhoon response questionnaire to general public. The purposes of the investigation and assessment are to highlight the characteristics and disaster response, analyse the existing problems from both technical, and management sides, learn from domestic and foreign experience. Finally, to propose recommendations for targeted effectiveness, build typhoon Mangkhut disaster information map, and retain valuable disaster database.

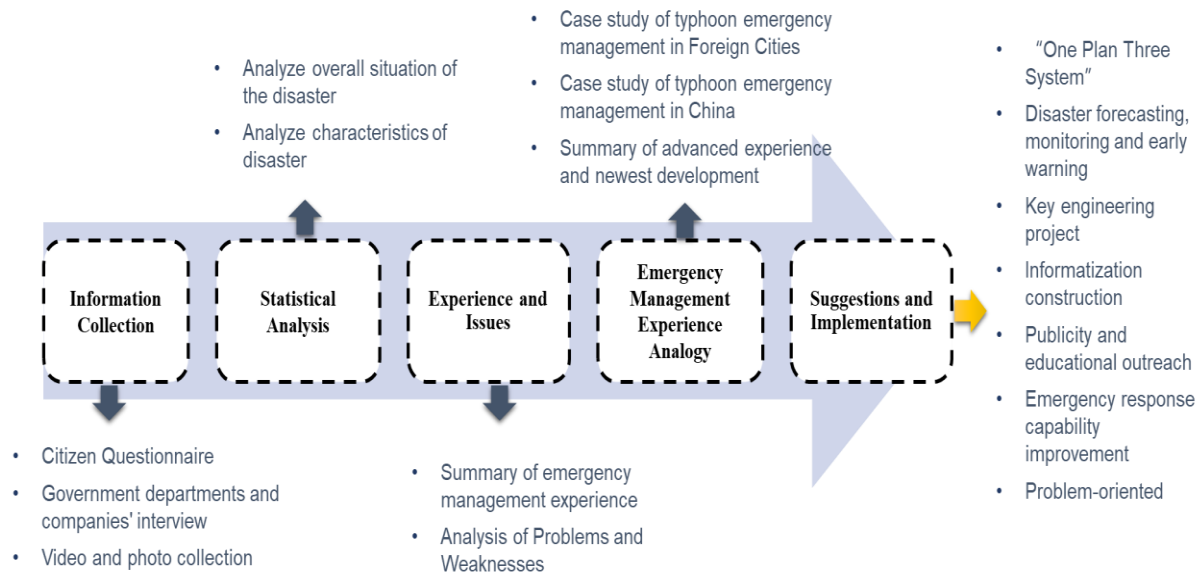


Figure 2. Typhoon Mangkhut disaster investigation and assessment implementation method

On the basis of the results of the investigation and assessment of Mangkhut, in conjunction with the actual situation of Shenzhen and in accordance with the principle of "problem traction, long-term and short-term consideration", Shenzhen Municipal Government formulated "Shenzhen City Key Program for Enhancing the Defence Capability of Storm and Storm Disasters", and 38 specific tasks were proposed. The solutions and enhancement measures were proposed for the outstanding problems and weaknesses.

## Findings

### Disaster Investigation and Assessment Index System

Natural disaster investigation and assessment is still in the early exploratory stage, and there are no relevant codes or standards to regulate it in China. In order to ensure the rationality and comprehensiveness of the investigation and assessment results, it is necessary to improve the indicator and index system, so that the result can be real, reliable, in-depth and specific.

Disaster mitigation requirements, starting from the actual disaster situation, face the whole process of prevention and emergency preparedness, monitoring and early warning, emergency response and rescue, post-disaster recovery and reconstruction. Taking typhoon and flood disasters as examples, the index system of disaster investigation and assessment is constructed, which is mainly divided into three categories: spatial-temporal information, disaster information and disaster response information.

### Spatial-temporal Information Index

Spatial-temporal information of disasters includes the time and duration of typhoon and flood disasters, and the information indicators of wind, rainfall, tide level, wave height and other water related indicators. The main indicators are: maximum wind speed of each meteorological station, maximum 10-minute average wind speed, maximum one-hour rainfall, maximum 24-hour rainfall and maximum cumulative rainfall during the disaster, maximum tidal level and the maximum wave height. Through the statistical analysis of the spatial and temporal information, the frequency, time distribution and spatial distribution of disasters can be obtained, as well as to analyse the intensity and destructive capacity of the disaster.

### Disaster Information Indicators

The disaster information indicators mainly include: agriculture, forestry, animal husbandry and fishery systems, industrial and mining systems, transportation systems, water systems, housing and construction systems, water, electricity and telecommunications systems, and tourism systems. Mainly from number of facilities damaged, interruption time, economic loss, affected population and etc. Taking the water, electricity and telecommunications system as an example, and its indicator system is shown in Figure 3.

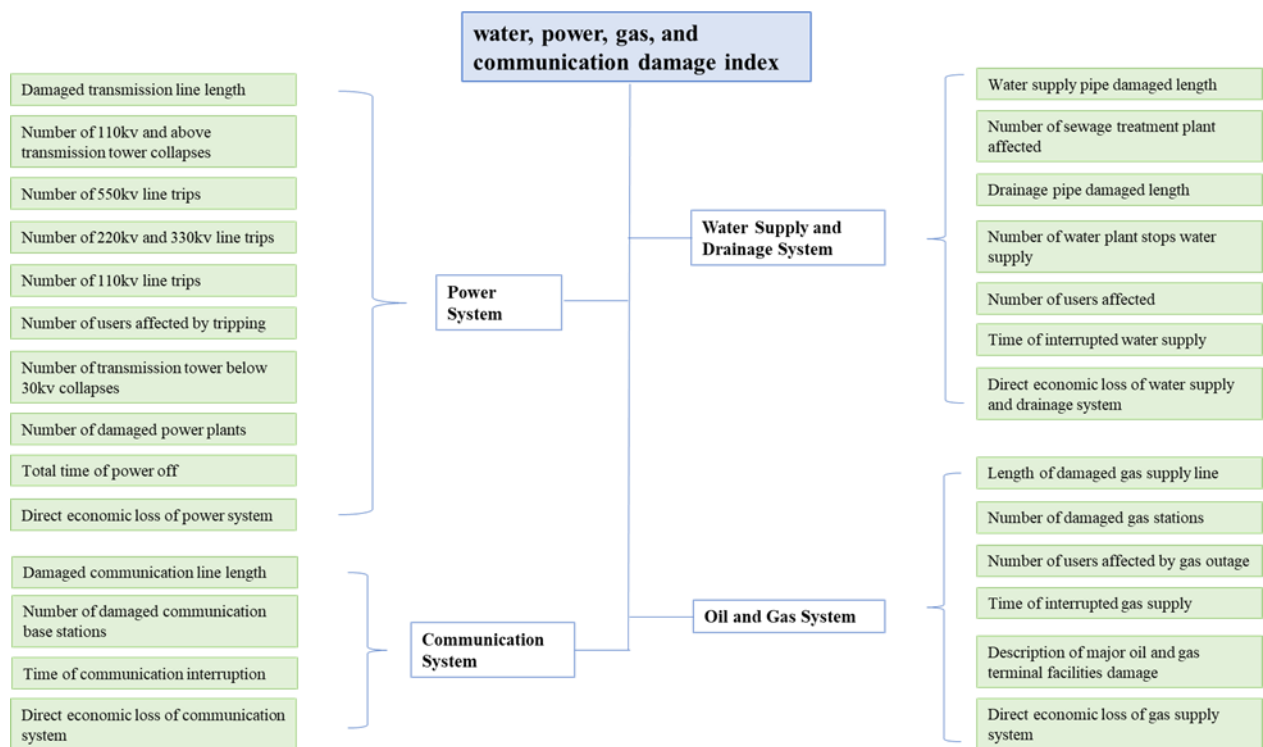


Figure 3. Infrastructure Information Index

### Disaster Response Information Indicators

The disaster information indicators are mainly for the response information of the comprehensive process of disaster, including: implementation of responsibility and emergency deployment, inspection of key areas, resettlement of personnel, emergency reserve and response team input, and recovery process. The implementation of responsibility and emergency deployment indicators include pre-planning and drill, disaster prevention responsibility implementation and deployment, early warning and response and etc. Inspections in key areas indicators include inspections of facilities in related industries, number of facilitate reinforcement, number of early warnings and etc. Resettlement of personnel indicators mainly count the number of people transfer in construction sites, tourist attractions, coastal areas, potential geological disasters areas, number of people in emergency shelters, and so on.

Emergency reserve include types of reserve, total amount of reserve, allocation of reserve and how effective of their use. Response team input include the number and types of governmental professional emergency rescue force, social rescue force and experts. Recovery process mainly includes number of excluded dangers, governmental paid disaster recovery subsidies and the number and time of lifeline system recovery.

## **Discussion**

### **The Key Direction of Comprehensive Prevention and mitigation System of Urban Typhoon and Storm Disasters**

The city needs to build a comprehensive, systematic, intelligent and refined typhoon and storm disasters prevention and mitigation system. Adhering to the "people-oriented" concept, focusing on people's livelihood issues, and combining the results of disaster investigation and assessment to make "problem-oriented" throughout. Considering the ability to improve the typhoon and storm disasters prevention is a systematic process, which need gradually promote the development of disaster prevention and mitigation work in various industries and fill in the shortcomings. To take the advantages of scientific and technological innovation, rely on simulation, remote sensing, Internet of Things, big data and other technologies to further improve the refinement level of urban emergency management. Focusing on mitigating the impact of typhoon and storm disasters at the present stage, and proposing specific measures, such as typhoon storm disaster mechanism and disaster chain. The ability of urban disaster prevention and mitigation are improved from five aspects: institutional and operation system, standard, engineering construction, scientific research and training and education.

#### **Institutional and Operational System**

According to the requirements of China's Emergency Management Institutional Reform in 2018, that the city need to maximize the integration and optimization of various resources at urban level, build a professional and effective emergency command system, improve the delivery and guarantee of emergency resources, establish and improve emergency support system, enhance emergency plan system, establish rescue support for emergency shelters, improve disaster and early warning publicity information , build cross-regional disaster information notification linkage, up-grade the catastrophe insurance guarantee workflow and commercial emergency materials reserve and guarantee.

#### **Standard**

The standards for improving disaster prevention capabilities in key industry sectors where historical disasters are more serious or have higher sensitivity to disasters must be close studied. The government will formulate disaster investigation and assessment work standards, disaster rescue operation manuals for various industries, waterproof and immersion ability of urban underground space, emergency communication support ability during extreme weather, roadside trees management rules, wind-resistant design of power lines, emergency evacuation assistance and resettlement work specifications.

#### **Engineering Construction**

Critical construction projects and key urban disaster prevention infrastructures are need to upgraded in next few years. First of all, projects such as urban flood and tide control, maritime emergency rescue stations, post-disaster waste disposal systems, emergency shelters and other related infrastructure construction are all need to strengthen. Secondly, the municipal government have to responsibility to enhance the support capacity of disaster relief reserve, establish an efficient mode for reserve allocation and transportation, and form an emergency reserve support system with reasonable layout and point-to-point integration. Thirdly, relevant government departments establish a land to sea integrated disaster early warning decision support system to provide timely meteorological monitoring and forecasting, comprehensive tide, storm surges and flood information, disaster impact prediction information for the disaster prevention decision-making in the region. Finally, to accelerate the construction of a new generation of emergency command platform that contains an intelligent emergency index integrating unified command, rapid response, information sharing and visual management functions.

#### **Scientific Research**

Strengthen systematic research on urban disasters, including refined disaster-accident chain research, corresponding disaster analysis and simulation, simulation models for disaster occurrence, development, evolution, and define risk ranges and risk levels. In order to identify weakness in the emergency management system, the city need to carry out risk assessment and emergency capability assessment work. To enhance technology of disaster prevention, we suggest to build a ‘space -ground integrated’ monitoring and early warning system m. By using satellites, drones, sensors and other facilities to complement each other and carries out monitoring and early warning work in an all-round way.

### **Training and Education**

In order to enhance public awareness of disaster prevention, we need to strengthen science popularization and education in the community. Firstly, to make full use of the social media, city official information service platform and other channels to further strengthen safety publicity and education during disasters, especially to make escape guidance during emergency situations such as driving in flooding, outdoor activities and severe weather. In addition, compile a concise, practical and interest handbook for disaster prevention and mitigation to the general public. We can also use school classrooms, public service and other ways to carry out disaster prevention and avoidance publicity education to enhance public disaster prevention and avoidance capabilities.

### **Conclusion**

The comprehensive prevention and mitigation system for the construction of typhoon and storm disasters involves a large number of units and departments, covering a wide range of industries. On the one hand, it is necessary to strengthen organizational leadership at the government level, and the emergency management departments should give full play to the overall coordination role, promote the work in a scientific and orderly manner, and increase the resources and strengths of the competent departments in various industries to earnestly perform the duties related to the typhoon and storm disaster prevention in this field; On the other hand, it is also necessary to give full play to the synergy of the society, mobilize the public, encourage and guide the multi-subjects to participate in the disaster prevention and control work, attach importance to the active participation, joint construction and common governance, and work together to create a new pattern of co-construction, co-governance and sharing in the field of disaster prevention and mitigation.

To improve the ability of natural disaster prevention and mitigation, it is necessary to accumulate long-term practice and summarize experience. Building a comprehensive prevention and mitigation system of typhoon and storm disasters based on disaster investigation and assessment is the first step for mega-coastal cities in China to actively explore and strengthen the emergency management of natural disasters. Facing the threat of extreme weather disasters under the influence of global warming trend, we still need to conduct in-depth study and timely summary of new situations and problems in the process of disaster prevention through disaster investigation and assessment, improve and perfect the comprehensive emergency management system.

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