

# Risk Management for Disasters in Taiwan

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This article aims to examine the nature of disasters, assess Taiwan's vulnerability in disasters, provide a conceptual framework for risk management and key actors' roles, and propose an integrated approach to risk management in disasters. The case of Typhoon Morakot in August 2009, the most serious precipitation in Taiwan in the past half-century, is illustrated in the discussion to supplement the theoretical framework with practical experience.

## Categories of Disasters

There are three main categories of disasters:

1. Natural Disasters. These are of three main kinds:
  - (a) Hydrological and meteorological disasters, such as droughts, floods, landslides, typhoons, heat waves, lightning, tornadoes, hurricanes, and wildfires.
  - (b) Geological disasters, such as earthquakes, tsunami, volcanic eruptions, and avalanches.
  - (c) Biological disasters, such as contagious diseases and epidemics.
2. Technological Disasters. These include radiation, pollution, and chemical hazards.
3. Environmental Disasters. These are usually referred to as man-made disasters, such as chemical spills, nuclear waste, illegal logging, shark finning, and endangering other species.

## Taiwan's Vulnerability in Disasters

Taiwan is one of the most vulnerable areas frequently suffering from natural disasters (Table). The island is located in the earthquake belt and also on the major tracks of typhoons in the northwest Pacific area and of the East Asia monsoon system. Typhoons, floods, landslides, droughts, and earthquakes are the most frequent natural disasters in Taiwan. Heavy rainfall occurs frequently in the typhoon season. In addition, due to the steep central mountains in Taiwan, the short collection duration for rainfall provides great potential for flooding, landslides and debris flow disasters. According to *Natural Disaster Hotspots – A Global Risk Analysis*, published by the World Bank in 2005, Taiwan is an area at high risk of natural disasters. Around 73% of the land and population is exposed to more than three natural hazards, while 99% is exposed to two or more natural hazards.

According to the Environmental Protection Administration of the Executive Yuan, the high risk of natural disasters in Taiwan derives from:

1. Natural vulnerability – frequent typhoons, intensive rainfall, steep mountains and rushing rivers, high precipitation variation between

rainy and dry seasons, low-lying terrain in southwest coastal area, fragile geology, and loose surface soil;

2. The effects of socioeconomic development – flooding caused by urban development, high temperatures and local convection enhanced by the heat island effect, increases in water consumption due to rapid industrial development, and land subsidence in southwest Taiwan caused by excessive pumping of groundwater;
3. The impact of global climate change – persistent rising of temperatures, increase in intensity of extreme precipitation events, changes in temporal and spatial distribution of precipitation, and rise of sea level surface.

In August 2009, Typhoon Morakot brought 2,854 mm of rain to mountainous regions in central and southern Taiwan. It took 699 precious lives and caused damage worth approximately NT\$20 billion, roughly 1.6% of GDP that year.

Typhoon Morakot also exposed the deficiencies of Taiwan's disaster relief mechanism. Officials of the Organic Laws and Statutes Bureau made an educational tour to Japan and learned about the Japanese experience in disaster prevention and response. They were

TABLE

### Overview of Taiwan's natural disasters in 1980-2010

No. of events	65
No. of people killed	4,056
Average killed per year	131
No. of people affected	3,762,573
Average affected per year	121,373
Economic damage (US\$1,000)	19,331,490
Economic damage per year (US\$1,000)	623,596

Source: PreventionWeb

impressed with Japan's shift from its past focus on hardware development to software and management, and the shift from main prevention efforts by the central government to joint cooperation between local residents and the administration to mitigate the impact of disasters. Furthermore, they noted that Typhoon Morakot highlighted the "inappropriate concept and approach" in flood prevention, lack of a land safety and conservation plan, a faulty command system in the central and local disaster response centers, and rigid procedures and slow response in providing military support for rescue operations, as well as a lack of regular drills.

### Conceptual Framework for Risk Management

Based on the concept from the United Nations International Strategy for Disaster Reduction (UNISDR), the definition of risk herein is an interaction of the hazard, vulnerability and capacity.

Risk management may be conceptualized as having two components, namely risk assessment and risk control (Chart 1).

Risk assessment itself entails two dimensions – risk analysis and risk evaluation.

1. Risk analysis comprises: (a) hazard cause identification, (b) probability of occurrence, and (c) level of negative impact/vulnerability.
2. Risk evaluation comprises: (a) level of acceptance, (b) legal framework, (c) institutional arrangement, and (d) responsibility centers.

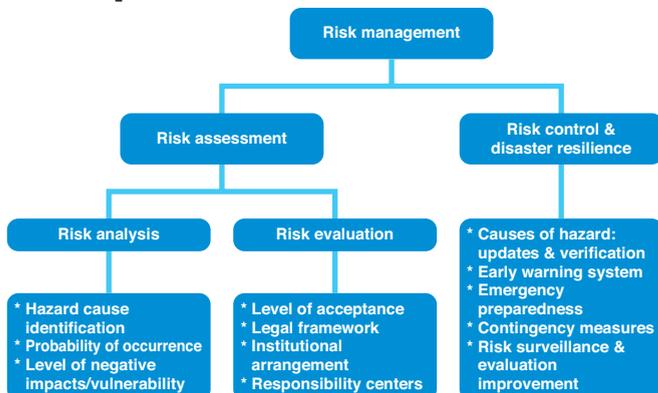
$$\text{Risk} = \text{probability of occurrence} \times \text{level of impact/vulnerability} \times \text{capacity index}$$

The purpose of risk assessment is to resolve the following challenges: (a) ways of minimizing probability of occurrence; (b) means of lowering level of impact/vulnerability, and (c) preparedness for beefing up capacity.

Risk control and disaster resilience are geared towards minimizing risk level, maximizing capacity level, and speeding disaster resilience, which consist of the following: updating and verifying the causes of hazards; an early warning system; emergency

CHART 1

### Risk management: conceptual framework



Source: Compiled by author with reference from Chen Zhen-Yu, *Landslide Risk Management*, Agricultural Council, Executive Yuan, ROC

preparedness; contingency measures; and risk surveillance and evaluation improvement.

An integrated approach to risk management encompasses all areas of discipline, including political, economic, legal, social, and cultural aspects. Efficient and successful risk management will enhance government accountability and credibility, minimize economic catastrophes, strengthen legal frameworks, improve social harmony, and sustain cultural preservation.

### Key Actors' in Risk Management

The key players in risk management include government, business, NGOs, and international organizations (Chart 2).

#### 1. Government Inter-Agency Coordination

After Typhoon Morakot, coordination among government agencies, military, and private organizations was quickly in place. At the same time, the government also sought assistance from private organizations to begin comprehensive post-disaster reconstruction efforts. Within seven days after the typhoon, the Executive Yuan established the Post-Disaster Reconstruction Council (PDRC), while the Legislative Yuan also approved the Special Act, and a special budget of NT\$116.5 billion was passed within three months so that disaster reconstruction efforts could continue on a solid legal and financial basis.

To make up for the deficiencies discovered during the Typhoon Morakot experience, inter-governmental coordination and various simulation exercises have been put in place to achieve maximal efficiency.

Existing public facilities, such as stadiums and schools, should act as refuge shelters in an emergency; constructing a new evacuation site seems too costly because such a structure would be useless in ordinary times, according to Minister of the Interior Jiang Yi-huah.

The central government requires each local government to make thorough evacuation plans, looking for places such as schools, stadiums and large temple buildings that can be utilized as evacuation sites, Jiang said.

The current standard demands a daily necessity supply of seven to

CHART 2

### Key actors in risk management: structural functionalism



Source: Author

14 days. If necessary, a local government can ask for support from other cities or counties. The current disaster prevention plans should be able to cope with large-scale destruction, but further prevention proposals for extreme disasters are still under discussion, according to Jiang.

In offshore Kinmen County, many evacuation sites such as underground channels and pillboxes were established in times of cross-strait military tensions; almost every household had its own bomb shelter at the time. At present these places are mostly being used for wine storage by the locals, but they can still serve as evacuation sites if an emergency occurs.

## 2. NGOs' Voluntary Engagements

NGOs also worked closely with the PDRC and introduced green energy equipment such as solar power generators, solar thermal water heating systems and wind power generators to the reconstructed permanent housing community, disaster prevention shelters, and newly reconstructed facilities on campuses. Procurement was made for environmentally friendly and energy-saving products so as to build green and sustainable homes. A budget of NT\$84 million was appropriated to install 67 solar power generating units, and an emergency disaster-prevention electrical system.

The private sector has played a key role in the post-disaster reconstruction efforts. For instance, the BENQ Foundation helped provide a 3-kw solar power generating unit to Kaaluwan Elementary School in Taitung County, and a 67.5-kw generator to Taiwu Elementary School in Pintung County. The Delta Electronics Foundation helped provide a 10.5-kw solar power generator and six 3-kw wind power generating units to Minquan Elementary School in Namaxia District in Kaohsiung, which has helped the school save about NT\$27,000 in electricity annually.

Furthermore, the Delta Electronics Foundation also helped the Pintung County government advocate the plan of "Transforming Fish-Farming into Solar Power Generation." The plan was initiated at unregistered fish farms in Linbian township and was applied to farms that were buried or washed away by the typhoon. Private companies were invited to invest in the 434,445 square meter pilot project. It is estimated that 43,362,000 kw of renewable energy will be added each year, and that carbon dioxide emissions will be reduced by 32.08 million kg.

The Tzu Chi Foundation, the largest private charity organization in Taiwan, was also engaged in Typhoon Morakot relief and reconstruction work, with its own "6Ps" guiding goals:

- **Prompt relief and safety:** Tens of thousands of Tzu Chi volunteers were mobilized immediately after the typhoon to provide hot meals, relief kits, emergency cash assistance, and to help with cleanup work, including street sweeping, sludge cleaning, and survivors' house rebuilding. In order to reduce the spread of infectious diseases, Tzu Chi International Medical Association personnel and volunteers held free clinics throughout the affected area.
- **Psychological and spiritual support:** Tzu Chi volunteers visited and comforted the affected people, offering compassionate

psychological support to help them regain their confidence in life. They will continue to do so in the future.

- **Preservation of children's education:** Tzu Chi provided children with a continuous and safe educational environment and helped with the development of their skills and talents. It also offered tuition assistance and allowances to affected students. The Tzu Chi Teachers Association offered academic counseling in middle schools and elementary schools in the stricken areas on weekdays and holidays.
- **Permanent housing:** Tzu Chi respected different ethnic cultures and constructed buildings in accordance with these differences. Residential buildings were constructed to resist winds of force 17 (on the extended Beaufort scale) and magnitude 7 earthquakes. Tzu Chi also allocated public spaces for tribal communities as well as religious centers, enabling each ethnic village to maintain its traditions and culture.
- **Peaceful livelihood:** Tzu Chi provided livelihood support and counseling for survivors, and assisted in discussions with the government so that the survivors could lease or acquire cultivated land in order to restore economic vitality.
- **Protection of the environment:** Mountains are the soul of the aborigines. When the aborigines' territories are damaged by natural and man-made disasters, Tzu Chi helps restore the natural habitat and protect the beautiful environment by advocating long-term land restoration and conservation policies.

More than 200,000 volunteers joined the relief work, and 51 countries around the world launched fund-raising activities. The foundation also held candle-light prayermeetings across Taiwan, sending blessings to typhoon victims and survivors. When the disaster occurred, a total of more than 700,000 hot meals were served, more than 26,000 households received emergency cash assistance ranging from NT\$5,000 to NT\$10,000, more than 40,000 eco-friendly blankets were delivered, and hundreds of thousands of relief kits and sets of eco-friendly bowls and utensils were distributed.

## 3. Business Sector – Securing Supply Chain Connectivity

The business sector is one of the key stakeholders of risk management in disaster. It is necessary to have an early warning system in place and plans on disaster prevention or mitigation. Contingency plans should be mapped out for disaster recovery, safety of the employees, retrieval of business back-up data, emergency communications, relocation of business operations, and sourcing of alternative suppliers. The business sector ought to make use of adequate insurance programs, and conduct cost benefit analysis in terms of facilitating single or multiple sources. Proprietary knowledge and technology in the design stage is usually a major concern in diversifying sources of supply. Efficiency and effectiveness within the supply chains should be built up with a strong sense of "we are all in the same boat" in a disaster situation. Rules and safety stock or "pooled risks" could be arranged. Usually, a "Supplier Flexibility Agreement" is prepared so that volume increase of up to 25% within one week and 100% within four weeks could be guaranteed. Inventory policies including stockpiles and replenishment could be revisited.

The business sector's roles in risk management in disasters also include hard and soft infrastructure building. The hard infrastructure building for investing in manufacturing facilities should consider the right amount, right time, right type (air, sea, land connectivity), and right place (less disaster-prone venues). Consideration of soft infrastructure building should include Information Technology (IT) systems, regulations and licensing, transparency and predictability, freedom for cross-border logistics operations, good governance and coordination, and appropriate technology and regulations.

There is a strong need for a public-private partnership, particularly in the areas of multi-approach to securing regional trade, developing pilot projects, encouraging harmonization and standardization, and establishing centers of excellence.

#### 4. International Community

The international community plays a key role in disaster rescue, relief, reconstruction, and capacity building.

One week after Typhoon Morakot struck, the US offered helicopters to help in rescue efforts. International assistance from other nations also began pouring in, following Australian, Canadian and British aid. A China Airlines flight arrived with a 5,000 kg payload, with Taiwan Red Cross assistance in immediate distribution. The US military based in Okinawa, the nearest US facility to Taiwan, provided Sikorsky CH-53E Super Stallions – its largest and heaviest helicopters, capable of transporting heavy earth-moving equipment.

The UNISDR has come up with the first plan to explain, describe and detail the work that is required from all different sectors and actors to reduce disaster losses, namely the Hyogo Framework for Action (HFA). It was developed and agreed on with the many partners needed to reduce disaster risk – governments, international agencies, disaster experts and others – bringing them into a common system of coordination. The HFA outlines five priorities for action, and offers guiding principles and practical means for achieving disaster resilience. Its goal is to substantially reduce disaster losses by 2015 by building up the resilience of nations and communities to disasters.

#### Priority Action 1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.

Countries that develop policy, legislative and institutional frameworks for disaster risk reduction, and are able to develop and track progress through specific and measurable indicators, have greater capacity to manage risks and achieve widespread consensus on engagement in and compliance with disaster risk reduction measures across all sectors of society.

#### Priority Action 2: Identify, assess and monitor disaster risks and enhance early warning.

The starting point for reducing disaster risk and promoting a culture of disaster resilience lies in knowledge of the hazards and the physical, social, economic and environmental vulnerabilities to disasters that most societies face, and of the ways in which hazards and vulnerabilities are changing in the short and long term, followed by action taken on the basis of that knowledge.

#### Priority Action 3: Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

Disasters can be substantially reduced if people are well informed and motivated towards a culture of disaster prevention and resilience, which in turn requires the collection, compilation and dissemination of relevant knowledge and information on hazards, vulnerabilities and capacities.

#### Priority Action 4: Reduce the underlying risk factors.

Disaster risks related to changing social, economic, and environmental conditions and land use, and the impact of hazards associated with geological events, weather, water, climate variability and climate change, are addressed in sector development planning and programs as well as in post-disaster situations.

#### Priority Action 5: Strengthen disaster preparedness for effective response at all levels.

At times of disaster, impacts and losses can be substantially reduced if authorities, individuals and communities in hazard-prone areas are well prepared and ready to act and are equipped with the knowledge and capacities for effective disaster management.

Taiwan participates in the regional Asia-Pacific Economic Cooperation (APEC) forum under the name "Chinese Taipei". Given the volatile occurrence of natural disasters in the region, Chinese Taipei has been keen to initiate meaningful projects in APEC. Over the past few years, Chinese Taipei has put forward several projects relevant to risk management in disaster, including Emergency Preparedness, the APEC Center for Typhoon, the APEC SME Crisis Management Center, Cloud Computing for Value Chains, and the APEC Food Emergency Response Mechanism. We will continue to collaborate with regional like-minded partners and undertake risk management for disasters. At the same time, we aspire to be part of other important international organizations that aim to upgrade human security around the world.

## Conclusion

Risk management for disasters requires a comprehensive integrated approach. The scope of disasters encompasses natural disasters and made-made catastrophes. The impact dimension is multiple, including political, economic, legal, social, and cultural factors. The key players are diverse, including governments, NGOs, businesses, and the international community.

As the case of Typhoon Morakot has illustrated, there is a need for collaborative risk management that includes risk assessment as well as risk control and disaster resilience. The UNISDR's HFA embodies the guiding principles that we should strive to achieve by 2015. In the meantime, experience sharing and capacity building will be necessary for us to survive disasters and safeguard human security. 

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