

UNISDR Scientific and Technical Advisory Group Case Studies - 2015 Improved Evacuation Procedures Save Lives in Taiwan from Severe Flood and Debris Flow

The problem

On 8 August 2009, Typhoon Morakot brought record-breaking rainfalls to the southern Taiwan causing large-scale floods, landslides, and debris flows (Figure 1). Typhoon Morakot resulted in 699 deaths or missing persons and an estimated economic loss exceeding \$6.7 billion USD¹. The indigenous tribes, living in the hardest hit mountainous areas, suffered from loss of and damage to traditional homes and heavy casualties. As the Earth becomes warmer and moister as a result of human-induced climate change, more intense rainfall, severe typhoons, and frequent extreme weather events are inevitable problems² that challenge the Nation's disaster risk reduction capabilities.

The science

Forensic Investigations (FORIN) methodology developed by the Integrated Research on Disaster Risk (IRDR) of the International Council for Science (ICSU) aims to investigate the root causes of the disaster events that would potentially support future evidence-based decision-making in disaster risk reduction³. A study based on the FORIN methodology was conducted to compare two indigenous villages (i.e., Nansalu and Daniao) that were adversely impacted by floods and debris flow during the Typhoon Morakot⁴. The study reviewed available government data and academic papers and reports as well as conducted in-depth interviews with disaster victims and village leaders. Both villages had similar accumulated rainfall and were adjacent to potential debris flow torrent, but the number of casualties varied greatly (Daniao Village did not have any casualties, while Nansalu Village had 35 casualties.)

The case study showed that although the two villages had similar environmental characteristics and received similar rainfall amounts, there was a significant difference in their pre-disaster preparedness (e.g., education and drills) and emergency response including evacuation before the disaster. The Township Office and the leader of Nansalu Village did not implement any response measures. Even worse, the village leader was nowhere to be found and the villagers were left to respond on their own⁴. In contrast, the head of the Daniao Village and the Township Office actively responded to emergency situations and decisively evacuated residents within the potentially hazardous areas. Furthermore, shelter operations of the two villages also had shown significant differences. The shelter of Nansalu Village was poorly operated with insufficient supply of food, water, and medication. In contrast, Daniao Village and the Township Office properly accommodated evacuees and handled necessary supplies for operation. These two cases clearly pinpointed that involvement of social factors related to

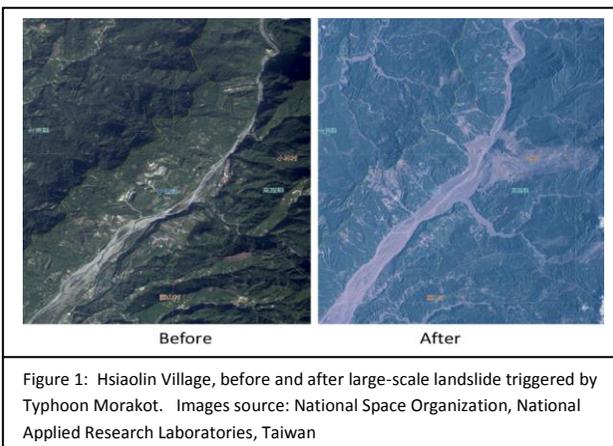


Figure 1: Hsiaolin Village, before and after large-scale landslide triggered by Typhoon Morakot. Images source: National Space Organization, National Applied Research Laboratories, Taiwan

preparedness and emergency response are essential elements to lower the adverse impacts and disaster risk brought by natural disasters.

The application to policy and practice
Typhoon Morakot triggered further improvements on disaster management and emergency response in Taiwan. Central and local governments, communities, NGOs, and citizens have raised awareness of high disaster risk after witnessing catastrophic aftermaths brought by Typhoon Morakot. The Taiwan government has issued a series of remedial measures including law amendments, restructuring framework of disaster management, publicizing the hazard maps of flood, landslide, and debris flow. These maps receive routine annual updates to document the threshold values of flood depths and accumulated rainfall to induce debris flow, locations of shelters, orphanages, nursing homes, and evacuation routes. The inter-and-intra coordination and risk communication among government agencies are enhanced. By introducing science and technology into practical emergency operations, the emergency responders are able to make decisions on early evacuation by scientific evidences (Figure 2). The information provided to governments includes real-time monitoring data, numerical simulation of hazard events, and threshold values of debris flows or floods based on historical events. As a result, the officials of Emergency Operation Centers at different levels of government could work on “common operating pictures” that result in improving “the timing of evacuation” during emergencies.

Did it make a difference?

In 2010, a year after Typhoon Morakot, Lai-Yi village, an indigenous community located in a mountainous area that had been hit by debris flow during Typhoon Morakot, was under threat of Typhoon Fanapi as it was approaching southern Taiwan. In the afternoon of 18 September 2010, the Central Weather Bureau formally issued the land warning that meant Typhoon Fanapi could make a landfall within the next 24 to 36 hours. The same day, the Central Emergency Operation Center made a decision based on “Scientific Prediction” to carry out “Early Evacuation” in Lai-Yi village at 3:00 pm. With assistance of the army, all dwellers were safely evacuated to a shelter. Thirty two hours later, debris flows engulfed the village and buried 50 houses. If it had not been for the early evaluation, the debris flow would have caused severe casualties. The experience of Lai-Yi village gives a strong confidence to policy-makers that Scientific Prediction, Early Evacuation and In-time Operation are the key elements to reduce natural disaster risks.

References

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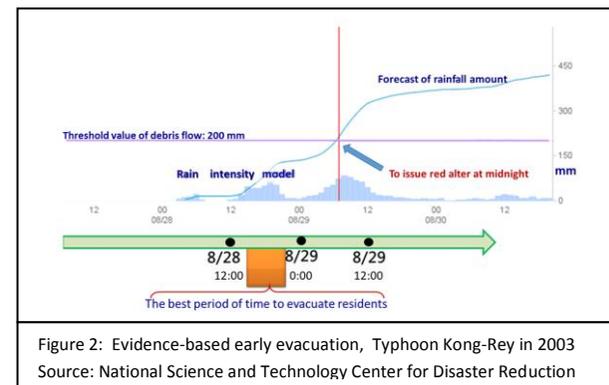


Figure 2: Evidence-based early evacuation, Typhoon Kong-Rey in 2003
Source: National Science and Technology Center for Disaster Reduction