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The Evaluation of Debris Flow Risk Management Effectiveness in Taiwan - Using F-N Curve as a Tool

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From the past experiences in Taiwan, debris flow warning and evacuation acted as one of the most effectiveness risk avoidance options to reduce risk. Although during Typhoon Morakot of 2009, more than 600 were killed in landslides, floods or debris flows, it is believed the casualties would be higher if no evacuation were conducted during the period. But the effectiveness of debris flow risk management could not be easily measured; this study aims to evaluate the societal risk of debris flow hazard in Taiwan with F-N curve as a tool.

Taiwan is located on an orogenic belts in the region between the Philippine Sea plate and the Eurasian plate. Respect to the steeper topography, weak geological conditions and swift currents. After Chi-Chi earthquake of 1999, landslides and debris flows occurred frequently, the Soil and Water Conservation Bureau (SWCB) of Taiwan, in charge of the management of debris flow hazards, devoted great resources on debris flow hazard managements since 2000. Recently the concept of risk management was introduced to better manage debris flow hazard.

First define the upper and lower limit of F-N graph with average accidental death rate of Taiwan (around 4.3E-04, taking 1.0E-04 as standard) and slope of 1, thus divided the F-N graph into three zones: Unacceptable, ALARP (As Low As Reasonable Practicable) and Acceptable. Then from the data base of SWCB and other records, the casualties of each debris flow event between 1990 and 2010 was gathered, totaling 39 events with 226 causalities, with the most in 2009 with 41 causalities. Considering the total number of enlisted debris flow creeks numbering at 1552 and over a duration of 21 years (1990-2010), the frequency of each event could be calculated and mapped, thus an F-N curve could be plotted.

The location of the curve indicated that Taiwan was exposed in a high debris flow risk environment; especially when comparing the F-N curve of 1990-2008 (exclude Typhoon Morakot) with 1990-2009 (include Typhoon Morakot), it clearly shows the event raised the F-N curve a lot.

For showing the effectiveness of the evacuation, by adding the possible casualties into the historical casualties list, we could observe that if no evacuation were taken during Typhoon Morakot (2009) and Typhoon Fanapi (2010), how the F-N curve would be. The numbers of possible casualties were taken from the official record about preventing casualties in Typhoon Morakot and Typhoon Fanapi, totaling 14 events which prevented 868 more casualties.

The effectiveness of evacuation could be clearly shown on the curve, the curve would raised dramatically if no evacuations were conducted during these 2 typhoons, stating that F-N curve might be a good tool to evaluate the effectiveness of debris flow risk management.

Key Words: Debris flow, Risk management, F-N curve