RISK ASSESSMENT OF DEBRIS FLOW DISASTER IN SONGHE COMMUNITY IN TAIWAN

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Concept of the risk management has been popular on the field of natural hazard mitigation in the world. In order to understand the distribution of risk around the potential debris flow torrents, this study established a model for assessing risk of debris flow disaster. The definition of risk herein is based on the concept from the International Strategy Disaster Reduction (ISDR). Risk is an interaction of the hazard, vulnerability and capacity, which indicates a close connection with humans' activities. Therefore, risk could be expressed by the function of hazard, vulnerability and capacity. According to the foregoing function, the risk level of this study was calculated by multiplying hazard grade, the value of vulnerability and the normalizing index of capacity (i.e., the disaster-stricken degree).

METHODOLOGY OF HAZARD ASSESSMENT

We used FLO-2D software to simulate the submerged areas under different rainfall events with 10 and 150 years return period respectively. By dividing the height of deposit into two classes, we can get two levels of intensity for debris flow. Resulting from combination of different levels of intensity and probability, the areas which are endangered by debris flow could be classified into two hazard rating zones, i.e. red and yellow zones. The different groups of elements at risk have distinct damage factors, which represent the average ratio of actual loss to the value of an element, in the two zones. The hazard grade of each element equals the corresponding damage factor.

METHODOLOGY OF VULNERABILITY ASSESSMENT

We used land-use layer covering the layer of submerged areas to get the distribution of vulnerability. The original land-use modes were reclassified into six groups, i.e. house, farming land, forestry land, road, bridge and no-direct-loss. The average value of each kind of land and the average cost of each building are based on the prices announced by the local authorities. For each kind of elements, the value of vulnerability means the price just mentioned.

METHODOLOGY OF CAPACITY ASSESSMENT

The Analytic Hierarchy Process (AHP) was used to establish the framework and evaluate the resilient capacity of the community, which includes the ability of residents to resist natural hazard and the resources of the community for preventing from disasters. The former was

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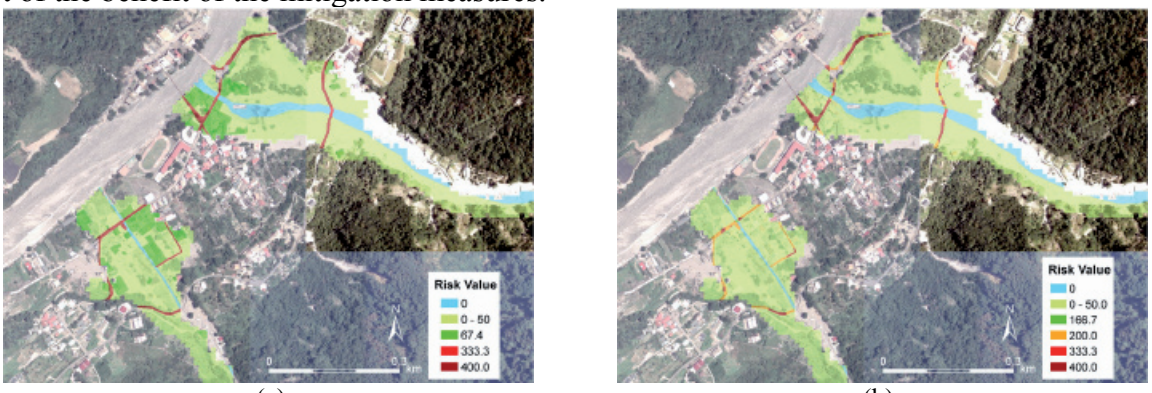
evaluated by questionnaires to residents living in the range of potential debris flow torrents, and the latter was evaluated by check lists to the village heads. Questionnaires to professionals were used to calculate the weighting of each item in the AHP framework. Therefore, the total score of capacity could be evaluated with the weightings and then be transformed into a normalizing index (i.e., the disaster-stricken degree).

THE AVERAGE RISK MAP AND MAXIMUM RISK MAP

By multiplying three terms mentioned above, the risk level could be computed. Then the risk map could be obtained in the absence or installation of mitigation measures. The value of element multiplied by the corresponding damage factor stands for the average losses under the same sized rainfall events with 150 years return period. It is also important to evaluate the possible maximum losses, besides of considering the average losses, so that all the damage factors would equal one. We used the term "average risk" and "maximum risk" to refer to the average losses and to the maximum losses respectively. Therefore, the risk map could be divided into two types, average risk map and maximum risk map.

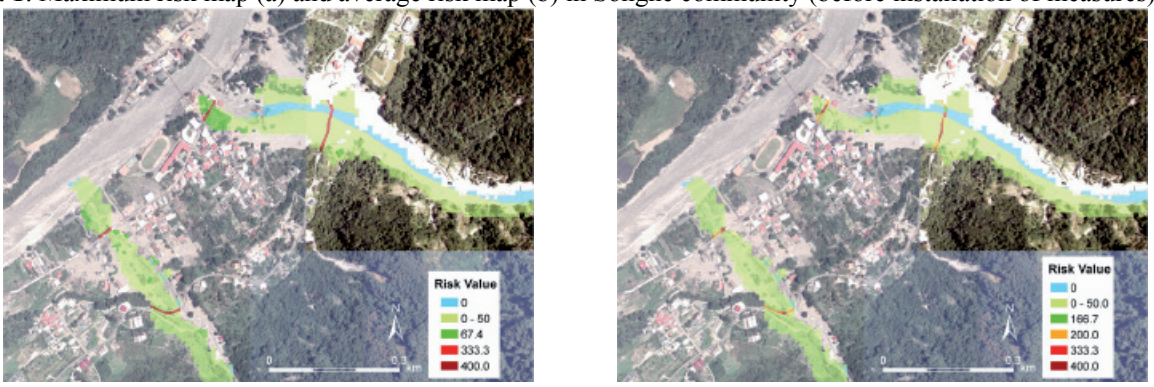
CASE STUDY

Take Songhe community for example. Under the rainfall events with 150 years return period, the total maximum risk value and total average risk value equal around US$ 4.4 million and 1.4 million, respectively, in the absence of mitigation measures. After installation of mitigation measures, the total maximum risk value and total average risk value become around US$ 1.3 million and 0.4 million, respectively. The difference in the total risk value could be treated as a part of the benefit of the mitigation measures.



(a) (b)

Fig. 1: Maximum risk map (a) and average risk map (b) in Songhe community (before installation of measures)



(a) (b)

Fig. 2: Maximum risk map (a) and average risk map (b) in Songhe community (after installation of measures)

Keywords: Risk Assessment, Debris Flow, Capacity, Vulnerability.