P48

A study on Warning and Evacuation System for Sediment Disaster in the Tseng-wen Reservoir Watershed

○Chen Yu-Chin, Masaharu FUJITA

1. INTRODUCTION

An optimal early warning system for adverse event is the most important thing of disaster risk reduction. The warning systems are widely used as a means of evacuating inhabitants to prevent sediment disasters. However, recent landslide events demonstrate the need to improve landslide forecasting and early warning capabilities in order to reduce related risks and protect human lives. In landslide susceptibility assessment, an important issue is the correct identification of significant contributing factors, which leads to the improvement of predictions regarding this type of geomorphologic processes. In the scientific literature, different weightings are assigned to these factors, but contain large variations. This study aims to identify the spatial variability and range of variation for the coefficients of landslide predictors in different conditions.

2. Materials and methods

Typhoon Morakot struck Taiwan on 8 August 2009. According to the Central Weather Bureau of Taiwan, it dumped more than 25,00mm of rain over three days. It brought a record-breaking rain over Taiwan and caused catastrophic damages due its characteristic of long duration and high intensity.

Multi-temporal satellite images and geo-spatial data are used to build landslide susceptibility map for the post-disaster in the Tseng-wen reservoir watershed in this research. There were 1,246 landslides triggered by Typhoon Morakot and observed slope failures were shallow landslides on soil mantled slopes with depth less than 2m. Fig.1 shows their spatial distributions.

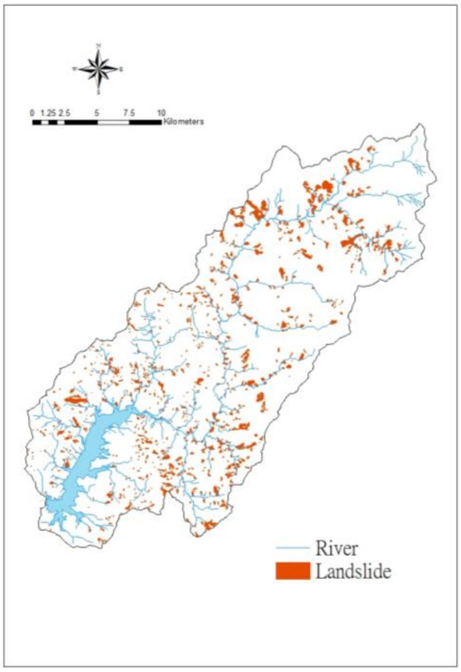

Fig1. Landslide map of the Tseng-wen reservoir watershed

Elevation, slope, aspect, NDVI (normalized differential vegetation index), relief, roughness, distance to river, and distance to road are the considered factors for estimating landslide susceptibility. Maximum hourly rainfall and total rainfall, accompanied with typhoon event, are selected as the trigger factors of landslide events. Logistic regression analysis adopted as the statistical method to model landslide susceptibility. The assessed susceptibility is represented in 4 levels which are high, high-intermediate, intermediate, and low level, respectively. Landslide spatial distribution can be depicted as a landslide susceptibility map with respect to each considered influence factors for a specified susceptible level.

3.Results and Discussion

3.1. Landslide susceptibility map

The logistic regression analysis provides the constant and the co-efficient of the independent predictor variables. GIS provides the database and processing platform for the slope stability assessment, and is used to generate the landslide susceptibility map from the logistic regression model. More the probability of the cell lies closer to one; more likely are the chances of slope failure. The cumulative percentage of probability estimates are plotted against cumulative percentage of study area (Matthew et al. 2009). The probability value of slope failure is divided into four classes – low, intermediate, high-intermediate and high to produce the landslide susceptibility map. The landslide susceptibility map generated for the study area using logistic regression model is shown in Fig2.

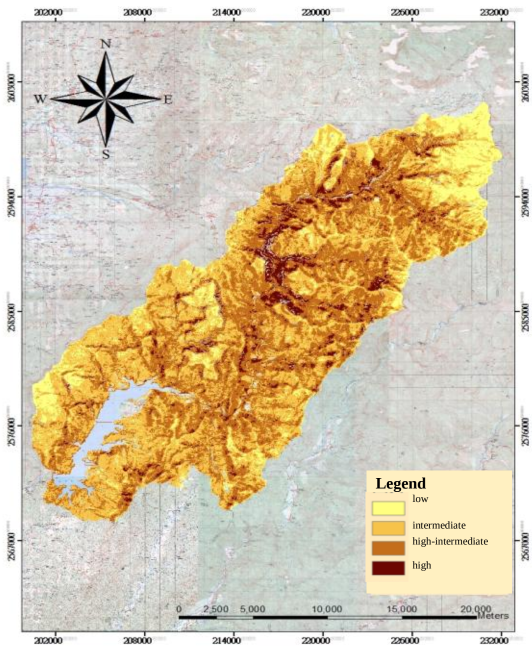

Fig.2 Landslide susceptibility map of Tseng-wen reservoir watershed, using logistic regression model

3.2Verification

The landslide susceptibility model had an overall Furthermore, the AUC value of the success rate curve was 0.821, which indicated that all landslides occurred in areas with a relatively high susceptibility (Figure 3). The separation of the landslide group from the non-landslide group in the frequency distribution plot revealed that the model's parameters possessed the ability to distinguish landslides from non-landslides. This result indicated that this model also retained fairly good accuracy under relatively light rainfall conditions, such as the rainfall during Typhoon Morakot.

Table 1 The table of classification error matrix for Typhoon Morakot

		Observed data		Total grid
		Landslide grid	Non-landslide grid	
Prediction results	Landslide grid	39,992	15,839	55,831
	Non-landslide grid	12,249	43,132	55,831
Landslide group accuracy		Non-landslide group accuracy	Overall accuracy rate	
76.55%		73.14%	74.74%	

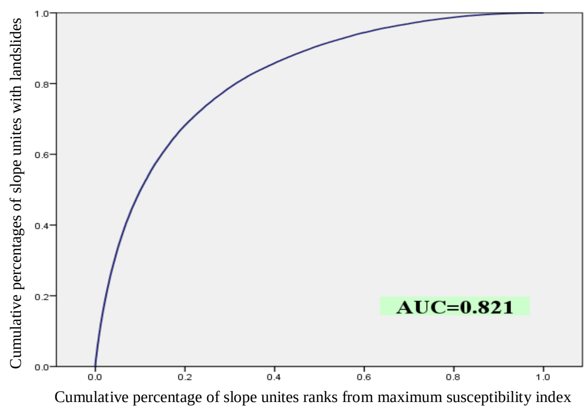

Fig.3. Success rate curve for the established model

4.Conclusion

There is one element to early warning system: the risk information and assessment. Scenario-based risks can be estimated using scenario-based landslide probability models, but few landslide probability models existed for Taiwan. Therefore, this is a quick and cost effective tool that is suitable on regional scale for planer to make a warning and evacuation decision for sediment.