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The comparison of landslide ratio-based and general logistic regression landslide susceptibility models in the Chishan watershed after 2009 Typhoon Morakot

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The research built the original logistic regression landslide susceptibility model (abbreviated as or-LRLSM) and landslide ratio-based ogistic regression landslide susceptibility model (abbreviated as lr-LRLSM), compared the performance and explained the error source of two models. The research assumes that the performance of the logistic regression model can be better if the distribution of landslide ratio and weighted value of each variable is similar. Landslide ratio is the ratio of landslide area to total area in the specific area and an useful index to evaluate the seriousness of landslide disaster in Taiwan. The research adopted the landside inventory induced by 2009 Typhoon Morakot in the Chishan watershed, which was the most serious disaster event in the last decade, in Taiwan. The research adopted the 20 m grid as the basic unit in building the LRLSM, and six variables, including elevation, slope, aspect, geological formation, accumulated rainfall, and bank erosion, were included in the two models. The six variables were divided as continuous variables, including elevation, slope, and accumulated rainfall, and categorical variables, including aspect, geological formation and bank erosion in building the or-LRLSM, while all variables, which were classified based on landslide ratio, were categorical variables in building the lr-LRLSM. Because the count of whole basic unit in the Chishan watershed was too much to calculate by using commercial software, the research took random sampling instead of the whole basic units. The research adopted equal proportions of landslide unit and not landslide unit in logistic regression analysis. The research took 10 times random sampling and selected the group with the best Cox & Snell R2 value and Nagelkerker R2 value as the database for the following analysis.

Based on the best result from 10 random sampling groups, the or-LRLSM (lr-LRLSM) is significant at the 1% level with Cox & Snell R2 = 0.190 (0.196) and Nagelkerke R2 = 0.253 (0.260). The unit with the landslide susceptibility value > 0.5 ($\leqq$ 0.5) will be classified as a predicted landslide unit (not landslide unit). The AUC, i.e. the area under the relative operating characteristic curve, of or-LRLSM in the Chishan watershed is 0.72, while that of lr-LRLSM is 0.77. Furthermore, the average correct ratio of lr-LRLSM (73.3%) is better than that of or-LRLSM (68.3%). The research analyzed in detail the error sources from the two models. In continuous variables, using the landslide ratio-based classification in building the lr-LRLSM can let the distribution of weighted value more similar to distribution of landslide ratio in the range of continuous variable than that in building the or-LRLSM. In categorical variables, the meaning of using the landslide ratio-based classification in building the lr-LRLSM is to gather the parameters with approximate landslide ratio together. The mean correct ratio in continuous variables (categorical variables) by using the lr-LRLSM is better than that in or-LRLSM by 0.6 $\sim$ 2.6% (1.7% $\sim$ 6.0%). Building the landslide susceptibility model by using landslide ratio-based classification is practical and of better performance than that by using the original logistic regression.