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Landslide Susceptibility Analysis Based on Three Different Triggering Events and Result Comparison

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ABSTRACT

This study utilizes a geographic information system and a statistical method to integrate geomorphic, geologic and other relevant data, to analyze the basic properties contributing to each landslide potential factor and the triggering factor. The statistical method was used to clarify the correlation of each factor to actual landslides, and to realize the independency of those factors. Several important factors were then selected for further analysis. Rating was done for each selected factor, and the weighting between the factors was determined by using discriminant analysis. Landslide susceptibility analyses were actually performed at a test site in Central Taiwan, at Kuohsing, and susceptibility maps for the test site were made.

Three different triggering events were adopted in the study including two typhoon events and the Chi-Chi earthquake event. Landslides induced by each event were extracted from SPOT imageries and were used in individual analysis. Three landslide susceptibility maps with different trigger factors were made and then were checked against actual landslides associated with the event, so that the probability of landslide occurrence within each susceptibility interval was revealed. As well, three landslide susceptibility maps without trigger factors were also made and compared to each other. They showed similar patterns and values. They may be utilized to prepare a basic landslide susceptibility map of a region which may be used to predict landslide probability due to a triggering event of similar magnitude in this or neighboring regions.

KEYWORD: landslide, landslide susceptibility, multivariate analysis, discriminant analysis

INTRODUCTION

Regional landslide evaluation and mapping have been pursued by many research institutions and government agencies for a long time. Many different methods and techniques for assessing landslide hazards have been proposed and/or tested. In the early stages, semi-quantitative ratings and the expert weighting method were used (e.g., Carrara and Merenda, 1974; Meneroud and Calvino, 1976; Kienholz, 1977; Malgot and Mahr, 1979; Chang, 1980; Ives and Messerli, 1981; Varnes, 1984; Chen et al., 1985). In the past couple of decades, quantitative approaches using multivariate statistical method have been the trend for the landslide susceptibility studies (e.g., Neuland, 1976; Kobashi and Suzuki, 1988; Gao and Lo, 1991; Koukis, 1991; Carrara et al., 1992; Hearn, l995; Lee and Min, 2001; Dai and Lee, 2003). Quantitative approaches using the infinite slope analysis method and/or the Newmark displacement method have also been an active branch of landslide susceptibility studies, especially when landslides triggered by earthquakes or heavy rainfall are considered (e.g., Keefer, 1984, 2000; Pearce et al., 1985; Harp et al., 1995; Fukuoka, et al., 1997; Jibson, 1998; Allen, et al., 1998; Polemic and Sdao, 1999; and Jibson et al., 2000). The application of neural networks to landslide susceptibility studies has also been recently attempted by some researchers (Lin, 2003, Lee et al., 2004).

Landslides are a recurrent problem throughout the hilly and mountainous terrain of Taiwan, and cause extensive damage to property and even loss of life. This type of hazard has been particularly great in recent years especially after typhoon Herb (1996),