

THESIS INFORMATION

Title: STUDYING EFFECTS OF RAINFALL ON STABILITY OF SOIL SLOPES AND LANDSLIDE HAZARD MAPPING IN KHANH VINH DISTRICT, KHANH HOA PROVINCE

Major: Geology engineering

Major code: 62.52.05.01

PhD student: Nguyen Thanh Danh

**Scientific advisors: Assoc Prof. PhD. Dau Van Ngo
 PhD. Ta Quoc Dung**

University: University of Technology, VNU-HCMC

The overarching goal of this thesis is to study landslide by rain and methods of landslide hazard maps.

The theories of two-dimensional permeability and the extended Mohr-Coulomb failure criterion for unsaturated soil were used to study the effects of rainwater on slope stability. Rainfall is supposed as a main trigger caused failure of the potential sliding slopes. Rainwater into the slope due to infiltration caused an increase in moisture content and negative pore water pressure; a decrease in matric suction and in shear strength on the failure surface. Therefore, slopes are reduced stability and can be failed.

A numerical model of analysis coupled seepage-stability used to simulate the seepage and slope stability under conditions of specific environment such as soil permeability, rainfall intensity, water table location and slope geometry in the study area. Finite element method used in seepage analysis, results of change of negative pore water pressure then used in the slope stability analysis to calculate the safety factor by the application of the limit equilibrium Morgenstern and Price slope stability method. The relationships between safety factor and rainfall intensity, soil permeability, angle slope, high slope were identified.

Applying statistical probability approaches, including frequency ratio (FR), statistical index (SI), weights of evidence (WoE) and logistic regression (LR) methods integrated

with GIS analytical tools to produce landslide hazard maps in Khanh Vinh district, Khanh Hoa province.

A landslide inventory map identifies the definite and probable areas of existing landslides (231 landslides), and is the most basic requirement for a landslide hazard assessment. The product of a landslide inventory map is a spatial distribution of landslides as points or to scale. Landslides-related factors chosen primarily upon available data and experiences of experts to the study area. In this study, there are eleven landslide-related factors were chosen: elevation, slope angle, slope direction, topographical wetness index, slope shape, lithology, distance from road, distance from drainage, distance from fault, normalized difference vegetation index and maximum precipitation in year. The weight maps of the influence factors were established based on the spatial relationship between the influencing factors and the distribution of existing landslides by FR, SI, WoE and LR methods.

Landslide hazard maps were established upon the combination of the weight maps of the influence factors. The landslide hazard maps were divided into different landslide hazard zones. In this study, there are 5 levels of landslide hazard zone: very low, low, moderate, high and very high.

Using the success rate curve and prediction rate curve assess the fit and accuracy of FR, SI, WoE and LR approaches. The value of the area under these rate curves (AUC) was used as a quantitative parameter to validate the method. The results show that these approaches has the goodness of fit and the high accuracy (AUC = 0.8 ~ 0.9).

WoE method is the best forecasting method for highest accuracy, followed by FR, SI and LR. FR and SI methods have slightly lower accuracy but the calculation is simple. Therefore, FR and SI methods should be considered for application in landslide hazard prediction.

Scientific advisors

PhD student

Assoc Prof. PhD. Dau Van Ngo

PhD. Ta Quoc Dung

Nguyễn Thanh Danh