LANDSLIDE SUSCEPTIBILITY MAPPING USING TRIGRS FOR ARE-DI VILLAGE, CHIANG RAI PROVINCE, THAILAND

A. PARAPAN[1], K.C. CHAO[2]

[1] Master's degree student, Asian Institute of Technology, Pathumthani, Thailand,
[2] Associate Professor, Asian Institute of Technology, Pathumthani, Thailand,
Correspond to A. PARAPAN (st122112@ait.asia)

Keywords: *Landslide susceptibility mapping, TRIGRS, factor of safety*

1. INTRODUCTION

Severe rainfall often causes rainfall-induced slope failures and can lead to severe effects such as loss of life and property. In September 2020, the amount of rain that fell continuously caused flash floods and landslides at the Are Di Village, damaging 24 houses. Therefore, it is crucial to understand the landslide mechanism in the area and establish the landslide susceptibility map to minimize the risk that may occur in the future. This research uses a geotechnical model to focus on rainfall-induced landslide susceptibility analysis by using a Fortran program named Transient Rainfall Infiltration and Grid-Based Regional Slope-Stability Analysis (TRIGRS). This paper presents the preliminary results of our landslide mapping analysis at the study area.

2. ANALYSIS METHODS

TRIGRS is designed for modeling the timing and distribution of shallow rainfall-induced landslides. The input parameters used for the study are shown in Table 1. The engineering soil properties obtained from Geotechnical Engineering Research and Development Center (GERD) were used to run the model. The monitoring rainfall data of 8 September 2022 at the Suntisuk village weather station near the study area was used to simulate the model.

Table 1. Input parameters for the TRIGRS model

Parameters	Input Values
Soil cohesion (N/m^2)	15,691
Soil friction angle $(Degrees)$	30.76
Unit weight of soil (N/m^3)	18,437
Saturated hydraulic conductivity (m/s)	1.4e-05
Residual volumetric water content	9.8e-02
Saturated volumetric water content	0.42
Alpha parameter $(1/m)$	0.17
Hydraulic diffusivity (m^2/s)	3.27e-04
Steady infiltration rate (m/s)	0
Soil thickness (m)	3.0
Groundwater table below the G.S. (m)	3.0

3. RESULTS OF ANALYSIS

The relationship between precipitation and landslide instability probability at the site was analyzed, and the analysis results are shown in Figure 1. Figure 1 indicates that shallow landslide could be triggered as an accumulative rainfall increases to be more than 100 mm at the study area. The relationship between the instability proportion and accumulative rainfall can be represented by the following equation: y = 8E-06x^3 - 0.0013x^2 + 0.0602x - 0.1892, where: y is the instability proportion and x is the accumulative rainfall. Figure 2 shows the spatial distribution of safety factors after the rainstorm on 8 September 2022. The areas with the calculated factor of safety less than unity are shown in red in Figure 2. For comparison purposes, the scarp areas mapped at the site are shown in open solid lines on Figure 2. It is seen that the predicted potential landslide areas are more than the observed scarp areas. Therefore, the input parameters shown in Table 1 will be calibrated until the predicted potential landslide areas agree well with the observed scarp areas.

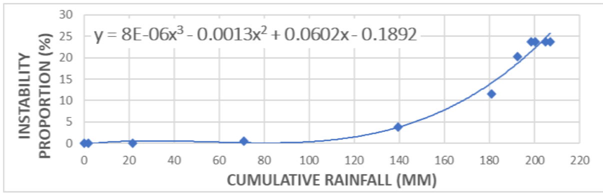

Figure 1. The relationship between the instability proportion and the cumulative rainfall in the study area

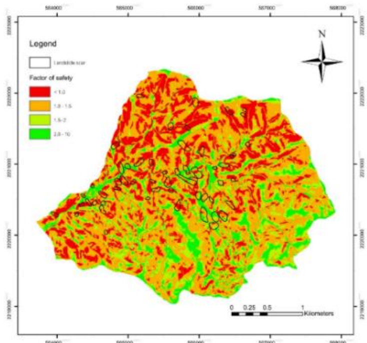

Figure 2. Spatial distribution of safety factors right after the rainstorm on 8 September 2020.

4. CONCLUSIONS

The TRIGRS could be used for modeling the timing and distribution of shallow, rainfall-induced landslides. However, the model is sensitive to the initial condition. The input parameters should be selected with caution.

REFERENCE

[1] R.L. Baum, W.Z. Savage, J.W. Godt, TRIGRS - A Fortran Program for transient Rainfall Infiltration and Grid-Based Regional Slope-Stability analysis, Version 2.0. USGS, Colorado, 2008.