Landslide Susceptibility Model Using Soil Mechanical Properties at Ban Mae Na, Mae Na Toeng Subdistrict, Pai District, Mae Hong Son Province

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ABSTRACT

Landslides are natural disasters that impact lives, property, and infrastructure, particularly in steeply sloped areas such as Ban Mae Na, Mae Na Toeng Subdistrict, Pai District, Mae Hong Son Province. This study aims to develop a landslide susceptibility model based on the mechanical properties of soil. 15 soil samples were collected across an area of 50 square kilometers, and various soil property tests were conducted. The results indicate that more stable soils can withstand shear forces better, whereas landslide-prone soils exhibit lower cohesion and internal friction angles. The particle size analysis shows that areas with higher gravel and sand content have greater stability, while those with higher clay and silt content are more susceptible to landslides, especially under high moisture conditions. Tests on soil physical properties reveal that the Plastic Limit (PL) and Liquid Limit (LL) are in the moderate to high range, indicating that the soil may lose strength and transition into a liquid state when water accumulates. The Landslide Susceptibility Index (LSI) analysis using Geographic Information Systems (GIS) shows that areas with high clay content and low internal friction angles are the most prone to landslides, whereas areas with higher gravel and sand content exhibit greater stability. The model's accuracy assessment using the Area Under Curve (AUC) confirms its high predictive capability. This model can serve as a valuable tool for risk assessment and landslide prevention planning in the future.

STUDY AREA

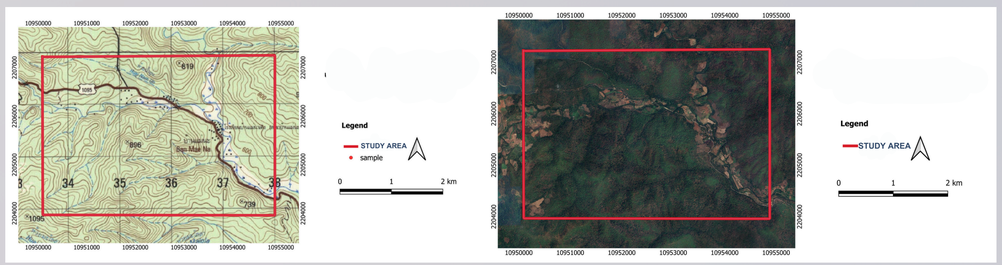

Fig.1. Topographic Map at Ban Mae Na, Mae Na Toeng Subdistrict, , Pai District, Mae Hong Son Province

Fig.2. Satellite image from Google Earth Pro

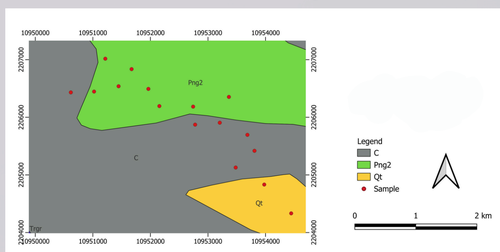

Fig.3. geological map of the study area.

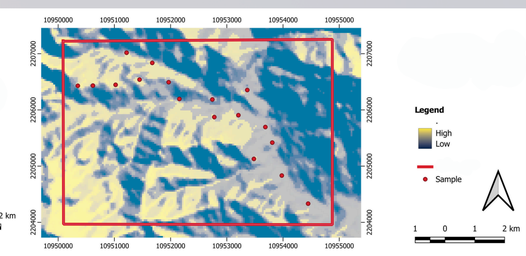

Fig.4. Elevation map of the study area

OBJECTIVES

- To study the soil's mechanical properties, and to classify the soil types based on engineering classification.
- To create a distribution map of the soil properties in the study area.
- To create a landslide susceptibility model mapin the study area, using Geographic Information System (GIS).

CONCLUSION

This study successfully developed a landslide susceptibility model based on soil mechanical properties in Ban Mae Na, Mae Na Toeng Subdistrict, Pai District, Mae Hong Son Province. The findings highlight the critical role of soil composition, cohesion, and internal friction angle in determining slope stability. Soils with higher gravel and sand content exhibit greater stability, whereas those with higher clay and silt content are more vulnerable to landslides, particularly in high-moisture conditions. The plasticity tests confirm that soil in the study area may lose strength and transition into a liquid state when water accumulates, further increasing landslide susceptibility.

However, the analysis is not yet complete. The Frequency Ratio (FR) analysis and landslide susceptibility modeling are still in progress. These additional analyses will provide further insights into the relationship between each factor and landslide occurrence, as well as improve the accuracy of the susceptibility model. Once completed, the results will be valuable for land-use planning and risk mitigation in the study area.

REFERENCES

Saenton, S., (2021). *Engineering Geology Course Materials. Chiang Mai*: Department of Geology, Faculty of Science, Chiang Mai University.

Department of Mineral Resources, Ministry of Natural Resources and Environment (2007). *Geological Map of Mae Hong Son Province.* Department of Mineral Resources.

METHODOLOGY

- **Soil Sampling**

  Soil samples were collected from the area by selecting 15 locations where residual soil. The soil samples were analyzed in the laboratory for shear strength, particle size distribution, and Atterberg's limits.

- **Mechanical Testing**

  Direct shear tests, sieve analysis, and water content tests were conducted on the soil to assess its properties.

- **Landslide Susceptibility Model**

  Using GIS, a susceptibility model for landslides was developed by analyzing factors such as slope, geology, and soil properties. The study utilized Frequency Ratio (FR) to evaluate the landslide susceptibility index (LSI).

RESULTS

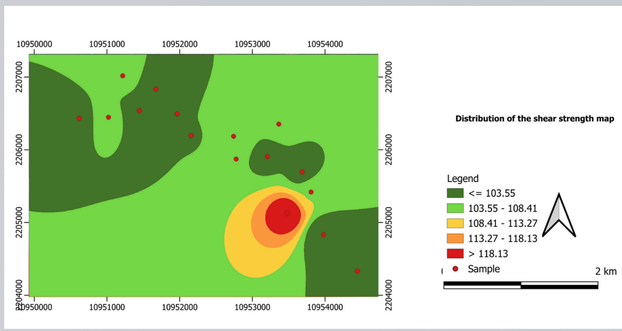

Fig.5. Distribution of the shear strength

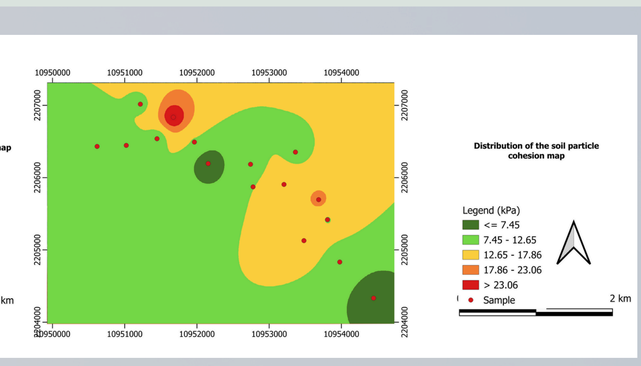

Fig.6. Distribution of soil particle cohesion

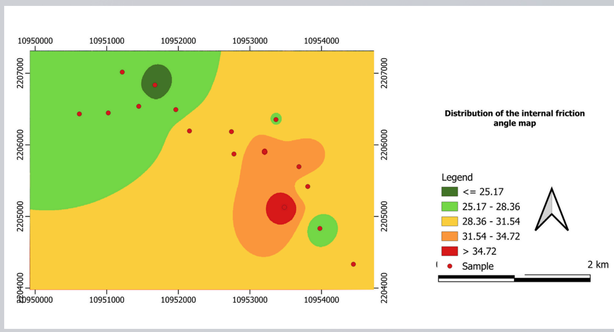

Fig.7. Distribution of internal friction angle

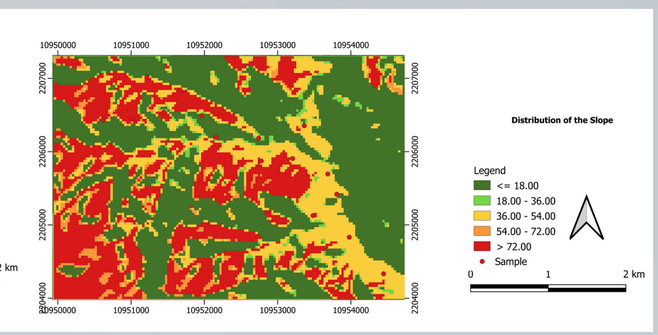

Fig.8. Distribution of the Slope

The mechanical properties of soil were tested and used to create a distribution map using the Geographic Information System (GIS), applying the Inverse Distance Weighting (IDW) method. The data utilized in the mapping process included:

- Shear Strength Map – The highest shear strength values were found in the southeastern part of the area, with an overall average showing higher shear strength in the south compared to the north.
- Angle of Internal Friction Map – The highest values were also located in the southeastern region, while the average showed higher internal friction in the southeast than in the northwest.
- Cohesion Map – The average cohesion values were higher in the north compared to the west and south.
- Slope Map – The southwestern and central areas exhibited steeper slopes than other parts of the study area.
- Based on the Unified Soil Classification System (USCS), the soil types found in the study area include SW (Well-Graded Sand), SC (Clayey Sand), SM (Silty Sand), and SP (Poorly Graded Sand).