ASSESSMENT LANDSLIDES HAZARD MAP IN THAILAND USING EXTREME DAILY RAINFALL

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1. INTRODUCTION

Landslides can result in enormous damage to people and huge economic losses in mountainous regions. Landslides often occur in Thailand as a consequence of heavy rainfall especially in the northern and southern regions of Thailand. The land was eroded and conveyed by a huge water flow from the top of the high mountain and then slide down to low-lying land, burying located at the foot of that mountain. Therefore, assessment landslide and prediction is one of important challenges, not only for Thailand but also around the world. There are several research for assessed probability of landslide. In Thailand, Yumuang (2001) was studied about landslide and debris flow in Phetchabun Province by geographic information system (GIS) and remote sensing techniques. Kawague et al. (2010) assessed landslide hazard in Japan by multiple logistic regression analysis. Ono et al. (2014) assessed rainfall induced shallow landslide in Phetchabun and Krabi province in Thailand by shallow landslide instability prediction model (SLIP). Furthermore, Inoue et al. (2014) effort to project probability of landslide in Thailand using landslide probability model under multiple Global Climate Models (GCMs).

The objective of this study is to develop a landslide hazard map in Thailand using daily extreme rainfall daily data and assess trend of change probability of landslide with 5, 10, 30, 50, and 100 year return period.

2. STUDY AREA

Thailand is located at the center of peninsular Southeast Asia. Topography can divined into 5 major physical regions consists of central valley, highlands of the north and northwest, northeast, southeast coast, and the peninsula. Roughly 20 percent of Thailand is covered by mountains and hill especially in northern and southern regions. Therefore, landslides occur frequently in Thailand due to the influence of monsoon rain. In most cases, landslide would occur in the northern and southern parts of the country which are the mountainous.

3. METHODOLOGY AND DATA

3.1 Calculation extreme daily rainfall

The rainfall data is an important factor in landslide prediction. We used the daily rainfall data from 150 stations over Thailand by Thai Meteorological Department (TMD) (Fig.1). We estimated extreme daily rainfall for 5, 10, 30, 50, and 100 year return period by frequency analysis.

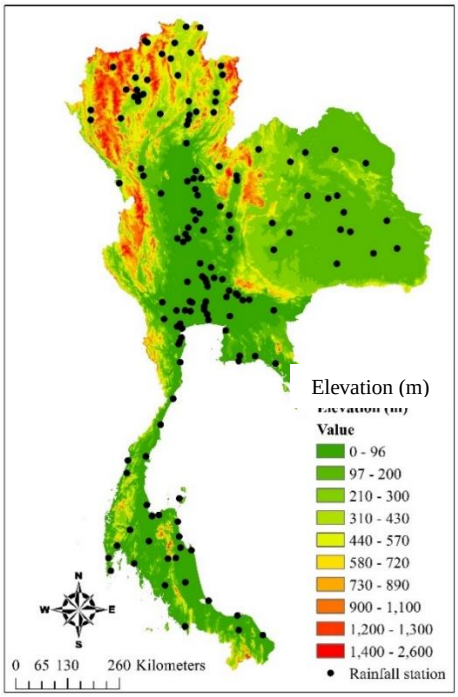

Fig.1 Elevation of Thailand and rainfall station

3.2 Hydraulics gradient and relief data

Hydraulic gradient and relief data were important inputs for calculate the landslide probability. We estimated hydraulic gradient by Richards infiltration analysis model. Moreover, the future hydraulic gradient was calculated using soil type, slope and extreme daily rainfall data. The soil type data was classified as clay silt and silt which the data from Land Development Department (LDD) in Thailand. The relief data is a difference between maximum and minimum elevation inside the digital elevation map (DEM) by the United States Geological Survey (USGS) with resolutions 0.05 degree × 0.05 degree (latitude × longitude).

3.3 Probability of landslide model

In this study, we estimate probability of landslide in Thailand using multiple logistic regression. The equation for calculate probability was shown that in equation 1. For more detail, refer to Kawague et al., (2010)

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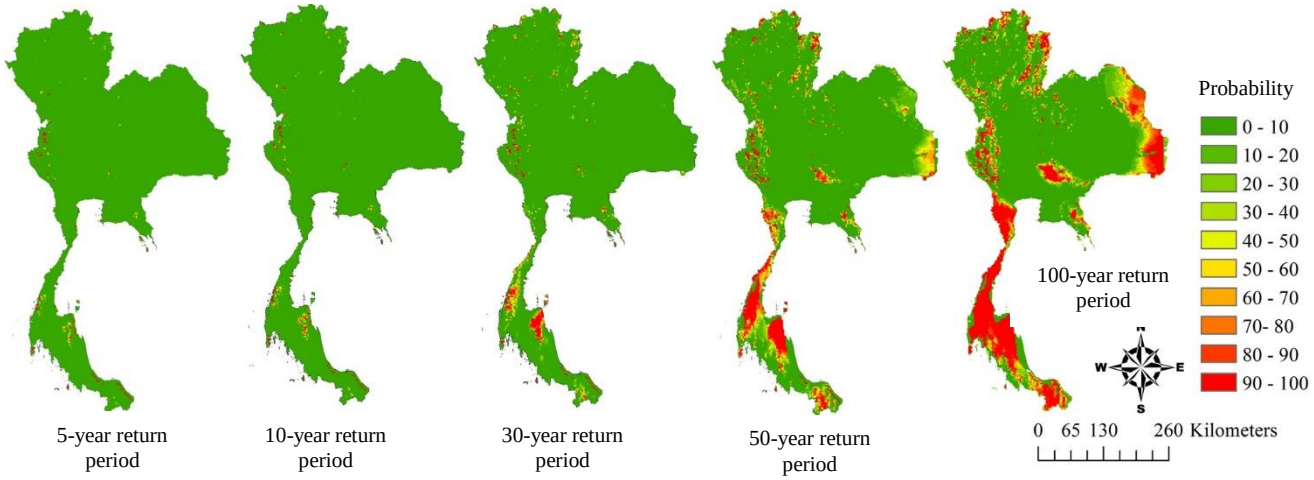

Fig.2 Landslide Hazard Map

$$p = \frac{1}{1 + \exp[-(\psi_0 + \psi_h \times hyd + \psi_r \times relief)]}$$

Where P is the probability of landslide (%), ψ_0 is the interception, ψ_h is the coefficient of hydraulic gradient, ψ_r is the coefficient of relief energy, hyd is the hydraulic gradient (m/m), and $relief$ is the relief energy (m).

4. RESULTS AND DISCUSSION

We assess of landslide hazard map of Thailand for future projections using daily extreme rainfall daily with 5, 10, 30, 50, and 100 year return period by probability of landslide model (Fig.2). This study summarized a probability of landslide for each scenarios in terms of return period. The results was found that in the north and south region of Thailand have a risk by landslide hazard, which landslide in the southern part will start from heavy rainfall with 10 year return period and northern part will occur by rainfall with 30 year return period. However, almost area in the northern part with high risk due to landslide are account under the high probability.

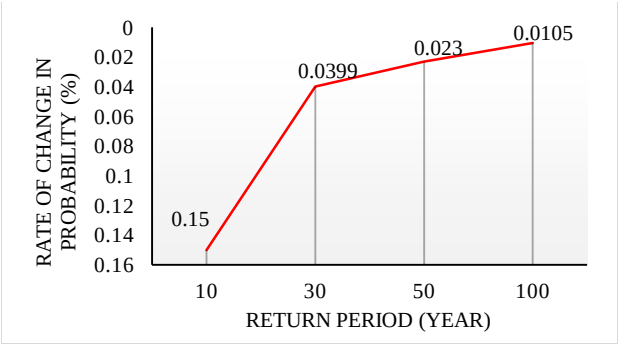

Fig.3 Relationship between rate of change in probability and return period

Fig.3 shows relationship between rate of change in probability of landslide in Thailand with return period. We found the maximum of probability change is 0.15 percent for difference 5 year return period (difference probability between 5 year return period and 10 year return period) and will decreasing until constant when the difference of return period increasing.

5. CONCLUSIONS

This study was assessed probability of landslide in Thailand using probability landslide model. From the results was found landslide in Thailand will increasing when return period increase especial southern region. Furthermore, rate of change in probability of landslide in Thailand will increasing maximum 0.15 percent.

6. ACKNOWLEDGMENTS

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