

# Critical Rainfall Analysis of Large-scale Landslide Occurrence

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## INTRODUCTION

The disaster event in Xiaolin village awakens the public awareness of large-scale landslide. The pre-warning procedure of large-scale landslide is one of the most important issues in Taiwan recently. In this study, 36 cases from Xiaolin village disaster event were used to estimate possible occurrence rainfall thresholds of large-scale landslide. The methods of rainfall time-series analysis and dimensionless rainfall analysis were taken in this study, the information including area, volume, location, occurrence time, and hydrography data of each landslide sites were considered in those analysis. Some trends of occurrence rainfall in Taiwan could be found in this study.

## RESEARCH METHODS

To find out the trend of critical rainfall in Taiwan, this study is based on the following procedures.

1. **Large-scale landslide location recognition:** In this step, satellite imagery was used to find out the accurate locations and types of landslides.
2. **Large-scale landslide occurrence time confirmation:** The second step was try to link the records from formal government reports or seismic data with landslides found in foregoing step to confirm the occurrence time of landslides.
3. **Rainfall data collection and analysis:** This procedure includes two analyses.
  - Rainfall time series analysis: Hydrograph of every case was drawn and the related time and accumulated rainfall of landslide occurrence was marked on the curve.
  - Dimensionless rainfall analysis: Two dimensionless factors, the ratio of equivalent friction angle ( $\phi$ ) to average slope ( $\theta$ ) of landslide and the ratio accumulate rainfall (R) to landslide depth (D), were used to draw a regression relationship.
4. **Results and applications of critical rainfall analysis of large-scale landslide occurrence:** Base on the foregoing results people can setup a threshold for pre-warning system of large-scale landslide, and estimate the soil production easily.

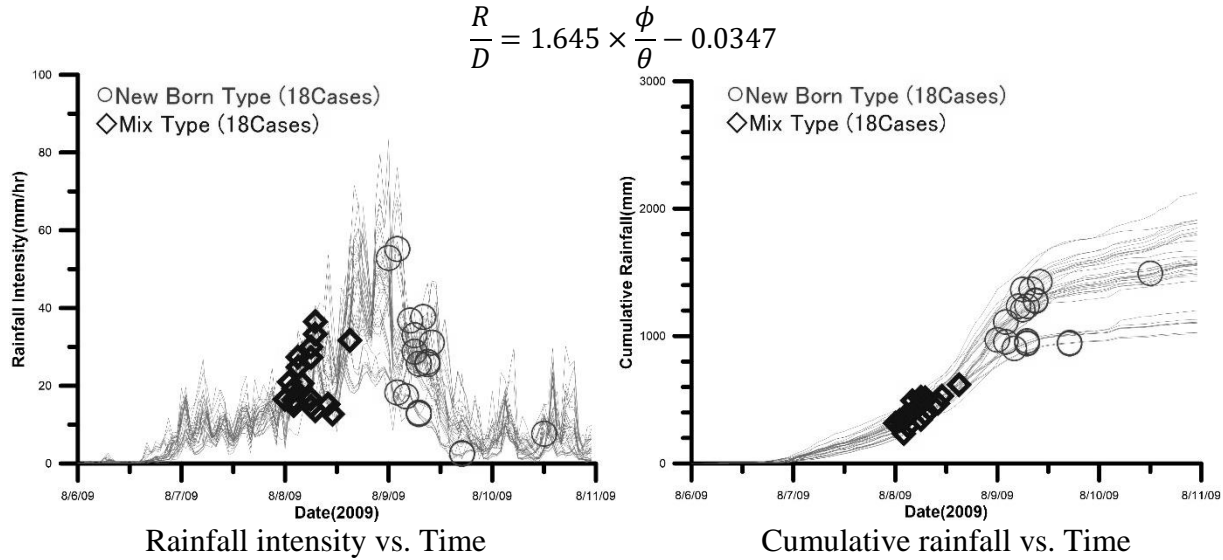
## RESEARCH RESULTS

Preliminary The study obtained the following results.

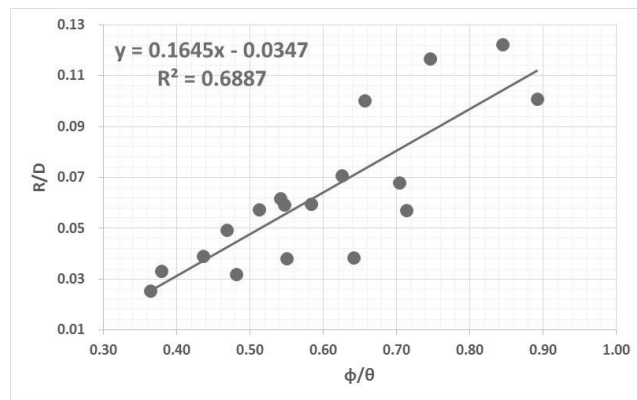
1. **The rainfall threshold to trigger large-scale landslide:** Those study cases could be divided into two groups; the group of purely single new large-scale landslide will occur after the peak rainfall, the relative accumulated rainfall value exceeded 1,000 mm and the occurrence time was close to the turn point of hydrograph curve. In the other group, large-scale landslide will

occur before or close to the peak rainfall, the relative accumulated rainfall value was around 300 mm to 500 mm and the occurrence time was fall into the rise part of hydrograph curve.

2. **The result of Dimensionless rainfall analysis:** Through linear regression the relationship of the ratio of equivalent friction angle ( $\phi$ ) to average slope ( $\theta$ ) of landslide and the ratio accumulate rainfall (R) to landslide depth (D) was found as the follow equation, and it's  $R^2$  value is about 0.6887.



**Fig. 1** Rainfall time series analysis results.



**Fig. 2** Dimensionless rainfall analysis results.

## CONCLUSIONS

Purely single new large-scale landslide will occur after the peak rainfall, the relative accumulated rainfall value exceeded 800 mm and the occurrence time was close to the turn point of hydrograph curve; although there are obvious groups in the hydrograph, there was still need more cases to support. Since it is not easy to obtain the exact time of occurrence, the number of valid samples is still insufficient. Therefore, this research needs to include other analytical methods in the future to obtain more reliable research results. The study is still ongoing.

**Keywords:** Large-scale Landslide, critical rainfall, Pre-warning system