

# A Quantitative Approach for Classifying Governance Unit of Watershed Management and Flood Mitigation Based on a Long-term Landslide Inventory

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## INTRODUCTION

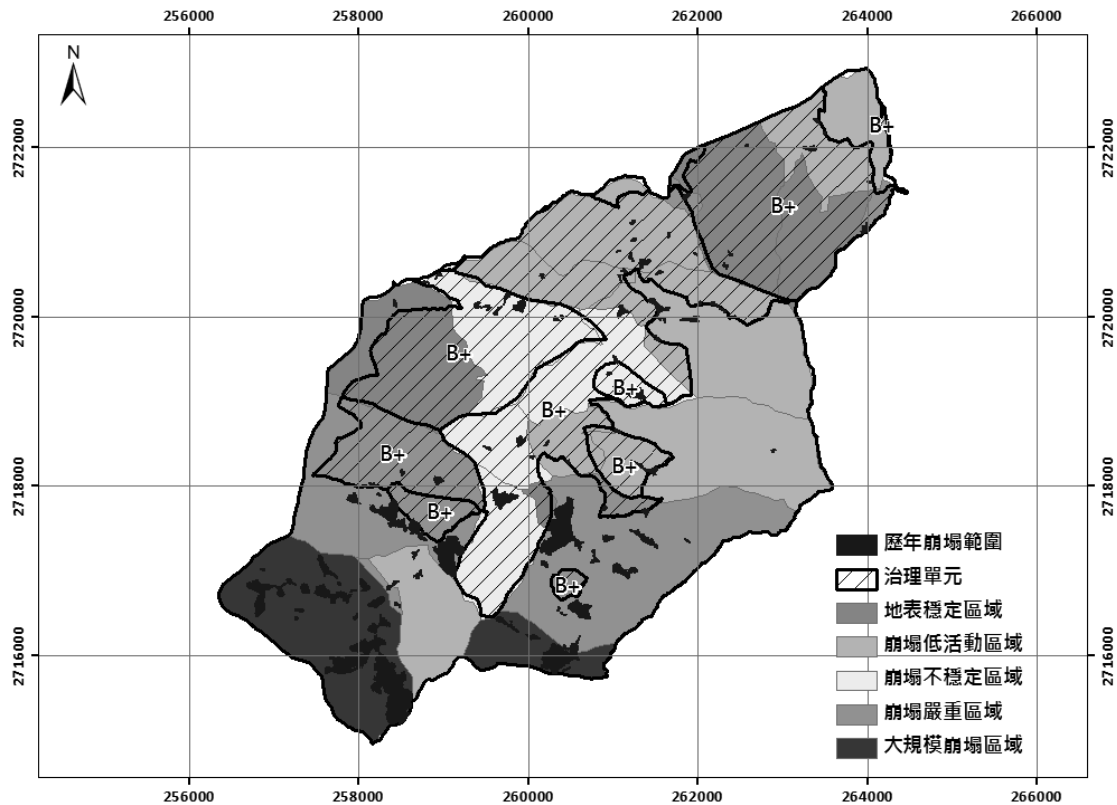
Extreme weather events caused by global warming intensify rainfalls. Together with the high mountains, broken terrain and frequent earthquakes, mean that Taiwan has one of the highest erosion rates in the world (Dadson *et al.*, 2003) and is one of the places on Earth most vulnerable to landslides (Dilley *et al.*, 2005). Taiwan's government, therefore, has been endeavoring to manage watersheds and mitigate the problems of flooding by developing various measures. To evaluate their effects and facilitate the planning, it is necessary to employ a quantitative approach for classifying governance unit of watershed management.

## METHOD

In this paper, landslide data sheets over 12 years defined by Soil and Water Conservation Bureau and Forestry Bureau are used. In order to accomplish the goal, the first step is to classify the watersheds by the optimum size. The second step is to determine unstable coefficients based on landslide areas over years and their standard deviation. The last step is to distinguish landslides into five types by using natural breaks classification: stable zone, high stability zone, low stability zone, severe landslide zone, and large-scale landslide zone.

## RESULTS

Take the Qingquan watershed in Wufeng Township, Hsinchu County for example, large-scale landslides occurred in four potential debris flow torrents when Typhoon Aere hit Taiwan in 2004. The Qingquan watershed is classified as 22 optimum watersheds after being processed by hydrologic analysis. The result from overlaying landslide data sheet of these 22 optimum watersheds from 2005 to 2016 shows major landslides occurred mostly during typhoon Aere. After typhoon Aere, vegetation recovery in the landslide zones was getting better, despite landslides occurred sporadically. Only in 2008, landslides occurred near Tuchang bulao caused severe damage. Two large-scale landslide zones, where the average rate of landslide occurrence is higher than 10%, are Debris-flow source areas. Several large-scale landslides occurred by two sides of Shangping Creek flowing through Tuchang bulao, Qingquan bulao, and Minduyou bulao, which are defined as low stability zone and severe landslide.



**Fig. 1** The outcome of applying the classification qualified measures of mountain management and flood control of management units to watersheds of the Qingquan watershed in Wufeng Township, Hsinchu County.

## CONCLUSIONS

Unstable coefficients determined by the long-term landslide data sheet of each watershed can serve as tool to quantify the classification measures of mountain management and flood control of management units.

## REFERENCES

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