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Spatial distribution of soil properties on a landslide in Taiwan: effects of movement types and vegetation

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Landslides are critical natural disturbances in tropical and temperate areas and exert immense impacts on forest ecosystems and soil properties. The impacts of landslides on soil properties not only vary with their movement type, scale, or location but also have great spatial variation inside landslide. In this study, the effects of movement type (erosion and deposition) and succeeding vegetation on soil properties inside a landslide scar were evaluated. The study site was located in Chiufenernshan, central Taiwan. The landslide was triggered by the Chi-Chi Earthquake (Ritch magnitude 7.3) in 1999. A huge amount of waste debris (30 million m^3) was moved along the sliding slope (with a tipping degree at 26^o) and deposited in the lower parts. Total area size of landslide scar was 200 ha and about 30 - 50 m depth waste material was eroded/deposited in the upper/lower scar areas. After 17 years, the succeeding vegetation varied inside landslide scar. The erosion areas were covered with grass (*Miscanthus floridulus*) or left barren in some slopes. In contrast, a secondary forest, dominated with *Trema orientalis*, *Lithocarpus konishii*, *Mallotus paniculatus,* and *Smilax bracteata*, developed in the deposition areas. We collected soil samples in different landscape areas including (i) erosion areas without vegetation, (ii) erosion areas with grass vegetation, (iii) deposition areas, and (iv) adjacent undisturbed areas. Our results indicated that the erosion areas had higher bulk density, rock fragment and pH value, but less soil organic carbon, total nitrogen, total phosphorus and N-mineralization rate than both deposition and adjacent undisturbed areas. The soil properties without vegetation even showed the extreme end compared to the soils with grass vegetation. Soils at the deposition zone had similar rock fragment, bulk density, soil pH, soil organic carbon and N-mineralization rate values to the undisturbed site ($p > 0.05$). We speculate that movement types could determine the initial establishment of vegetation types and then influence soil properties under vegetation succession. Therefore, both waste movement types and vegetation and their interactions play important roles on soil properties.