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Gully development on flows and deep-seated slides in the Mangaoporo catchment, North Island, New Zealand
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Mass movements and gully erosion are widespread phenomena in many steep, erosion prone catchments. Understanding gully erosion on unstable slopes is important for the management of slopes as well as for management of river systems, as large quantities of sediment are supplied by gully erosion directly into river systems causing off-site damage.

The development of gullies on unstable slopes is not well understood. In this study gully development on slopes affected by mass movements was analysed in 14 headwater catchments of the Mangaoporo catchment, North Island, New Zealand. Bedrock consists of Cretaceous-aged, highly crushed and sheared mudstones and sandstones. Deforestation by European settlers at the beginning of the 20th century for pastoral farming was followed by reforestation for wood production from the 1980s. Sequential aerial photographs from 1939 to 2005 were interpreted to map mass movements and the development of gullies. Digital elevation models were extracted from aerial photography using ERDAS to assess the applicability of the commonly applied topographic threshold approach for gully incision.

Flows of varying depth occurred in all catchments underlain by mudstone, while the catchment consisting of alternations of mudstone and sandstone were affected by deep seated sliding and secondary shallow sliding. Deep (few meters to 15m) gullies were located at the toe of mass movement bodies. Such gullies developed oversteepened sidewalls, which in turn initiate extensive mass movements at the gully walls. Shallow (about 1 -2m deep), hundreds meter long gully arms extended upslope. Topographical changes by active flows and slides caused stream capture or gully destruction. Cracks and scraps functioned as incision pathways.

The topographic threshold approach is not appropriate for unstable slopes, as the mass movement topography exhibits irregular drainage pattern and gully incision depends on the morphology of mass movements. New approaches need to be developed for gully incision on unstable slopes to understand the spatial and temporal variability of incision dynamics on unstable slopes.

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