

Spatio-temporal relation between landslide occurrence and abandoned or not maintained agricultural terraces in the Moldavian Plateau, NE Romania

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Terraced landscapes are one of the most obvious human-shaped landscapes, mainly used to reduce the negative impact of soil erosion due to uncontrolled runoff and shallow landslides occurrence. Nevertheless, as the recent literature emphasizes, these old best practices can transform into a potential hazard for soil degradation, if not appropriately maintained.

In Moldavian Plateau (NE Romania), agricultural terraces were built after the 1960s for landslide, soil erosion and runoff control, mainly in connection with construction of reservoirs, for increasing their operation time. Usually, the slope reduction was obtained by construction of cut-off ditches, hillside ditches, intermittent terraces, bench terraces, broad-based terraces, vineyard and orchard terraces. Due to the dry climatic setting, to the lack of hard rocks for construction, and to the generally light earth moving machinery available for construction, terraces are generally characterized by a small escarpment (0.5m to 1m), and a relatively short lateral extension (5 to 40 m). When the terraces were maintained, the backslope was typically covered with grass.

When, after the 1990s, the lands were returned to the initial owners, the vegetation cover of the terraces was no more maintained, and the terraces themselves were progressively abandoned, due to lack of funds.

Accurate landslide mapping on high resolution LiDAR DEM derived images, allowed to produce geomorphological inventories in 5 test cases, representative of the whole study area. In each inventory, landslides were classified based on type and relative age based on published classification schemes. We investigate the spatial and temporal relation between landslides occurrence and terraces, based on the spatial interactions of landslides of different ages and terraces.

Results reveal that terraces were built, both on landslide-free and landslide-bearing slopes, and that frequently landslides and gullies develop on terraced slopes. Reactivations of landslides which were terraced only with the scope of soil erosion control are the most frequent, whereas new landslides also occur, which are generally smaller than 2,000 m², and are mostly shallow slides affecting the agricultural layer. We hypothesize that landslides affecting the terraces occur mostly due to the lack of adequate and maintained drainage measures, and as well as of protective measures at the base of the hillslopes to prevent water incision.

Our findings provide new input to the study of the relations between agricultural terraces and geomorphological processes, and have direct implications on land management, helping to decipher the critical conditions for landsliding of terraced terrains, which is the base for designing efficient mitigation measurements. Results are relevant because provide a suitable scientific framework to support decisions for a sustainable development of the agricultural communities of these rural areas in the context of a changing climate.