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A grand comparison of soil & water conservation in 50 vineyards under 5 different terracing systems

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Steep-slope agricultural landscapes often show a mosaic of diverse terraced and non-terraced hillslope configurations. The use and specific design of Soil and Water Conservation (SWC) measures such as earth bank or dry-stone wall terraces is often the result of agro-landscape evolution, and is shaped by various factors such as culture-historical values (e.g. traditional cultivation methods), agronomic development (e.g. mechanisation), site-specific conditions (e.g. local rainfall regime and construction materials), as well as environmental concerns (e.g. runoff and erosion control). Concerning the latter, **the effectiveness of SWC measures is becoming increasingly urgent in the face of climate change expressed as extreme rainfall interspersed with drought periods**, as commonly found in Mediterranean Europe.

While past research has provided unique insights in the impact of several terracing practices on runoff and erosion control (doi.org/10.1016/j.catena.2020.104604), this mostly focussed on descriptive analysis of detailed soil degradation patterns in a limited number of study areas. In this study, **we expand this research by a comprehensive and massive evaluation of 50 vineyards cultivated by 5 different terracing and non-terracing techniques in the cultural landscape of Soave, northern Italy**. This provides a grand comparison of SWC impacts based on a systematic workflow of high-resolution topographic analysis, physical erosion modelling, and statistical evaluation. Analysis is performed on a preselected set of 50 representative vineyards (10 sites for each practice) with homogeneous soil type and properties, geometric shape and size, slope positioning and steepness (calculated from 1-m LiDAR data). A set of SWC indicators is determined (e.g. average rates of soil erosion, deposition, and runoff), and are computed for each vineyard using spatially-distributed physical simulations by the Simulated Water Erosion (SIMWE) model. Simulated processes are quantified by zonal statistics, while differentiating between potential detachment and deposition hotspots (i.e. pre-determined uphill and downhill zones inside each vineyard). This allows a first indication of SWC impacts by the different hillslope configurations. Furthermore, we provide a comparison of the actual cultivated study sites and an assumed “natural scenario” (i.e. smoothed terrain, natural vegetation), in order to quantify the impacts of the 5 different terrace configurations on SWC.

Our findings provide relevant insights in the SWC effectiveness of terraced and non-terraced cultivation practices commonly found in the steep-slope agricultural landscapes of Italy. **The**

unique experimental scale of our systematic comparison offers reliable and novel findings, which support sustainable landscape planning and management, e.g. as in our case by rural development plan Soilution System *"Innovative solutions for soil erosion risk mitigation and better management of vineyards in hilly and mountain landscapes"* (www.soilutionsystem.com). Future research along the same lines are encouraged in order to improve the general understanding of SWC in steep cultivation systems across diverse geographical settings.