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The role of man-made terraces as NBS measure for geo-hydrological risk reduction in the Portofino Park (Italy) - H2020 RECONNECT project

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Man-made terraces are widely diffused in hilly-mountainous areas, representing an ancient anthropogenic landscape modification for agricultural purposes. Then, terraces have been involved in several changes through times: socio-economic evolution caused a progressive general abandonment of terraced areas causing land use change and even their obliteration or collapse. In some cases, terraces deeply shaped the landscape and then their maintenance is considered crucial for cultural, aesthetic and even touristic value.

Terraces belong to the soil and water conservation measures as they allow to reduce erosion, improve slope stabilization and retain water runoff; as such they fit perfectly into the Nature-Based Solution definition. The artificial immobilization of debris and stone in terraces may turn in a possible source of geo-hydrological hazard in case of heavy rains, as happened in the Riviera Ligure in the last 20 years; a sequence of events was associated to landslides and flash flood, causing damages and casualties. Then, the proper terraces maintenance and monitoring is crucial for the maintenance of the geomorphological and geotechnical slope stability.

We focused on terraces identification and on the evaluation of debris/stones volume trapped after centuries of human activity in the pilot area of the Portofino Park, which represents a unique natural and cultural landscape that is severely endangered by geo-hydrological hazards. The further step has been the spatial relationships assessment with the exposed elements like buildings, infrastructures and culverted stream, that is the basis of risk assessment and land use planning activities.

The research has been carried out within the framework of the Horizon 2020 RECONNECT - Regenerating ECOSystems with Nature-Based Solutions for hydro-meteorological risk rEDuCTION; the Italian RECONNECT demonstrator is set in the Portofino Park.

Using a detailed Lidar survey, the edges of dry-stone walls were firstly identified, allowing a detailed mapping. Focusing to terrace bases allowed to recognize a possible natural surface through their interpolation along the slope: the difference between the terraced slope profile and the interpolated one allowed a preliminary volume assessment.

Dry-stone wall basis has been detected applying a local upslope curvature routine that is the weighted mean of local curvatures of the directly neighboring upslope contributing cells, controlled with 5 cm orthophoto. In very steep areas terraces stored volume mediumly accounts about $0.35 \text{ m}^3/\text{m}^2$, which agrees with the back analysis estimation of volumes collapsed after recent geo-hydrological events in the Ligurian Riviera.

Stored volume is an essential parameter for prioritizing terraces restoration interventions for risk reduction through NBS techniques. Finally, the survey and analysis outcome may be useful to investigate the recent numerous geo-hydrological events that have been triggered in terraced areas in large sectors of the Mediterranean.