Modelling soil erosion in Prosecco DOCG vineyards by simulating different land-management scenarios: toward a soil footprint of bottled sparkling wine

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Vineyards in Europe are one of the most erosion-prone agricultural lands, especially in Mediterranean regions, with the highest erosion rates in comparison to other type of land uses.

In the last five years, sparkling wine continued to grow with an annual rate of 7% in value and 6% in volume, turning the Prosecco brand to one of the most exported wine in the world. Prosecco is produced in NE Italy by a rate of 400 M bottles per year, with the fastest growing demand in the global market at present. A production of 90 M bottles year-1 is currently running in the historical Prosecco DOCG (215 km2), in a steep hilly landscape of Veneto Region (Conegliano-Valdobbiadene). To sustain wine production, agricultural intensification is increasing, by re-setting of hillslopes and land use changes towards new vineyard plantations. The Prosecco DOCG vineyards doubled cropping area from some 4,000 ha in 2000 to 8,000 ha in 2018, representing the 50% of all crop production. Moreover, in 2019 the Prosecco DOCG was declared UNESCO World Heritage site, fuelling the public debate about the environmental sustainability of Prosecco farming system.

The general aim is to estimate a sort of soil footprint for wine production in five simulated different land-management scenarios by modelling and mapping erosion rate. We selected RUSLE model to estimate potential soil erosion in t ha−1 year−1, by using high resolution topographic data (LiDAR), 10 years rainfall data analysis, detailed land use, and local soil characteristics.

Total soil erosion simulated for the conventional scenario is 411,266 t year-1, with an erosion rate of 19.5 t ha−1 year−1. Modelled soil erosion is mainly clustered on steep slopes, with rates higher than 40 t ha−1 year−1. In Prosecco vineyards soil erosion modelled was 300,180 t year-1, by a mean rate of 43.7 t ha−1 year−1, which is 31 times higher than the upper limit of tolerable soil erosion threshold defined for Europe. In contrast, simulation of different nature-based scenarios (hedgerows, buffer strips, and grass cover) showed soil erosion could be effectively reduced: a 100% inter-row grass cover showed a reduction of almost 3 times in vineyards (from 43.7 to 14.6 t
ha-1 year-1), saving about 50% of soil in the whole Prosecco DOCG. The soil footprint modelled for a conventional land-management scenario is about 3.3 kg every bottle produced; in contrast it would be reduced to 1.1 kg/bottle in the completely green land-management scenario.

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