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Assessing The Impact of Terraces On Soil Erosion

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Introduction

Tuscany countryside (Italy) is characterized by a hilly landscape that over the centuries, has been shaped by farmers, leading them to realize terraces (Agnoletti et al., 2015). However, from the 1960s, the development of agricultural mechanization has led to an expansion of up and down the slope cultivated fields and to a progressive abandonment of terraced surfaces (Landi, 1989; Napoli et al., 2016). Our study was focused in the Municipality of Radda in Chianti. The aims of this study were: 1) to evaluate the effectiveness of the land setting practices such as diversion ditch and stonewall terraces on reducing soil loss by water erosion in the vineyard and olive groves; 2) to compare erosion rates from fields with non-degraded and degraded (fully or partly collapsed) stonewall terraces.

Materials and Methods

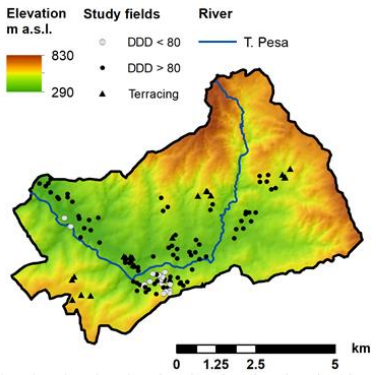

Fig. 1. *Digital elevation model of the area, with the position of the study fields*

The study was conducted in the "Alta Val di Pesa" area, Tuscany, Italy (Fig.1) across the period 2016–2020. Vineyard and olive groves selection was based on the proximity to roads. The soil losses associated with land setting practices were studied: 1) Level ditching with a distance between successive diversion ditch (DDD) higher than 80 m (DDD>80); 2) Level ditching with DDD lower than 80 m (DDD<80); 3) degraded stonewall terracing, 4) standing stonewall terraces. Soil loss (SL, t ha-1 y-1) measurements were carried out in 161 fields. A total of 10 undisturbed soil core samples were taken from each field to determine the bulk density (kg·m−3). The yearly volume of soil loss (V, m3·y−1) by water erosion was determined as proposed in Napoli et al. (2016) and Napoli et al. (2020). On stonewall terraced fields, the SL measurements were carried out on 50% of the terrace bed and then averaged over the whole field surface. The Kruskal–Wallis (K-W) test was applied to check the SL difference between land settings at significance level $p < 0.05$. Pairwise multiple comparisons for detected significant differences were analyzed by applying the Dunn's post-hoc tests with Bonferroni's p-value adjustment method. The SL values were also compared with the (OECD, 2008) tolerable average annual SL limit (T, 6 t·ha−1·y−1) to evaluate the land settings effectiveness in reducing the soil losses.

Results

n° of fields	Land setting	Average yearly soil loss (t ha^{-1} y^{-1})
17	DDD < 80	23.8 (4.2) ab
78	DDD > 80	32.8 (3.2) a
43	Degraded stonewall terraces	17.7 (1.9) b
23	Standing stonewall terraces	3.1 (0.4) c

Table 1: *Average and standard errors (in brackets) of yearly measured soil losses. Dara is reported as a function of the type of land settings. Lowercase letters indicate significant differences in average soil loss between land settings according to the Dunn post hoc test (p<0.05).*

The average measured SL were consistent with those found in other sites in the European Mediterranean area. The average measured SL in DDD<80 was 27.6% lower (p>0.05) than that measured in DDD >80. The average soil loss measured in degraded terraces was significantly lower than that measured in DDD >80, while no significant difference was detected with respect to DDD<80. The average SL from standing terraced vineyards resulted in 10.7, 7.8, and 5.8 times lower than that measured in DDD >80, DDD <80, and degraded stonewall terraces, respectively. The average SL values in DDD >80, DDD <80, and degraded stonewall terraces, were found to be 5.5, 4, and 2.9 times higher than T, respectively. On the contrary, the average annual soil losses from standing stonewall terraced fields did not exceed the tolerable average annual soil loss limit (OECD, 2008). These results indicated that the contour ditching was not sufficient to control the erosion process in steep hillslope Further, soil loss values measured at standing and degraded stonewall terraced fields indicated that terraces maintenance could reduce soil erosion by about 82.5%, with respect the terraces abandonment.

Conclusions

Diversion ditches were not sufficient to contain the erosive process within the tolerable limits in the olive groves and vineyards. Similarly, soil loss measured on degraded terraces exceeds the tolerable limits by 2.9 times. On the opposite, standing stonewall terraces have instead shown their value as land settings capable of reducing the erosive process.

Literature

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