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Quantification of the effect of terrace maintenance on soil erosion: two seasons of monitoring experiments in Cyprus

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In the Mediterranean region, rural communities in topographically challenging sites have converted large areas into dry-stone terraces, as the only way to develop sustainable agriculture. Terraces allow softening the steep mountainous slopes, favoring water infiltration and reducing water runoff and soil erosion. However, population decrease over the past 30 years has led to a lack of maintenance of the terraces and the onset of a process of land degradation. The objective of this study is the quantification of the effect of terrace maintenance on soil erosion. We selected two terraces – A and B, 11 and 14 m long, respectively - for monitoring purposes. They are located in a small catchment (10,000 m^2) in the Troodos Mountains of Cyprus, at an elevation of 1,300 m a.s.l., and cultivated with vineyards, which is the main agricultural land use of the region. We monitored soil erosion by means of sediment traps, which are installed along 1-m long sections of terrace. We monitored four sections on terrace A and seven on terrace B. During the first monitoring season (winter 2015/16), on terrace A the traps caught sediment of two collapsed and two standing sections of dry-stone wall. The catchment areas of one set of traps (degraded and non-degraded) were closed by a 1x4-m^2 plot, to relate erosion rates to a known draining area. On terrace B the traps were all open and caught four collapsed and three standing sections. Also, we installed a weather station (5-minute rainfall, temperature, and relative humidity) and 15 soil moisture sensors, to relate soil erosion processes with climate and (sub)surface hydrology. From the open traps, we observed that soil loss is on average 8 times higher from degraded terrace sections than from standing, well maintained sections, which in our case study corresponds to an 87% reduction of soil loss due to terrace maintenance. If we compare data from the two closed plots, we obtain a much higher soil loss ratio (degraded/standing) of 56, which corresponds to a soil loss reduction of 98%. From the closed plots, we derived an erosion rate of 2.8 t ha^{-1} y^{-1} for degraded terraces and 0.05 t ha^{-1} y^{-1} for well-maintained terraces. Also, soil moisture monitoring confirmed that standing terraces favor surface water infiltration. For the second season (winter 2016/17), given the differences in results between open and closed traps and therefore the difficulty in consistently upscaling the results, we modified the monitoring design. The 11 traps were kept, all open, but the comparison between maintained and degraded areas is carried out on a sub-catchment basis, rather than on a section basis. We restored the whole sub-catchment of terrace A ($\approx$480-m^2) to be considered the maintained treatment of our experiment and kept the sub-catchment of terrace B ($\approx$600-m^2) in degraded conditions. To obtain the sub-catchment erosion rate, the sediment collected in the traps is averaged on running meter of wall and integrated on the wall length.

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