

Soil redistribution and nutrient delivery in a Mediterranean rain-fed agro-ecosystem with different crops and management: environmental and economic aspects

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Mediterranean agro-ecosystems are characterised by fragmented fields and patched vegetation. This shape governs the spatial patterns of water, soil and nutrient redistribution. Rainfall parameters, human infrastructures, crop management, support practices, and land use changes (set aside crops, land abandonment) control the magnitude of these processes. Under rain-fed water supply conditions, runoff generation and soil water content are two important factors in determining crop yield. Soil erosion and nutrient delivery are two of the factors which limit crop yield and thus, the gross earning of the landowner. In hilly landscapes, farmers usually supply extra soil to fill in the ephemeral gullies, and nutrient replenishment with fertilizers is a common practice.

The aim of this study is to evaluate the environmental (runoff yield, soil erosion and nutrient delivery) and economic (replenishment of soil and nutrient losses with new soil and fertilizers) consequences of different conventional and conservative practices (fallow/crop rotation, cover crops, land abandonment, buffer strips) in a Mediterranean rain-fed agro-ecosystem (27 ha) with vineyards, cereal crops, cultivated and abandoned olive orchards, several trails and patches of natural vegetation. The five winter cereal fields (wheat and barley) follow fallow/crop rotation. The four vineyards are devoted to the Garnacha variety: one planted in 2007 with white wine grapes, and three planted in 2008 with red wine grapes. The inter-crop strips are managed with a mixture of plant species as cover crop (CC), including: i) spontaneous vegetation, and ii) plantation of common sainfoin (*Onobrychis viciifolia*). The maintenance of the CC includes one mowing pass at the end of spring, between May and June. The appearance and development of ephemeral gullies and the deposition of soil at the bottom of the hillslope are two of the main concerns of the landowners. In some places, the accumulation of soil complicates grape harvest operations with machinery, forcing manual labour.

A total of 222 soil samples were collected in 74 points, and some physical (coarse fragments, effective volume, bulk density, texture, infiltration, etc.) and chemical (soil organic carbon - SOC, total nitrogen, phosphorous and potassium) parameters analysed. The highest values of SOC and TN were found in the forestry (4.64% and 0.198%) and abandoned soils (2.96% and 0.132%), whereas the highest values of TP appeared in the cereal, olive and vineyards (458.4, 458.0 and 440.3 mg / kg P). The highest content of TK appeared in the vineyards (1979.1 mg / kg K), especially in the grapevine strips (2188.3 mg / kg K), due to the fertilizer supply. In order to assess the water, soil and nutrient budgets, four buried sediment traps were installed near the bottom and before reaching the depositional-prone area. The upslope contributing areas of the traps are not nested. Monitoring the magnitude of runoff and sediment yield and the chemical composition of the collected samples allowed calculating the economic cost of water, soil and nutrient losses. The results of this study have implications for other rain-fed productive agro-ecosystems as well as where conservative practices may reduce the economic cost of farmland management.