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Soil conservation and ecosystem services from agroforestry systems: a GIS-based approach for soil erosion in Central Italy

Preserving natural resources, such as soil, is one of the major challenge for agriculture, in the view of developing sustainable adaptation strategies to climate change. Soil loss by water erosion is a critical issue in the Mediterranean region due to high rainfall erosivity caused by the increased frequency of extreme precipitation events. In Tuscany, the risk of soil erosion is exacerbated on arable soil of hilly areas, where the persistent application of conventional tillage is associated with: (i) long periods with bare soils within the crop rotation, (ii) poor herbaceous vegetation cover due to low biomass productivity and (iii) scarce presence of trees on farmland. Agroforestry systems - "the practice of deliberately integrating woody vegetation (trees or shrubs) with crop and/or animal systems to benefit from the resulting ecological and economic interactions" - can reduce soil erosion risk by enhancing cover-management factor. In this study the (R)USLE (Revised Universal Soil Loss Equation) was implemented on a GIS-based model in order to assess the potential of different agroforestry systems in decreasing soil erosion risk on arable land below the tolerance threshold (11 Mg ha^{-1} yr^{-1}). The JRC-EU map proposed by Panagos et al. (2015) was used for rainfall erosivity, whereas the agroforestry P-factor values were derived from Delgado & Canter (2012). The reference scenario, based in current soil uses (Corine Land Cover 2012) allowed to determine the baseline of potential soil losses on arable land in Tuscany and to identify areas characterized by the highest risk of erosion. About 50% of the cropland in the study area, 450,000 ha, has a severe soil erosion risk, more than 33 Mg ha^{-1} yr^{-1} of soil loss. The development of alternative scenarios, based on the possible implementation of agroforestry systems, allowed to highlight that: (i) alley cropping systems (P-factor from 0.1 to 0.5) would reduce soil loss rate under the tolerance threshold on 60 % of the arable land of Tuscany; (ii) the 11% of the arable land would urgently need high conservative agroforestry practices (P-factor less than 0.1) in order to reduce soil loss below the tolerance threshold.

Parole chiave: Natural resources, soil degradation, sustainable intensification, smart agriculture

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