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Sensitivity of a soil landscape to land use changes in a southern Alpine valley (Ticino, Switzerland)

Manuele Bettoni[1,2], Sebastian Vogel[2], and Michael Maerker[1]
[1]Department of earth and environmental sciences, University of Pavia, Pavia, Italy
[2]Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Potsdam, Germany

The sensitivity of a landscape to changes is expressed by the likelihood that a given change in the controls of a system will produce a sensible, recognizable and persistent response in the properties of the system (Brunsden & Thornes, 1979).
The aim of this study is to investigate the sensitivity of an alpine soil landscape for human-induced perturbation in terms of land use changes that might affect soil properties and consequently affect also the stability of the soil landscape. The latter is of particular relevance since in alpine landscapes, land use effects tend to be intensified by extreme climatic and topographic conditions (Gordon, 2001). The study area is located in the southern Alps in the Canton Ticino (Switzerland) which is characterized by a centennial history of land use changes. The landscape can be subdivided into the following main land use-topography units: (i) forest areas in "natural" conditions on south and north facing slopes (reference state), (ii) pasture, (iii) meadow, (iv) cultivated agricultural terraces, and (v) abandoned terraces with forest regrowth in the last 40 years. Land use effects were verified by comparing the different land use-topography units with the reference state of "natural" forested slope.
The following physicochemical key soil properties and soil water dynamics were measured that are known to be vulnerable to land use changes: saturated hydraulic conductivity, soil organic carbon (TOC), soil bulk density, hydrophobicity and aggregate stability as well as surface runoff generation and related soil erosion. Especially the latter can be considered the main contributor to soil degradation in alpine landscapes, reflecting the sensitivity of the soil landscape to land use changes.
Statistical methods were used to detect changes, differences and correlations of key soil properties and soil water dynamics in the different land use-topography units in comparison to the natural conditions.
The results of the analysis show that land use and land use changes have a significant impact on soil properties and soil water dynamics. Most of the investigated soil properties show statistically significant differences compared to the reference condition. Land use-induced vegetation changes have a considerable effect on soil's TOC which is directly related to hydrophobicity and inversely related to bulk density. Soil water dynamics are also land use-specific showing higher values of surface runoff in forests and abandoned terraces where soil hydrophobicity plays a significant role. Even though, land use and related vegetation change had significant effects on investigated soil properties, no effect on soil erosion. Hence, due to the particular characteristics in the

lithology and soils of the study area, the soil landscape in the Onsernone valley seems to be resistant at least under the present-day climate variability.

Reference

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