Understanding deforestation impacts on soil erosion rates using Cs-137, Pu239+240, and (210)Pbex and soil physicochemical properties in western Iran

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Author(s) Khodadadi, Maral; Alewell, Christine; Mirzaei, Mohammad; Ehssan-Malahat, Ehssan; Asadzadeh, Farrokh; Strauss, Peter; Meusburger, Katrin
Author(s) at UniBasel Alewell, Christine ;
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To investigate the effects of converting forests into vineyards typical to Zarivar Lake watershed, Iran, which occurred mainly in the 1970s and 80s, on soil erosion,Cs-137 and Pb-210(ex), being mid-and-long-term soil loss tracers, were applied. In Chernobyl-contaminated areas like those found in some parts of Europe and Asia, the proportion of Cs-137 Chernobyl fallout needs to be determined to convert Cs-137 inventories into soil erosion rates. To do so, Pu radioisotopes were applied for the first time in Iran. The soil samples were gathered from two adjacent, almost similar hillslopes under natural forest (slope length: 250 m; slope gradient: 20%) and rainfed vineyard (slope length: 200 m; slope gradient: 17%). Cs-137/Pu239+240 ratios indicated that 49.8 +/- 10.0% of Cs-137 originated from Chernobyl. The net soil erosion rates derived by Cs-137, and Pb-210(ex) approaches were 5.0 +/- 1.1 and 5.9 +/- 2.9 Mg ha(-1) yr(-1) in the forested hillslope, and 25.9 +/- 5.7 and 32.5 +/- 14.5 Mg ha(-1) yr(-1) in the vineyard hillslope, respectively. Both Cs-137 and Pb-210(ex) highlighted that deforestation increased soil erosion by around five times. Moreover, the impacts of deforestation on soil physicochemical properties were investigated in surface and subsurface soils. Compared to forested hillslope, soil organic carbon stock in the upper 40 cm of the vineyard reduced by 14 Mg C h(-1) (29%), 8 Mg C ha(-1) of which was removed by erosion within 35 years, and the remaining have likely been lost via emissions (6 Mg C ha(-1)). The vineyard topsoil experienced the most dramatic drops in percolation stability (PS), sealing index, and organic matter by about 55, 51, and 49%, respectively. Among all measured physicochemical properties, PS showed the greatest sensitivity to land-use change. Overall, the present study's findings confirmed that deforestation for agricultural purposes triggered soil loss, deteriorated soil quality and possibly contributed to the reduction of the lake's water quality and climate change.
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