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Analysing surface runoff and erosion responses to different land uses from the NE of Iberian Peninsula through rainfall simulation

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Rainfall simulation experiments are being used by soil scientists, geomorphologists, and hydrologist to study runoff generation and erosion processes. The use of different apparatus with different rainfall intensities and size of the wetted area contribute to determine the most vulnerable soils and land uses (Cerdá, 1998; Cerdà et al., 2009; Nadal-Romero et al., 2011; Martínez-Murillo et al., 2013; León et al., 2014). This research aims to determine the land uses that yield more sediments and water and to know the factors that control the differences.

The information from 152 experiments of rainfall simulation was jointly analysed. Experiments were done in 17 land uses (natural forest, tree plantation, burned forest, scrub, meadows, crops and badlands), with contrasted exposition (north-south), and vegetation cover variety and/or density. These situations were selected from four geographic contexts (NE of Catalonia, high and medium lands from the Ebro valley and Southern range of central Pyrenees) with significant altitude variations, between 90 and 1000 meters above sea level, which represent the heterogeneity of the Mediterranean climate. The use of similar rainfall simulation apparatus, with the same spray nozzle, spraying components and plot size, favours the comparison of the results. A wide spectrum of precipitation intensities was applied, in order to reach surface runoff generation in all cases. Results showed significant differences in runoff amounts and erosion rates, which were mainly associated with land uses, even more than precipitation differences. Runoff coefficient shows an inversed exponential relationship with rainfall intensity, which is the opposite what could be previously expected (Ziadat and Taimeh, 2013). This may be only justified by land use characteristics because a direct effect between runoff generation intensity and soil degradation conditions, with respect vegetation covers features and density, was observed. In fact, even though the highest rainfall intensities were applied in the most natural areas with a dense vegetation cover, the most intense responses were produced in the most altered environments (badlands, born forest, vineyard, pasture and stony soils). These results agreed with the cause-effect relationships observed in some antecedent studies, which compare the hydrological and erosive response in different land uses (Badía et al., 2008; García-Ruíz et al., 2008; García-Ruíz and Lana-Renault, 2011). This has been mainly associated with variations of soil chemical, physical and hydrological properties (Pardini et al., 2004, Emran et al., 2012; Regüés et al., 2012). Likewise, this analysis has provided comparable information for various contrasted land uses, allowing estimate proportionality factors between them. This information favours the classification of certain environments according to its relative trends to surface runoff and erosion.

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