



Factors controlling soil erosion in small agricultural watersheds in central Navarre (Spain)

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Two experimental watersheds – La Tejería (1.69 km²) and Latxaga (2.07 km²)– located in the centre of Navarre (Spain) have been continually monitored for 13 years (1996-2009). As a result, a detailed description and a general characterization of the hydrological and erosion behaviour of these watersheds were published recently by the same authors of this current research. However, this information, although extensive and valuable, is still insufficient for finding out the internal functioning of these watersheds, especially those processes and factors controlling the erosion in their soils.

Thus, the main objective of this article is to identify and weigh up the most relevant variables related to the production of sediments –and therefore to the predominant erosion processes– at the outlet of two grain-growing watersheds. All the above has the ultimate aim of gaining a better understanding of the hydrological-erosion behaviour of the typical agricultural watersheds in our region.

A detailed statistical analysis was made of the extensive database available, to be specific, using multivariate methods: Principal Component Analysis (PCA) and Multivariate Regression (MR). Although these techniques do not establish per se any relation of dependence but that causality has to be subsequently formulated by the analyst, they are valuable analysis tools just the same. The PCA, particularly, permits a reduction in the large number of starting-off variables (in our case 28 metric and 1 categoric variables) identifying the most relevant ones which relate best to a specific illustrative variable. It should be clarified that the illustrative variables do not intervene in the analysis but are much useful as they facilitate the interpretation of the causality between each other with all the remaining variables. In our case, the fixed illustrative variable was, thus, the total production of sediments. Next, and complementarily to the PCA, an MR analysis was performed with the aim of quantifying the degree of importance of those variables recognized by means of the PCA as being explanatory of the erosion processes.

The statistical analyses reveal that the variables which explained the generation of sediment in the watersheds studied best are, surprisingly, only two: the total runoff accumulated and the antecedent moisture; the latter was reflected by the mean flow generated one hour before the beginning of the event. Curiously, the intensity of the rainfall was hardly significant, which suggest that splash erosion is a minor form of soil erosion. In addition, the regression analysis indicates that of the 2 variables cited, the total runoff accumulated is, by far, that which carries the greatest weight at the moment of explaining the total generation of sediment.