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# Factors controlling gully erosion at different spatial and temporal scales in rangelands of SW Spain

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Gully erosion has been recognized as an important soil degradation process in rangelands of SW Spain. However, little is known about gullying processes at different spatial and temporal scales in these areas. Three different approaches were used in this paper to analyze the factors determining gully erosion intensity and rates at different spatial and temporal scales in rangelands of SW Spain.

The first approach was based on the monitoring of a permanent valley bottom gully and continuous measurement of rainfall and discharge during the period 2001-2007 in the Parapuños experimental basin. Parapuños is a small catchment (99.5 ha) representative of dehesa land use, with an undulated topography and Mediterranean climate. Gully erosion volume was obtained by means of 28 fixed cross sections measured with a frequency of 6 months. Discharge and rainfall were monitored using a water depth probe installed in a weir at the outlet of the catchment and 6 tipping bucket rain gauges, respectively.

The second approach was based on analyzing the development of the same permanent gully located in Parapuños using six series of aerial ortophotographs for the period 1945-2006. This methodology allowed to relate gully evolution with land use and vegetation cover changes.

Finally, a relatively new data mining technique, called Multivariate Adaptive Regression Splines (MARS), was applied to construct a model capable of predicting the location of gullies at the regional scale. A large database composed of 36 independent variables related to topography, lithology, soils, rainfall, land use and vegetation cover was used. This statistical technique allowed to determine the importance of the variables involved. This database was gathered in 46 farms representative of rangelands of SW Spain in Extremadura, covering a surface area of 35,459 ha. Farms were quite diverse although their main characteristics were undulating landforms, acid rocks (schists, greywackes and granites), and Mediterranean climate with Atlantic influences.

Results showed that at the catchment scale, and for a short period (1-10 years), rainfall and soil moisture were the most important factors controlling gully erosion rates. In fact, gully erosion was highly related with the rainfall amount (r=0,90), with the number of times event discharge exceeded 1000 cubic meters (r=0,76) and with the number of times peak discharge exceeded 100 l/s (r=0,72). However, when the temporal scale was extended to several decades (from 1945 to 2006), land use and vegetation cover (specially the extension of cultivated area and livestock density) proved to be the most important factors determining the area affected by gullying. With respect to the spatial variation of gullying at the regional scale, the model results indicate lithology as being the most important variable, followed by vegetation structure and summer rainfall. This model was able to explain a large portion of the spatial distribution of gullies at the regional scale.

Concluding, at different spatial and temporal scales the importance of factors which determine gully erosion intensity, extension and rates varies notably. At the short-term rainfall and runoff dynamics and the moisture content of the sediments are the dominant factors, whereas at the medium-term land use and vegetation cover become more important. At the regional scale lithology and vegetation turned out to be the dominant factors in determining the location of areas susceptible to gully erosion in rangelands of Extremadura.