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Gully erosion and land use during the last 60 years in a small rangeland catchment in southwest Spain

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Gully erosion represents an important soil degradation phenomena in Mediterranean environments. Gullying is a complex process controlled by a variety of closely related factors: lithology, soils, climate, topography, land use and vegetation cover. The main objectives of this work are 1) analyzing the evolution of a valley bottom gully and its relation with land use and vegetation cover, 2) evaluating the influence of the total amount of precipitation on gully growth and finally 3) exploring the role of land use and vegetation cover on the coefficient a and exponent b included in the equation $S=aA^{-b}$ (where S is slope at headcut and A is drainage area), which is based on the topographical threshold concept and is commonly used to predict the gully initiation.

The study is carried out in a small catchment (99.5 ha) located in the southwest of Iberian Peninsula. The topography is undulated with an average elevation of 396 m and an average slope of 7%. Climate is Mediterranean with a pronounced dry season. Annual and interannual rainfall variation is high with an annual average of 510 mm. The gully is incised into alluvial sediments fill of approximately 1.5 m. In most parts of the catchment soils are very shallow, developed on schists. Nowadays the land is grazed by sheep and seasonally by pigs and presents a disperse tree cover of Holm Oaks (*Quercus rotundifolia*).

The basic information of this work are the maps of gullying, land use units and vegetation cover for the years 1945, 1956, 1989, 1998, 2002 and 2006. To elaborate these maps it was necessary to digitize and orthorectify existent aerial photographs, using a photogrammetric scanner and software. Above the orthophotographs, and using a

GIS, the maps of gullying and land use for each of the dates was created. Aditionally, the geometric quality of the orthophotographs was tested, based on comparing length and area measures of different elements (enclosures, walls, country houses, etc.) determined in the field and tranfered to orthophotographs. Test results show a RMS from 0.19 m to 1.20 for length measures and a RMS from 1.09 m^2 to 5.81 m^2 for area measures.

To analyze the relation between precipitation and gully growth it was necessary to correlate data of different places (*Cáceres*, *Monroy* and the catchment) and dates, and then extrapolate them for the catchment for the full study period (1945-2006). We found a close correlation between different precipitation datasets with a R^2 of 0.81 and 0.98. However, no relations were detected between total precipitation and the evolution of the gullied area for the different periods.

Regarding the area affected by gullying, the results show an increase from 695 m^2 in 1945 to 1009 m^2 in 2006, reaching a maximum of 1560 m^2 in 1956. This gullied area is closely correlated with land use, especially with the amount of cultivated area within the catchment (R^2 of 0.92), with a similar evolution during the study period.

Finally, the obtained values of the b exponent for different headcuts in different dates (close to -0.5) are similar to those proposed by other authors for erosion caused by Hortonian overland flow in semiarid environments and permanent channels.