

SURFACES OF GULLIES GENERATED BY PIPING PROCESS IN ABANDONED FIELDS (SOUTH-EAST OF SPAIN)

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1. Introduction

In the Region of Murcia, the areas where the development of gullies is very important are numerous, in particular in the Neogene-Quaternary sedimentary basins that are filled with marl. In these basins, historically valley bottoms were terraced and turned into culture fields. More recently, from the decade of sixties and seventies to the present time, these terraced culture fields were abandoned and then processes of erosion by “piping” have affected very remarkably. As it is known, this is a process of subsuperficial erosion, that originates underground tubular conduits (pipes), with later loosening, that usually evolve to gullies, sometimes quite deep, with vertical walls. In this way, a new surface of gullies has settled on these areas, due to human origin.

Different areas of badland related to piping have been studied in the Region of Murcia: Harvey (1982) in Sucina; Romero Díaz and Lopez Bermúdez (1985), López Bermudez and Romero Díaz, 1989), and Romero Díaz et al. (2007), in the River basin of Mula; Vandekerckhove et al. (2000) and Poesen et al. (2002), in the Guadalentín river basin, etc.

It is important to mention how the areas with piping, in the Region of Murcia, are associated to areas of badland and, very specially, to lands that were cultivated and that currently have been abandoned (Sanchez Soriano et al., 2003). The reduced productivity of most of these lands and the process of water erosion affecting these soils, which implies a high cost of maintenance of the culture parcels, are the fundamental reasons for its abandonment. After them, the appearance and/or evolution of piping processes, in susceptible lands, take place immediately.

2. Study area

The studied area is located in the basin of the Mula river, in the municipal term of Campos del Rio, right margin of the Mula river (Figure 1). In the present time it is an area intensely affected by water erosion processes, which explains why it presents an important development of gullies and ravines. Great part of the bottoms of lowest part of valleys were terraced and used as cereal culture first, and as almonds tree culture later in some of them, until approximately the seventies of the last century. Since these days a progressive abandonment has been taking place, and the irreversible deterioration of these culture fields, where the piping process is very developed.

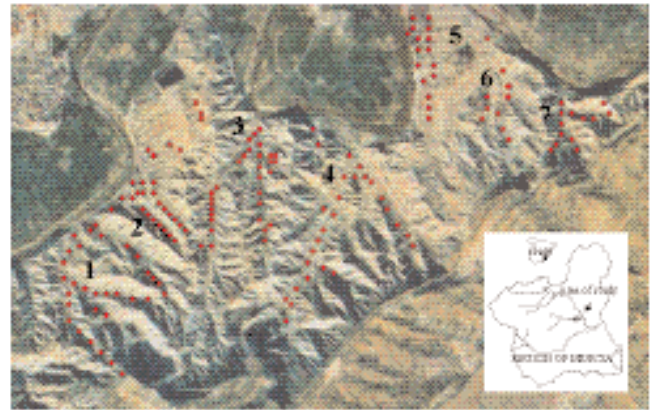


Fig. 1. Study area in the Mula basin (Region of Murcia). The points are plots affected by piping and gullies.

The Mula basin constitutes a Neogene-Quaternary basin that presents an advanced state of excavation. The present hierarchized drainage and canalized by the Mula river towards the Segura river has drained, and continues doing it, the depression composed of marls-clayey. The climatic characteristics are semi-arid, with an average temperature of 17 °C and annual average precipitations around 300 mm, but with a high irregularity and frequent extreme episodes.

The soils are Calcaric Regosols, developed on marls. The present few existing vegetation does not have the sufficient protective character that these soils need.

The development of the important existing bad-lands in the Mula basin is due fundamentally to the lithology and to the topographic configuration. In the area studied the marly filling is culminated by sandstones levels, that dip slightly towards the Southeastern, delimiting the area of bad-lands and forming a scarp. The remarkable existing topographic gradient between the level of sandstone units and the nearby channel of the Mula river (15% of slope) has favoured the erosion development in gullies and ravines in all this area, becoming thus very important.

3. Methods

The study of piping has been realized from detailed cartographic recognitions, aerial photo interpretation and meticulous field works, next to the determination of some soils analytical parameters. For the recognition of the different areas, at different times, available aerial photograms

have been used (years: 1956-1978-1984-1999). For the field works the cartography on 1:5.000 scale in line map and orthophotomaps has been used (Figure 1).

By means of the field work the pipe areas have been located and studied their forms and dimensions. Slopes, surfaces, pipe depths, different terraces from culture, altitudes, etc., have been measured with the purpose of relating these data to the different processes that characterize the appearance and the development of piping. On the other hand, these data provide us with important information about the new generated areas of gullies as a result of the pipe evolution.

The study zone has been divided in seven areas that are those displayed in figure 1.

4. Results and discussion

The measurements made show the existing relation between the depth of pipes and the height between agriculture terraces. The development of pipes is so that the pipes may connect two consecutive agriculture terraces, with a length over 8 metres (Figure 2). It should be mentioned how the importance of the hydraulic gradient like one of the generating causes of pipes, since it has already been done by many other authors.



Fig. 2. Gully generated by piping in an abandoned terraced plot.

In most cases, the pipes appear aligned and interconnected, both between the existing ones in the same field and/or between terrace plots having itself generated a new network of drainage, like the one that existed before the terraced plots.

The 7 studied areas occupy altogether a surface of 26.7 hectares, of which 17.6% are affected by processes of piping. 70.7% of the historical layers terraces are affected by piping and 5 hectares are seriously affected (Table 1). It is in these last plots where are hardly recognised, giving way to deep gullies formation.

Table 1. Surfaces affected by piping in the study area.

Area	Surface affected by piping %	Plots affected by piping			Seriously affected hectares
		Nº	%	Hectares	
1	11.9	18	72.0	1.4	0.32
2	20.0	2	66.6	0.7	0.23
3	8.9	19	50.0	1.8	0.53
4	6.8	26	88.5	4.9	0.94
5	9.3	8	40.0	1.9	1.12
6	25.7	13	86.6	2.0	0.79
7	40.5	11	90.9	0.5	0.43
Total	17.6	Σ=97	70.7	Σ=13.2	Σ=4.36
o					
mean					

5. Conclusions

The piping process have an important development in old agricultural terraced fields. The abandonment of these fields, together with the lithologies, hydraulic and climatic characteristics favour the quick development of pipes. Its subsequent evolution is the development of a landscape with gullies, with a deteriorated and non-recoverable space for agricultural use, in addition to constituting an important sediment source with elevated rates of erosion.

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