

## Land use changes and development of piping and gullies in Southeast Spain

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**Abstract:** In semiarid regions with low rainfall, poorly developed soils and marly lithologies, land abandonment leads to an increase in soil erosion and degradation processes. In some cases, the initiation of piping processes and the emergence of gullies takes place not long after its abandonment.

**Keywords:** land use changes, piping, gullies, semiarid region, Spain

### Introduction

Although the origin of the great erosive landscapes in SE Spain is more related with tectonic factors than with anthropic activity or even climate (Alexander et al. 1994, Wise et al. 1982), Wainwright & Thornes (2004) consider the erosion produced by agriculture a key factor in the evolution of the Mediterranean landscape since prehistoric times. This type of erosion occurs in a diachronic way as the new technologies arrive to different settlements. Moreover, most of the key processes in the present day degradation/desertification process are related with agriculture (López Bermúdez 2006), being the most significant environmental impact factor in the Mediterranean basin, although the important increase in industry and tourism during the second half of the last century (Wainwright & Thornes 2004).

Land use changes in Murcia Region are, as in the rest of the Mediterranean basin, closely linked with socio-economic dynamics, specially with the depopulation of rural areas (López Bermúdez et al. 1995, Barberá et al. 1997, Kosmas et al. 2002), government intervention and market conditions (García Ruiz & López Bermúdez 2009) although certain natural thresholds related with soil depth or plant growth are to be taken in to account (Thornes 2009).

The most remarkable land use changes in Murcia Region during the last 50 years are related with the abandonment of dry lands; an increase of irrigated areas, specially of modern irrigation in coastal areas; and the increase of urbanization. Romero Díaz (2003) quantifies the land abandonment in Murcia Region in 100,000 has (9.1% of the regional surface) since 1980. Most of this abandonment has occurred in neogene-quaternarie basins on easily erodible marls.

Land abandonment effects can be positive or negative depending on climate and soil conditions in the area (Kosmas et al. 2002). The Region of Murcia is characterized by a large environmental variability (López Bermúdez et al. 2003, Faz Cano 2003, Conesa García 2006) implying a large amount of possible consequences.

In general, it is accepted that abandonment allow for a reduction of runoff and erosion, as it has been empirically observed (García Ruiz & López Bermúdez 2009). That is usually correct in limestone areas (Romero Díaz 2003) where a slow recovery of organic mater content has been observed (López Bermúdez et al. 1998, Martínez Fernández et al. 1994, 1996, Belmonte Serrato et al. 1999).

However, where the lithology is dominated by marls the situation is very different due to the presence of sodium and expansive clays that reduce the stability of aggregates (Cerdá et al. 1994) and facili-



**Fig. 1.** Study area in the Región of Murcia (Spain)



**Fig. 2.** Pipe measurement

tate the formation of piping processes (Romero Díaz 2003, López Bermúdez & Romero Díaz 1989) triggered by high hydraulic gradients related with the presence of terraces (Fig. 1).

## Methodology

The study was conducted in a marl basin of the Region of Murcia (southeast of Spain) where the cropland, olives and almonds, after its abandonment

30–40 years ago have created a new landscape dominated by pipes and gullies.

We have studied several terraced areas where erosion processes are obviously important and where detailed observations and topographic surveys have been made. Detailed observations and measurements (calculating plot surfaces and erosion rates) have been taken out (Fig. 2). The surface per plot and affected area has been calculated, and erosion rates have been estimated having as reference the time when the fields were abandoned.

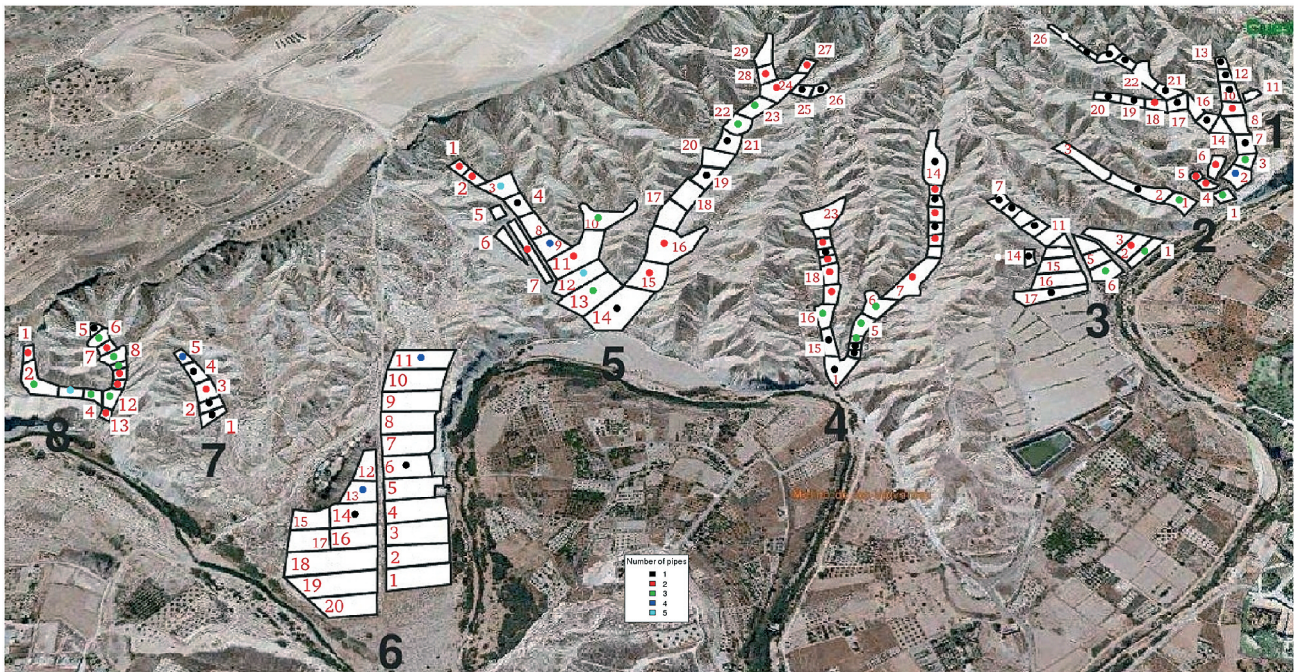


Fig. 3. Number of pipes per cultivation plot

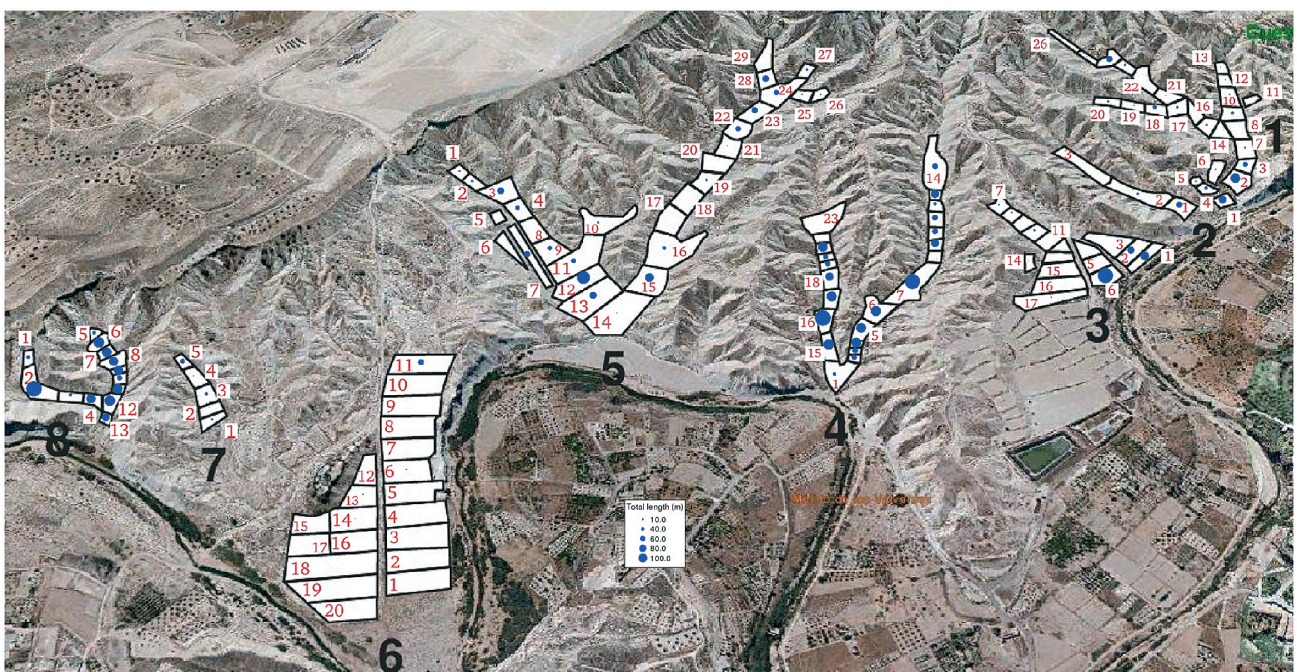


Fig. 4. Total length of pipes

An exploratory analysis integrating information about the pipes with environmental conditions is being developed to detect which factors are the most important to explain the evolution of quantitative variables used to characterise pipes.

### Results and discussions

As can be seen in Figure 3, there is not a random distribution of pipes, but a strong development in

some areas (1, 4, 5, 7, 8), and lower in others (3.6%), finally area 2 is difficult to allocate because it has just 3 cultivation plots.

Terracing, a usual conservation practice, in environments like the studied here, has been demonstrated not effective. Terraces create a hydraulic gradient high enough for the development of piping processes. The higher the terraces the larger the erosion rates and the pipes length (Fig. 4, 5 and 6).

The average erosion rates by plot are bigger than 200 ton ha<sup>-1</sup> yr<sup>-1</sup>, which indicates the importance of

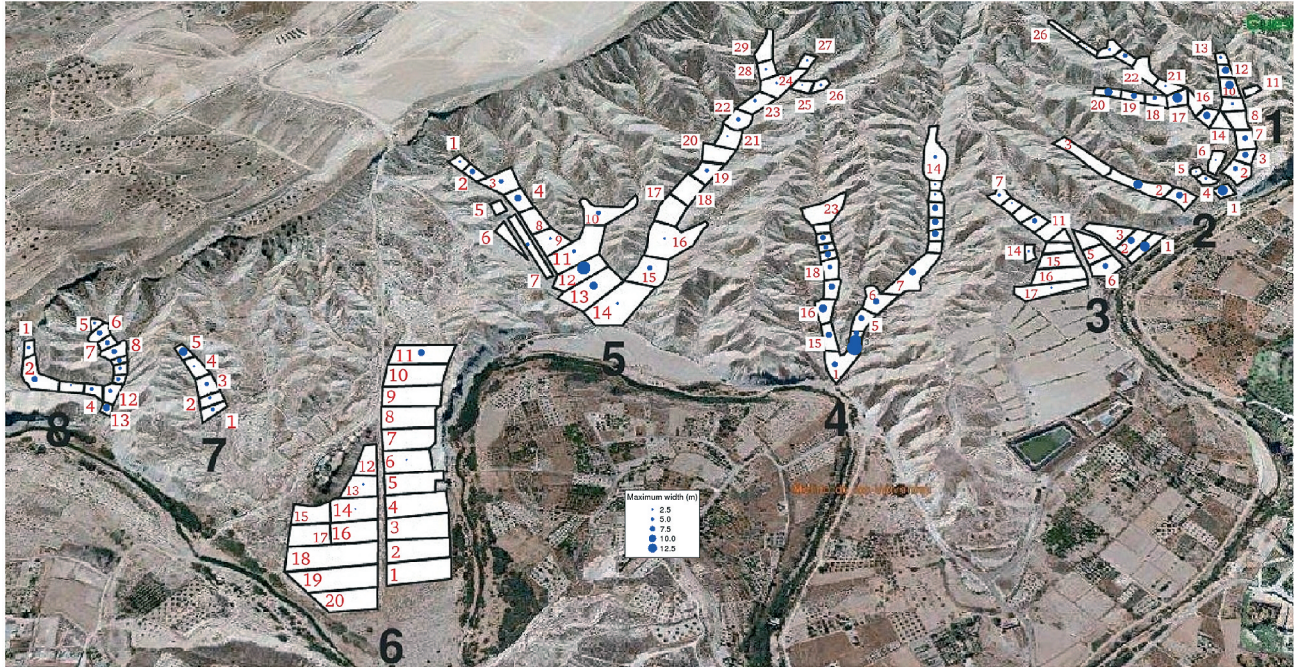


Fig. 5. Maximum width of pipes

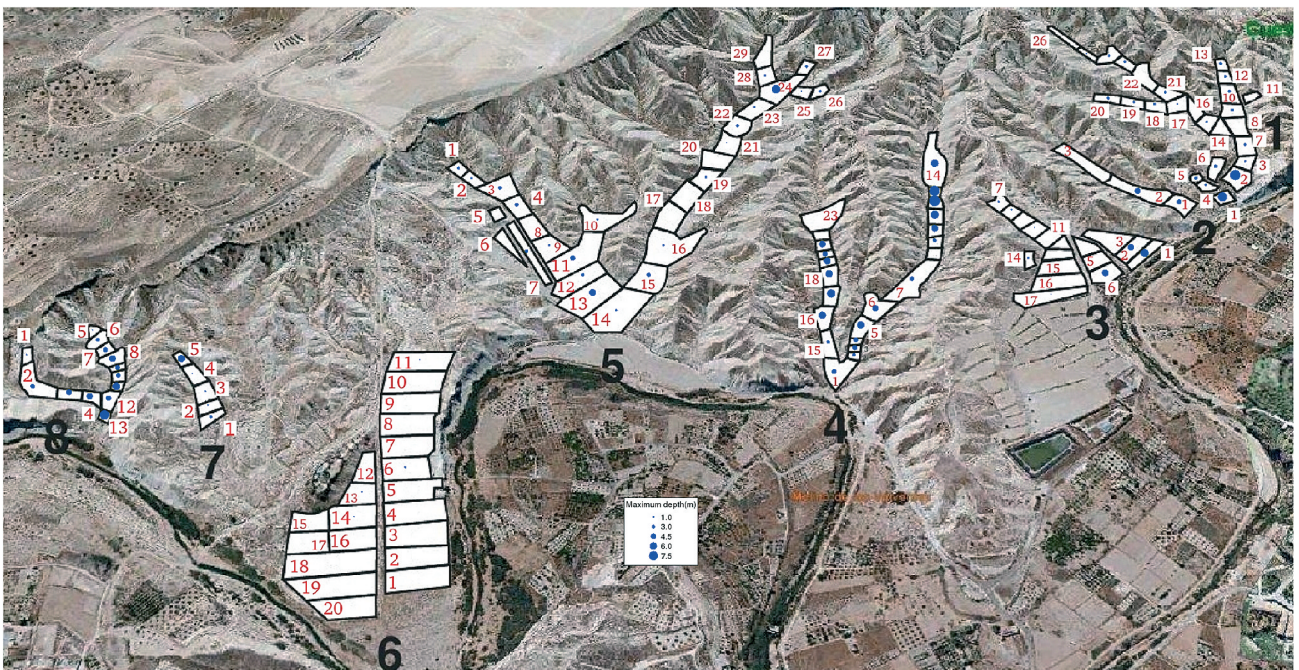


Fig. 6. Maximum depth of pipes

this human action, consequence of fields abandonment.

Moreover, is important to highlight, how a common conservation practice like terraced, in areas such as those studied here, also results counterproductive. The terraces create the hydraulic gradient necessary for the development of piping processes and the higher terraces are built, the greater the degree of erosion can be achieved.

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