

THE IMPORTANCE OF THE PRESENCE OF GULLIES IN THE PRODUCTION OF SEDIMENTS IN SEMIARID AREAS (MURCIA, SOUTH-EAST OF SPAIN)

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1. Introduction

Numerous authors have already put in evidence how areas with marly lithologies produce greater amount of sediments than other lithologies (Cerdeira, 2001; Romero Díaz, 2002). If, in addition, in them gullies, which can evolve quickly in semi-arid areas, are influenced by local climatic conditions, the erosion rates can remarkably increase.

In a study made on 425 dikes for hydrological correction, we have been able to verify and quantify, in a direct way, (i) the erosion rates and sedimentation that took place in the different flowing areas from each one of the dikes, (ii) the variation appearing between the different lithologies, and (iii) in areas with and without gully development.

2. Study area

The study has been carried out in the river basin of the Quípar river, affluent of the Segura river by its right margin (Fig. 1), where the Hydrographic Confederation of Segura (HCS) carried out two Projects for Hydrological Correction (1962 and 1996) to solve the serious filling problems that underwent the Alfonso XIII dam constructed in its mouth. Put in operation in 1916 with an initial capacity of 42 Hm³ it was decreased to 14.2 Hm³ in 1976 (Romero Díaz et al. 1992).

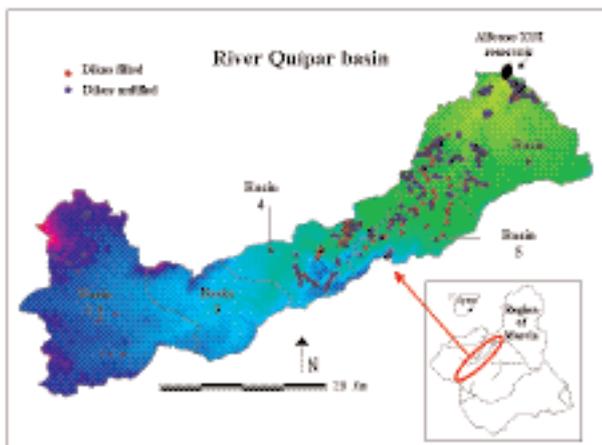


Fig. 1. Location of study area, main sub-basins and built dikes.

The works were developed in 33 ravines and gullies, where 425 dikes of gabions (stones within 1 m wide cages of metal mesh) and of masonry (cement and concrete), as well as a great quantity of dry-stone walls (HCS

1992). Using the dikes as a sediment trap, it is possible to calculate the tons of sediments retained in the sedimentation wedges, and later do an approach on the erosion rate in tons, hectare and year (Romero Díaz et al. 2006).

The most problematic zone of the river basin is subbasin 6 (according to denomination of the HCS). This is the zone nearest the dam, where the predominant lithologies are marls, marls-sandstone and clays, with a vegetal cover little developed, precipitations that oscillate between 250 - 350 mm per year and in which until mid 20th century an intensive culture of "*Stipa tenacissima*" was developed, with land preparation for such activity. The end of the commerce of "*Stipa tenacissima*" brought with it the abandonment of these lands and the acceleration of the erosive processes. The development of gullies is important to a great extent of the surface.

3. Methods

In the studied sub-basin there are 13 ravines, where 213 dikes have been constructed and which supposes 50.2% of the dikes constructed in the whole basin of the Quípar river. The amount of dikes selected for this investigation has been 165 (distributed by all the sub-basin), of which it has been possible to calculate the retained tons of sediments to date. In the non-filled dikes the rate of erosion has been calculated.

The basins have been analyzed separately in those which were predominating over the gullies and the ones that did not, comparing their results.

4. Results and discussion

The Ravines P.Nevado, Gilico, Salar, Romanos, H.Pilica and Coto are located in zones where gullies are very developed (Fig. 2).

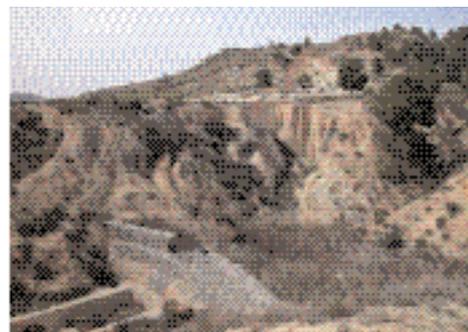


Fig. 2. Example of a increase dike for filled up of sediments in an area of marls with gullies.

According to the analyzed data (Table 1) it is observed that the ravines located in zones related with gullies have percentages of filled dikes very high, with data of up to 60% in the H. Pilica basin and of 70.5% in the Romanos basin. It is also remarkable how 42,4% of the studied dikes total, which are constructed in these zones, are filled.

The total volume of retained sediments, in the set of the dikes constructed in this sub-basin, is of 284,027 tons, of which 245,633 tons (86.4% of sediments) have been generated in areas with presence of gullies.

Table 1. Sub - basin 6. Dikes and characteristics.

Basin	Nº of dikes	Dikes filled %	Sediment retained (T)	T/ha/year
P. Nevado*	17	59	49.841	14.14
Bayo	5	0	7.980	1.29
Salinas	8	25	10.251	1.23
Gilico*	51	45	75.003	3.01
Casa Aire	2	50	5.507	5.33
Los Pinos	4	0	4.852	3.27
Salar*	19	63	33.235	15.9
Salero	6	33,3	3.330	10.88
Romanos*	17	70,5	63.866	1.93
H.Pilica*	5	60	12.454	4.5
Coto*	16	25	11.234	3.69
Marines	9	11,1	5.379	3.25
Losares	6	0	1.095	0.4
Total	165	42,4	284.027	5.29

* Basin with gullies

Regarding the calculated erosion rates for this sub-basin, 60% of the dikes have a lower erosion rate than 2 t/ha/year; 23% of dikes have a rate of erosion that oscillates between 2 and 5 t/ha/year; 17% remaining compose the dikes that have a rate of greater erosion than 5 t/ha/year, emphasizing the dikes constructed in ravines next to the zones of gullies with rates superior to 60 t/ha/year.

The average erosion rate in functional dikes (not filled) in this sub-basin is of 5.29 t/ha/year, being the highest erosion rate of all the river basin of the Quípar River. In sub-basin 1-2-3 (located in head-board and with predominance of quaternary materials, conglomerated and limestone), the obtained rate has been of 0.71 t/ha/year, in sub-basin 4 (with predominance of conglomerates and limestones) a value of 3,39 t/ha/year was obtained, and in sub-basin 5 (also with predominance of the same type of materials) a rate of 2.64 t/ha/year was obtained.

If figure 3 is observed, where the rates of erosion and their frequency of the existing dikes in basins with and without gullies have been represented, it is verified how the dikes located in settled areas of gullies they retain a greater quantity of sediments eroded upstream, which means that its rates of erosion are considerably superior to the registered ones in the dikes located in areas without predominance of gullies.

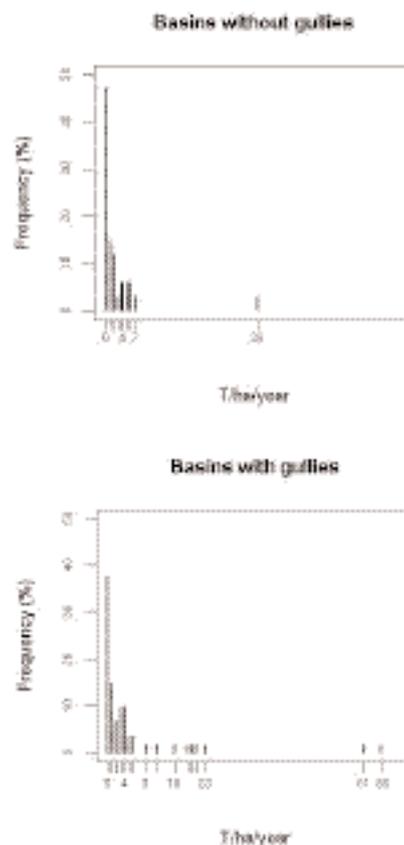


Fig. 3. Frequency of dikes and erosion rates in basins with gullies and without them.

5. Conclusions

The study has shown how the existence of gullies remarkably increases the rates of erosion and, therefore, the volume of sediments that arrives at the dikes of hydrological correction. A consequence of this is the need to carry out works of this type in basins with reservoirs to avoid its filling, in spite of the little life utility of the constructed dikes.

Acknowledgements: Part of the work reported in this paper was financially supported by the Ministry of Science and Technology and FEDER funds, Research Project REN2002-03426/HID.

References

- Cerda, A. 2001. *Erosión hídrica del suelo en el territorio valenciano*. Geoforma Ediciones. Logroño, 79 pp.
- Romero Díaz, A., Cabezas, F., López Bermúdez, F. 1992. Erosion and fluvial sedimentation in the River Segura Basin (Spain). *Catena* 19:379-392.
- Romero Díaz, A. 2002. *La erosión en la Región de Murcia*. Servicio de Publicaciones de la Universidad de Murcia. Murcia, 337 pp.
- Romero Díaz, A., Alonso Sarria, F., Martínez Lloris, M. 2006. Erosion rates obtained from check-dam sedimentation (SE Spain). A multi-method comparison. *Catena* (doi:10.1016/j.catena.2006.05.011).