Transforming Unsustainable management of soils in key agricultural systems in EU and China

Developing an integrated platform of alternatives to reverse soil degradation

Gully control

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Target area

Agricultural areas are usually the areas of the territory most affected by erosion. This is a consequence of reduced vegetation cover and modified soil properties (usually less organic matter and higher compaction) that produce higher runoff in the areas of flow concentration (troughs) as well as a lower resistance to erosion. Water erosion in gullies occurs when the energy of the flow exceeds the resistance of the soil to being washed away. The basic processes of gully development are vertical erosion (or incision), lateral erosion (at the foot of the slope) and slope failure. The first process tends to deepen the gully, while the latter two processes favor its widening. The advance of the gully network can continue as long as the conditions of imbalance between energy available for erosion and resistance to erosion persist. The areas of action will be those where the concentration of flow leads to gully formation.

Problem identification

Detection of rills and gullies can be supported by the TUdi Decision Support Tool app available under **dev-tudi.web.app**

Detailed description of protection

Gully erosion is a serious problem affecting many agricultural holdings around the world. The objective of the control of a gully is the establishment of a stable trough capable of safely evacuating the flows generated in the upstream contributing catchment. Stabilization of the gully involves:

- Minimizing erosive processes.

- Stopping the increase of its dimensions (length, width, and depth) in order to protect productive surfaces.

- Ensuring that there is a sufficient cross-section to discharge runoff water.

This usually requires a combination of engineering and revegetation measures. As biological measures are often essential in the long-term stabilization of the gully, gully control usually involves naturalization and increased diversity. Thus, control actions contribute to the triple objective of protecting productive areas, restoring the drainage functionality of the gullies, and diversifying the agricultural landscape.

There are three basic types of gullies that can be distinguished for control according to their size:

Type 1. Shallow gullies with little flow: the gully could be plugged and shaped by filling in adjacent areas with soil and then sowing with herbaceous species. Low obstacles can be constructed at a high spacing to reduce the water velocity and slow down the possible advance of the incision. In this case, the passing of machinery would be guaranteed, bearing in mind that it is necessary to modify the mode of operation in certain management practices to ensure the maintenance of the vegetation cover permanently.

Type 2. Medium-sized gullies: they perform with basin dams (up to about 1 m high) and revegetation. Basin dams made of different materials and techniques are among the most effective alternatives for gully control (Figure 1). These are gullies which, once corrected in a first control cycle, leave a free surface for the evacuation of flows and present a reduced difference in level between the surrounding surface and the base of the gully. It is feasible to execute machinery passes in multiple sections of the gully.

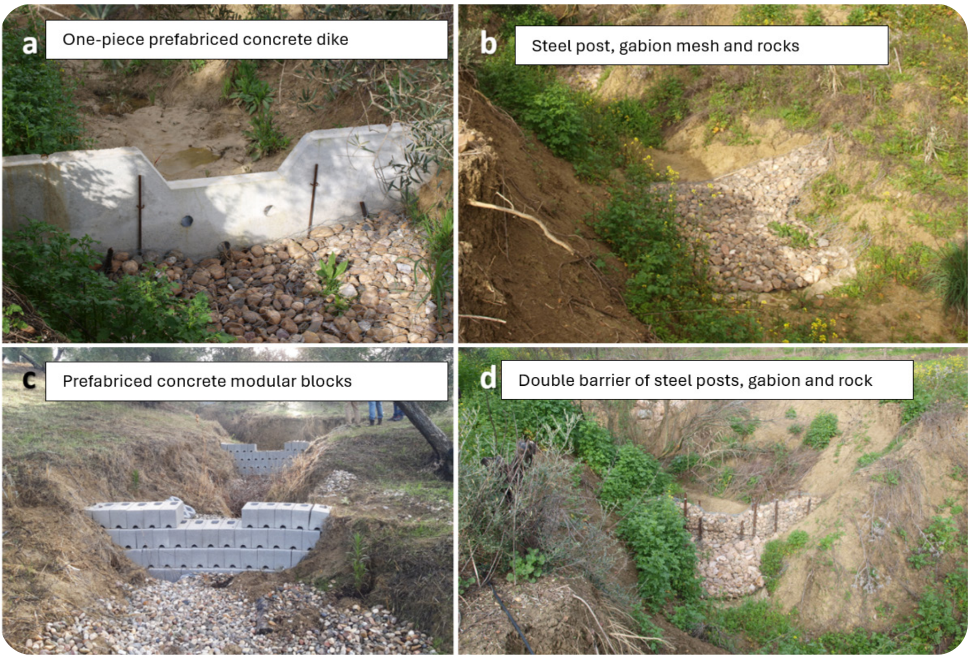

Fig. 1: Control gully dikes with different construction techniques.

Type 3. Large gullies: intervention with basin dams (up to approximately 1 m height) and revegetation. There are sections in the gully that, once the dikes are filled, present a significant difference in level between the margins and the base. The restored free section is much larger than necessary for flow evacuation. It could be considered to execute different control cycles, with progressive rebuilding of the dikes, until reaching a situation similar to type 2, provided that the remaining section is sufficient to evacuate the circulating flow during a storm.

The overlap space between dikes refers to the desired compensation gradient, which depends on the effective height of the dike and affects the spacing between consecutive dikes (Figure 2). The initial height of the levee is the distance from the river bed to the top of the levee. It is also common to include a point control action at the head of the gully, the point at which the gully opens abruptly. If the gully is large, which indicates that there is a high flow, this is usually done by means of riprap blocks to prevent the advance of erosion upstream.

Pros/Cons of technique, obstacles to implementation

Gully control through a combination of engineering and revegetation techniques helps to minimize the erosive processes that occur in gullies and to stabilize canals. In order to be effective, they need to be correctly dimensioned and executed. The lack of knowledge of the different stabilization techniques using control dikes and their associated costs is often an obstacle to their implementation by farmers. In this sense, there are some tools that help to analyze and optimize the costs of gully restoration with different techniques (https://www.optcheck.es/es/).

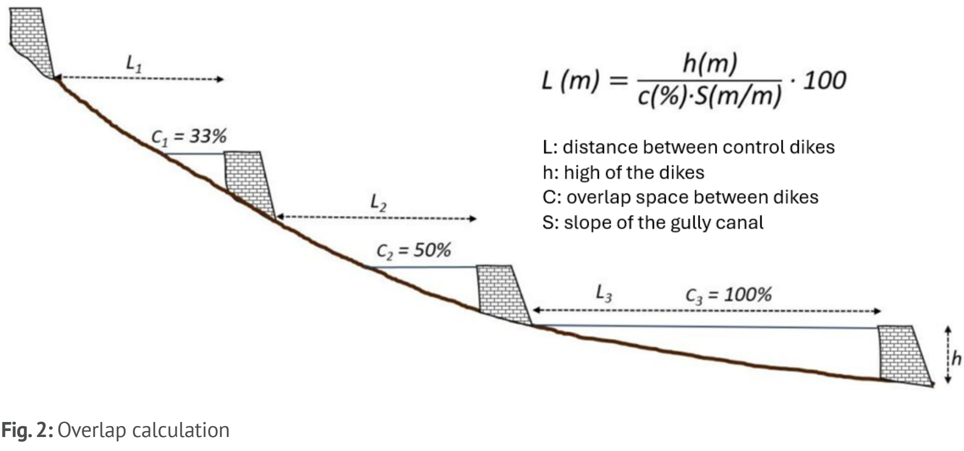

Fig. 2: Overlap calculation

Consortium

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