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Trapping efficiency of vegetative barriers in agricultural landscapes. An operational model from a review of available information

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Vegetative barriers have proven their effectiveness in controlling erosion and promoting other ecosystem services in agricultural areas. This has led to their conservation and promotion as landscape elements by the Common Agricultural Policy and other policy initiatives. However, predicting their efficiency in reducing hydrologic connectivity presents a large uncertainty (Gumiere et al., 2011).

This communication presents an analysis of trapping efficiency of sediment, runoff, and nutrients (P and N) by vegetative barriers aimed to provide a statistical approach to efficiency, based on a review of available studies, considering two climates: humid and arid/semi-arid (Muñoz et al, 2022). For this, different independent variables were grouped and identified to explore its influence: i) those defining the vegetative barrier dimension (width, slope of the plot, and area ratio buffer/plot) and ii) those related to experimental conditions (type of vegetation, soil protection of the non-buffered area, type of climate, type of experimental measurement and origin of the rainfall). A more detailed analysis was performed with the studies which reproduce similar situations to the ones occurring naturally (natural rainfall and paired plots).

In general, average trapping efficiencies for runoff and sediment are 40.1 and 62.6% and ranging between -81.0 to 99.9% and -109 to 100%, respectively. For nutrients, values of trapping efficiencies had an average of 44.9 and 38.4% for phosphorus and nitrogen, respectively. The lack of data and the large variability among and within the measurements from the studies considered in our review only allowed to detect slight trends and statistically significant differences in some cases for the different variables analysed.

In order to provide guidelines to farmers and technicians, a probabilistic model was developed for sediment trapping efficiency regarding the width of the vegetative barrier and the climatic region. The model showed that in 92% of the cases, a vegetative barrier will reduce erosion in humid climates while this trapping efficiency will be 100% in semi-arid/arid conditions. Grouping the vegetative barriers' width in different intervals, it was observed that the maximum trapping efficiency is ~80 % for a width of 2.75 to 3-m in arid/semi-arid climate and 5 to 6-m in humid regions.

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References

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