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Linking the field to the stream: soil erosion and sediment yield in a rural catchment, NW Spain

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Quantifying the linkages between field erosion, fluvial response and catchment sediment yield remains problematic, among other reasons, because of the re-deposition of eroded sediment within the catchment, which is controlled by the spatial organization of the land use and the connectivity between sediment sources and the stream network.

This paper presents the results of an integrated study that considered the relationship between erosion and stream sediment yield in an agroforestry catchment (16 km2) in NW Spain. The geology consists of basic metamorphic schist. The relieve of the area is steeper, the mean slope is approximately 19%. Main soil types are classified as Umbrisol and Cambisol. Soils are acidic and rich in organic matter. The soil texture is silt and silt-loam. Land cover consists of a mixture of forest (65%) and agricultural fields (mainly grassland, pasture and maize).

The study combined measurements of soil erosion by concentrate flow and sediment deposition at field scale with sediment yield measured at the catchment outlet. The hydrological data and water samples were obtained at the catchment outlet. Stream water level was monitored continuously and converted to discharge using a rating curve. The sampling for suspended sediments was supplemented by an automatic sampler. Suspended sediment load was calculated from the suspended sediment concentrations and discharge data.

Eroded volume was calculated from cross-sections (measured at specific points, where the section changed abruptly) and length of the channel segments. The total sediment delivered to stream was determined as the difference between all erosion features (rills and gullies) and the sediment volumes that were deposited on the fields.

The results showed that in the catchment during the period winter 2007/08 soil erosion by concentrate flow, i.e. rills and ephemeral gullies, occurred on unprotected crop field. Erosion by concentrate flow was highly discontinuous within the catchment, both spatially and temporally. The soil loss from these channels (rills and ephemeral gullies) during the study period amounted to 140.6 Mg .

When comparing the quantity of soil eroded at the field scale and the stream sediment load at the catchment outlet it was found that sediment yield from catchment was typically lower than gross erosion within the catchment. The total sediment load at the catchment outlet during the study period (winter 2007/08) was 24.60 Mg. The large difference between soil losses and sediment load in the stream indicates a significant storage of sediment in the catchment. Thus, the catchment appears to be inefficient in terms of suspended sediment export, but the fields themselves continue to experience significant on-site soil loss.