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The impact of slope on soil erosion: results from laboratory rainfall simulations

A. Armstrong and J. N. Quinton

Lancaster Environment Centre, Lancaster University, Lancaster, LA1 4YQ, United Kingdom
(alona.armstrong@lancaster.ac.uk)

Sediment and sediment-associated nutrients play a pivotal role in influencing water quality and biodiversity. Agriculture is thought to be responsible for 50% of the sediments found in surface waters, and this, coupled with the requirements of the EU Water Framework Directive, has made understanding and predicting the movement of these diffuse inputs from land to water increasingly important.

This paper provides some results of laboratory rainfall simulation experiments which were undertaken within MultiSEM, an integrated project which combines laboratory rainfall simulations, field data collection and a physically-based soil erosion model. Laboratory rainfall simulation experiments were undertaken in triplicate on 3%, 6%, and 9% slopes; a range representative of agricultural landscapes. Previous studies, which generally examined steeper slopes, observe an increase in sediment transfer with increasing slope. This pattern is not apparent in the simulation results and there was a clear difference in sediment dynamics between the 3% and steeper slopes: on the 3% slopes sediment concentration started high and declined whereas on the 6% and 9% slopes the sediment concentrations increased, peaked and then decreased. We suggest the higher sediment transfer on the 3% slopes at the beginning the event was due to greater water ponding and subsequent impacts on erosion processes. On all slopes the sediment size distribution coarsened through the event, with greater coarsening evident on the shallower slopes. Model results suggest the coarsening is related to the development of a shielding layer but increases in discharge, exhaustion of easily detached fines and ingression of fines into the surface layer may also contribute.