



Losses of soil carbon by erosion: evidence from the Woburn Erosion Reference Experiment, UK.

J.N. Quinton(1), J.A. Catt(2,3), G.A. Wood(4) and J. Steer(5).

(1) Department of Environmental Science, Lancaster University, Lancaster, LA1 4YQ, United Kingdom. (2) Department of Geography, University College London, 26 Bedford Way, London WC1H 0AP, United Kingdom. (3) Agricultural Environments Division, Rothamsted Experimental Station, Harpenden, Herts, AL5 2JQ, UK. (4) National Soil Resources Institute, Cranfield University, Silsoe, Bedford MK45 4DT, UK. (5) School of Health and Bioscience, University of East London, Romford Road, London E15 4LZ, UK

Data collected over a ten-year period from the Woburn Erosion Reference Experiment, UK are examined in order to quantify the amount of soil carbon mobilized by soil erosion in arable agriculture with different cultivation treatments and used to inform national scale modeling of carbon mobilization, delivery to watercourses and deposition in the landscape. Measured mean event carbon losses of 6.73 kg ha^{-1} from plots cultivated up and down slope were significantly higher ($p < 0.05$) than the 4.48 kg ha^{-1} lost from plots cultivated across the slope. No significant differences were found between minimal and standard cultivations. However, the across slope/minimal (AM) combination had a significantly smaller ($p < 0.01$) event carbon loss (2.74 kg ha^{-1}) than the up slope/standard treatment (US) (6.95 kg ha^{-1}) and upslope/minimal (UM) (6.51 kg ha^{-1}) treatments. 10 year mean carbon contents of the transported sediment were significantly higher ($p < 0.01$) from the A plots than the U plots, and from the M plots (4.19%) when compared with the S plots (3.72%) at the $p < 0.01$ level. Concentrations were also significantly higher ($p < 0.01$) from the AM plots (4.61%) than the US (3.39%) plots and from the UM (3.76%) and AS (4.04%) at $p < 0.05$ %. Over the ten years of the experiment the total amount of particulate carbon removed from individual plots ranged from 76 to 312 kg ha^{-1} . The mean of 312 kg ha^{-1} for the up and down slope treatment were significantly greater ($p < 0.05$) than the 135 kg ha^{-1} lost from the across slope treatments. No trends through time could be detected in either bulk losses or concentrations of carbon in the sediment. Soil carbon contents show

an initial decline from 1990 to 1992 followed by a more stable period. Where soil carbon contents were decreasing, losses by erosion accounted for 2% to 50% of that change. These results suggest that losses of carbon from sites suffering from moderate amounts of soil erosion are significant. Using a sediment delivery model combined with carbon enrichment data from this study and the literature we calculate that the amount of carbon mobilized by erosion in England and Wales is between 0.2 and 0.76 Tg C y⁻¹ of which 0.12 to 0.46 Tg C y⁻¹ is delivered to surface waters. If this is assumed to be completely replaced and the eroded material is protected from decomposition in sediments then there is a potential sink on eroding cropland in the UK of up to 0.76 Tg C y⁻¹. This sink is comparable to those associated with arable land management changes, such as straw incorporation and no-till and represents a significant uncertainty in the terrestrial carbon budget.