THE EFFECT OF DREDGING ON NUTRIENT DYNAMICS IN AN IRISH AGRICULTURAL CATCHMENT

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ABSTRACT

The River Clarianna catchment (29.8 sq. km) near Nenagh Co. Tipperary was studied to investigate the sources, movement and sinks of phosphorus (P) within a typical Irish lowland agricultural catchment under various seasonal, meteorological, hydrological, soil-type, and land-use conditions. The area is characterized by intensive agriculture with 42% of land in dairying, 13% in tillage and the remainder largely in drystock. Approximately 38% by area of soil is in soil P Index 4 (P > 10mg P/l) and does not require the addition of P to achieve its agronomic potential. Farm P balances indicate a P surplus of 3 kg P/ha/year. Soil-P analysis, streamwater chemistry, hydrology, meteorology, and groundwater chemistry monitoring was carried out. Streamwater monitoring took a nested approach, with stations at 0.8km^2, 7.3km^2, 13.6 km^2, and 29.8 km^2 in order to allow the examination of scale effects of a number of orders of magnitude. The monitoring programme ran from September 2001 to March 2003. Dredging, which is carried out every four to six years, occurred from July to December 2002. Analysis of hydrological and streamwater chemistry data indicate that streamwater P concentrations increase with flow and that most P is lost during high flow events. In contrast a dilution effect is observed with total oxidized nitrogen (TON); there is a decrease in concentration with an increase in flow. The mini-catchment (0.8km^2) is very responsive to rainfall due to its less permeable nature, with drainage from a raised bog and overland flow being the main source of discharge. In the permeable lower sub-catchments where there is a large subsurface influence on river discharge, there is a more buffered response to rainfall. These differences cause differences in both the concentrations and forms of phosphorus found. In general the total phosphorus (TP), total dissolved phosphorus (TDP) and dissolved reactive phosphorus (DRP) concentrations are much greater from the mini-catchment (0.091, 0.037 and 0.026 mgP/l respectively) than the lower subcatchments (0.035, 0.026, 0.024 mgP/l at outflow). Particulate phosphorus (PP) also makes up a greater fraction of TP from the mini-catchment (pre-dredging average of 59%) than the lower sub-catchments (pre-dredging average at the outflow of 26%). A classical clockwise hysteresis behaviour is observed with TP, TDP and DRP at all stations. The concentrations on the rising limb of the hydrograph are higher than those on the falling limb at equal discharge. During and after dredging similar behaviour in nutrient dynamics was observed but was quantitatively greater, except in the case of TON, which remained unchanged. During dredging suspended solid concentrations increased over one hundred fold. This was accompanied by a concentration increase in TP of over tenfold, primarily due to an increase in PP, as the dissolved fractions (TDP and DRP) only increased twofold. This shift in the relative importance of particulate phosphorus was significant (from 26% to 89% at the outflow). The export of phosphorus from the catchment prior to dredging was, on average, 0.28 kg/day. Since dredging this has increased to 2.2kg/day. Export rose to a maximum of 28 kg/day during the dredging, indicating the importance of sediment as a sink for P and also as a source of P when re-entrained into the water column. Residual impacts continue.

KEYWORDS: ***nutrient dynamics, agricultural catchment, dredging***