Impact Case Study

UoA 7: Earth Systems and Environmental Sciences

Changing Water Policy in the Republic of Ireland

Summary

Research undertaken by Professor Phil Jordan on nutrient pollution from land to waters has led to significant changes in government policy related to Waste Directive (WD) compliance in Ireland and in expectations for Water Framework Directive (WFD) implementation. The WFD is EU-wide legislation requiring that all water-bodies should be of at least good ecological status by 2015.

Inclusion of Professor Jordan's research on the specific environmental risk of rural point source pollution in assessments of septic tank system risk resulted in the overturning of a European Court ruling under the Waste Directive; this in turn lead to the lifting of daily fines of €19,000. He also contributed to research providing scientific evidence that bio-physical lag times preclude the achievement of WFD water quality targets from diffuse pollution by 2015. This has led to targets for good water quality in all River Basin Management Plans being extended without the threat of European fines.

Research

Since 2001, Professor Jordan's research at Ulster University has specifically focused on the history, processes and policies of nutrient (nitrogen and phosphorus) pollution in rural catchments and the freshwater eutrophication process.

Lake sediment work in the Oona Water tributary of the Irish cross-border Blackwater River (Jordan et al., 2001) demonstrated that a modern conceptual model of soil phosphorus accumulation, transfer and pollution was valid over a c.100 year period; and the rate of historical lake eutrophication was the same at the small (c.1km^2) lake catchment scale as the very large Lough Neagh (c.5,000 km^2) lake catchment scale in Northern Ireland.

The work in the Oona Water catchment was further developed with the NERC funded "Catchment Hydrology and Sustainable Management (CHASM)" infrastructure project and the Irish Environmental Protection Agency funded "Eutrophication from Agriculture Sources" project. This research lead to a conceptual framework for both diffuse and point source nutrient pollution in soils of low permeability which was used to advise government on eutrophication mitigation strategies.

As a direct development of this research, in 2004 Prof Jordan led the EU INTERREG IIIa funded Blackwater TRACE (Trans-boundary River-basin Action for Community and Environment) project which sought to test the efficacy of emerging and proposed WFD mitigation measures. The project collected high resolution chemical water quality data sets in three small (3-5 km^2) agricultural grassland sub-catchments and developed a bankside analyser instrumentation suite from equipment which had formerly been used in water treatment plants. This novel approach meant that, for the first time, water sampling for nutrients (Jordan et al., 2007) could be undertaken at high resolution (sub-hourly) and synchronous with river discharge. These data were subsequently used to test theories of river chemistry monitoring from less frequent data and to evaluate the use of new technology passive samplers (Cassidy and Jordan, 2011; Jordan et al., 2013).

The technique and robust equipment suite used for high resolution nutrient monitoring in rivers has since been used in a number of other high profile catchment studies (e.g. the Irish Agricultural

Catchments Programme, the UK Demonstration Tests Catchments, and the North Wyke Farm Platform).

Blackwater TRACE also included specific research into reducing phosphorus from excessively fertilised soils and replacing defective septic tank systems; the high resolution monitoring demonstrated pressures from these sources at both high and low river discharges. The results showed that soil phosphorus declines would be slow to achieve in the impermeable soils near the Blackwater River and would not necessarily be mirrored by synchronous changes in phosphorus concentrations during diffuse high flows in rivers (Campbell, 2013).

Through additional research, the results also demonstrated that replacing defective septic tank systems would only be successful if a planning strategy to avoid clusters (i.e. increased densities) in headwater systems was developed (Macintosh et al., 2011) – otherwise septic tanks would continue to be an environmental risk to the on-going eutrophication of headwaters during low summer flows in Ireland and elsewhere (Arnscheidt et al., 2007).

Impact

This research on septic tank system risk was recognised as a specific environmental risk and the principle of septic tank clusters on impermeable soil types was included in a revised risk assessment by the Irish Environmental Protection Agency. Previously, pathogenic contamination of groundwater from faecal matter in 25% of water samples was referred to the European Court of Justice resulting in a lump sum fine of €1.8m and a daily penalty payment of €19k until the infringement ended. The published inclusion and adoption of the environmental (and health risk) assessments, lead to daily EU fines being lifted on the 12th February 2012.

These themes were continued and augmented by Professor Jordan during a three year secondment period as Principal Scientist to Teagasc, the Irish Agriculture and Food Development Authority (01/01/09 to 31/12/11). Soil controls on diffuse pollution were validated in multiple soil types (Jordan et al., 2012) and the impacts of septic tank systems were reproduced. The techniques have also been used for the first time to investigate nutrient fluxes from karst springs and this on-going research has developed theories of critical source areas of diffuse P pollution in karst landscapes (Mellander et al., 2013).

In one companion study during this secondment period, the decline of excessive soil phosphorus was modelled to predict the time taken to reduce to an agronomic optimum under fertiliser deficit scenarios – and so become environmentally benign to diffuse pollution (Schulte et al., 2010). Here, lag-time scenarios of 7-20+ years were predicted, independent of soil type, and this validated the work in the Blackwater River catchment. In a partner study to this, a groundwater model of nitrate-nitrogen flux was developed to show how there was also a lag-time associated with high nitrate concentrations leaving a polluted aquifer and that this was dependent on metrics of soil permeability and on the geology controlling both vertical and lateral nitrate fluxes (Fenton et al., 2011).

This research indicated that there were bio-physical constraints that would ultimately hinder achieving water quality targets according to WFD deadlines. The original measures proposed to achieve these targets were deemed appropriate but only if sufficient time was allowed between implementation and effect.

The findings provided evidence for a more phased time frame for compliance with the WFD water quality targets and as a direct result, and following consultation with the EU, all River Basin Management Plan targets were amended to account for revised lag-times – up to 2027 for achieving 100% good status. The work has greatly benefitted the Irish Department of Environment, Community and Local Government which has overall administrative responsibility for WFD compliance via individual River Basin Districts.

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