A CATCHMENT APPROACH TO EVALUATE THE NITRATES DIRECTIVE NATIONAL ACTION PROGRAMME IN IRELAND

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Introduction

The effectiveness of agricultural measures implemented in Ireland in response to the EU Nitrates Directive is being evaluated by an Agricultural Catchments Programme funded by the Department of Agriculture, Fisheries and Food. The Programme is monitoring nutrient sources, hydrological pathways, water quality and socio-economic impacts in seven catchments across the country from 2008 to 2011. This paper describes the Geographic Information Systems (GIS) approach used to select representative and physically appropriate catchments for the Programme.

Methods

An objective, desk-top GIS-based approach was used to select six surface water catchments that represented the enterprise types and intensities across Irish agriculture. Initial catchment selection criteria were;

- catchment size - 4 to 12 km^2
- stream size - headwaters to stream order 3

Catchments were then ranked using a GIS-based multi-criteria decision analysis (MCDA) based on the:

- proportion and intensity of arable or livestock enterprises
- occurrence of non-agricultural areas, density of housing, proportion of peat soils and proportion underlain by limestone
- risk of either nitrogen (N) or phosphorus (P) loss to surface and/or groundwater-dependant streams, where risk was based on source (livestock or arable intensity) and transfer (soil and geological drainage and permeability) factors

The highest-ranked eligible catchments were then inspected for practical considerations. Predicted N and P loss risk of two of the selected catchments were compared with N and P concentrations of grab samples collected in winter event and baseflow conditions.

Results and Discussion

Over 1000 catchments, eligible on size and order criteria, were initially identified (Fig 1a), followed by the fifty arable and grassland catchments ranked highest in the MCDA (Fig 1b). Six catchments were then selected from the subset; four on grasslands and two predominantly arable (Fig 1c). In general, the GIS-MCDA approach was highly efficient in handling the large number of input datasets and attribute ranges.

No suitable limestone geology catchments were identified however because these tend to occupy low-lying parts of larger catchments and and/or tend to support generally lower intensity agriculture. Instead, a suitable catchment was identified over a karst region by expert knowledge and data mining.

The risk mapping procedure appeared to provide reasonable indications of the relative risks of N and P loss (Fig. 2) and was likely strengthened by agricultural data being made available to this project at a previously unavailable high level of resolution (townland scale).

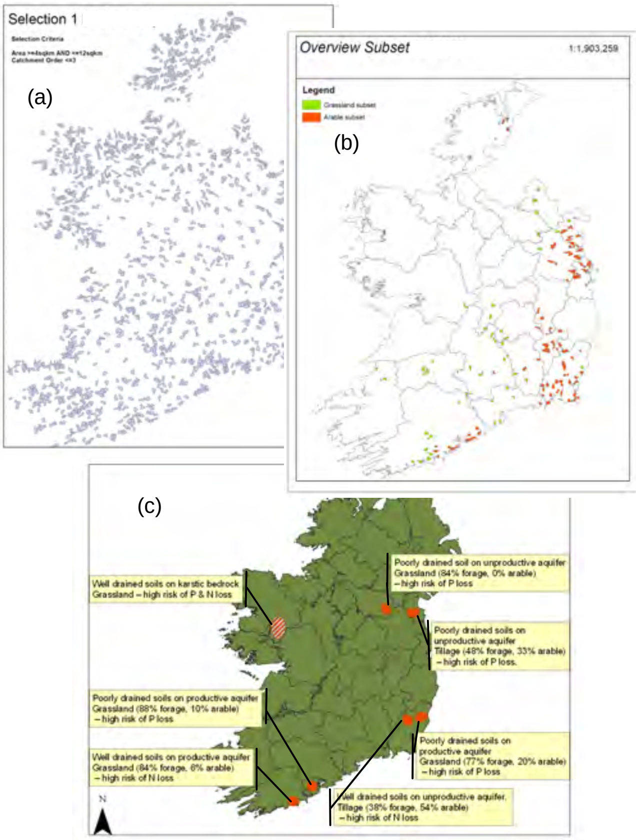

Fig. 1. Catchments selected catchments were selected using GIS analysis and practical considerations

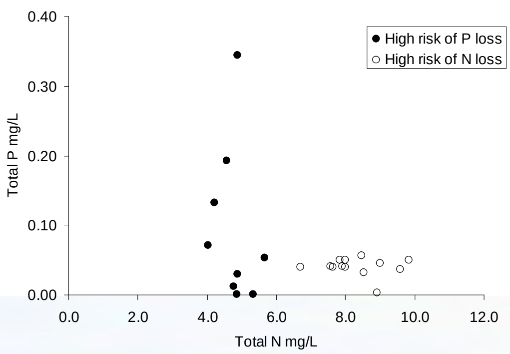

Fig. 2. Total P and N concentrations in preliminary water samples from catchments with high predicted N or P loss risk

Conclusions

The top-down, GIS-MCDA procedure provided an objective, comprehensive and efficient approach for selecting candidate surface water catchments. Preliminary water quality data indicated that the mapping procedures were useful indicators of the risk of N and P loss at the catchment scale.