

Water Pollution Control Under Uncertainty in Scotland

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Introduction

Diffuse nitrogen pollution related to agricultural land uses, a common water quality problem in the Western Europe and is the one of the main obstacle to Scotland achieving EU's Water Framework Directive standards. The main sources are fertiliser use and livestock production. Compared to point pollution it is hard to monitor and regulate. It especially affects groundwater systems and has very long response period to mitigation and recovery measures.

Results

We have designed an integrated modelling framework (Figure 1) that considers biophysical aspects of nitrogen mechanism in the soil and water coupled with an economic trading model. Once data requirements are met, the model will be calibrated for the Lunan Water catchment, which is a Monitored Priority Catchment with high dependency on groundwater resources.

Future

The modelling framework has the potential to be applied with other pollutants or agricultural catchments that suffer from diffuse pollution.

Methods

We consider the construction of water pollution rights that can be traded among the agricultural holdings ($i=1,\dots,n$) that are non-point polluters with pollution load in a catchment based on two objective functions:

$$1) \sum_i^n x_i h_{ijt} \leq q_{jt} ; \quad (2) \sum_i^n f_i(x_i)'$$

The water quality trading scheme looks to achieve pollution lower than the policy target concentration (q_{jt}) at measurement point ($j=1,\dots,m$) for the whole policy period ($T=1,\dots,t$) both as well as directive-complying loads at source (x_i) (1) while achieving a higher welfare (f_i) at catchment level from reducing the cost of pollution (2) versus asymmetric information uncertainties and transaction costs. Thus, the final model is a stochastic and de-centralised.

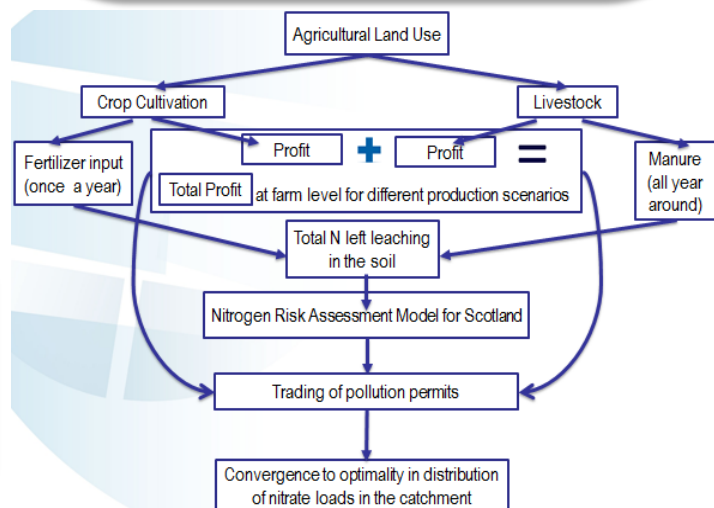


Fig 1 Schematic representation of the methodological framework used



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