LM0308: Catchment Management for Water Quality

Case Study 2: Effectiveness of land management policies and agri-environment interventions for reducing pollutant loads and maintaining environmental quality at the national scale.

Lead: Richard Gooday (ADAS); Peter Daldorph (Atkins)

Purpose: To determine the potential impact of an agri-environment scheme on total pollutant loads (from all sectors) entering watercourses for England, and any additional consequences of scheme implementation for national GHG emissions.

Policy driver(s)	Water Framework Directive (achieving Good Chemical Status)
Enduser(s)	Government Agencies
Pollutant(s)	Nitrate, phosphorus (for all sectors) Sediment, ammonia, nitrous oxide, methane and carbon dioxide (agricultural sector only)
Measures	Countryside Stewardship (previously Countryside Stewardship)
Scenario if appropriate	Long term impact of the implementation of approximately 30 mitigation methods representing major / common options within Countryside Stewardship
Outcome / output	Percentage change in total pollutant load for each catchment. Percentage change in national GHG emissions from agriculture. Cost of scheme implementation.
Scale / Location	England (3,800 WFD catchments)
Risks	IPR issues over data used in WQ0223 to develop SEPARATE is a critical issue to resolve that requires Defra/EA assistance.

Background / Narrative:

The new environmental land management scheme, Countryside Stewardship, is proposed to be more targeted with more focused agreements for the benefit of the environment. There is a need to

assess the potential impacts of this scheme in terms of pollutant reductions and other environmental outcomes, to help assess the cost-effectiveness of the scheme.

The results of this case study will show how stakeholders can determine where best to focus resources to encourage implementation of Countryside Stewardship which will achieve the greatest or most useful reductions in pollutant loads, taking account of some of the uncertainty in the reductions achieved through Countryside Stewardship and the potential cost to the industry (outside of any recompense associated with scheme enrolment).

Basic approach:

The intention of this case study is to link the changes in agricultural pollutant loads predicted by Farmscoper for a given scenario with a source apportionment tool which determines the contribution to the pollutant load from agriculture and other sectors. In previous applications of this type, Farmscoper has been paired with the SAGIS tool (Source Apportionment Geographical Information System). However, the Farmscoper/SAGIS linkage has only been carried out on a few well-studied catchments. There has been no national scale application of this type because existing source apportionment models (such as SAGIS) were developed primarily for catchment scale applications.

A recent Defra project (WQ0223) developed a new national scale multiple pollutant (nutrients and sediment) source apportionment screening framework for England and Wales. SEPARATE (SEctor Pollutant AppoRtionment for the AquaTic Environment) includes export to aquatic systems from both diffuse and point sources and summarizes the source apportionment on the basis of WFD cycle 2 waterbodies. This case study will link Farmscoper outputs describing changes in pollutant loads for different scenarios to the SEPARATE tool to evaluate effectiveness of scenario measures in improving water quality in WFD cycle 2 waterbodies.

The most recent version of Farmscoper incorporates a catchment-based calculation that operates at Water Management Catchment Scale (92 catchments representing England), whereas source apportionment input data is typically at waterbody scale (approx. 3,800 catchments representing England), so there is the potential for enhancement of the linkage between the two models.

A number of different scenarios will be applied within Farmscoper / SEPARATE to assess the uncertainty in the reductions in the agricultural load associated with the policy being modelled. The exact suite of the mitigation methods currently available within Farmscoper that will be used to represent the potential impact of Countryside Stewardship will be agreed with Defra. This can be a refinement of a previous assessment of the appropriate methods done under Defra Project WQ0223 (before Countryside Stewardship was finalised).

Case studies 1 and 2 are similar in that the consequences of land management policies and agri-environment intervention schemes to reduce multi-pollutant runoff are being examined. Both studies consider catchment scale responses as a starting point and evaluate co-occurring effects on ES. However, the case studies differ in their approaches for incorporating integrated modelling to address broader aspects of the topic.

Case study 1 starts at the catchment scale using Farmscoper but combines Glastir interventions in Wales with the LUCI modelling tool to disaggregate to smaller scales, evaluating the effects on ES at the scale of implementation (field or farm). Because of the greater spatial detail, case study 1 is implemented in a single catchment, the Conwy River in Wales, as an exemplar. At this smaller scale of resolution, the broader effectiveness of the policy at the national scale is potentially lost, but it

becomes possible to evaluate effects on a range of ES and to identify trade-offs and co-benefits operating at the scale of uptake and implementation of the interventions. This can provide feedback to development of the next policy initiative and/or help to target specific local instances of implementation that enhance co-benefits and minimize trade-offs.

This case study (2) also starts at the catchment scale using Farmscoper, but then combines Farmscoper / SEPARATE to extrapolate to larger scales providing assessments for thousands of catchments from regional to a national scale using Countryside Stewardship scenarios for England. As the scale increases, information about the linkages among interventions and ES (occurring both at field or farm scale) is potentially obscured, but a broader more-policy relevant perspective is obtained (effectiveness at national scale).

Case studies 1 and 2 are thus complementary in the added information they provide through an integrated modelling framework. Case study 1 highlights the increased spatial information that can be derived from ensemble models which can be used for more efficient targeting and evaluation of agr-environment interventions. Case study 2 demonstrates the ability to extrapolate from ensemble models to regional and national scales to provide policy relevant evidence and information.

Models to be used:

- Farmscoper
- SEPARATE

Data to be used:

- Inputs
    - Agricultural census by WMC
    - Robust Farm Type counts by WMC
    - Point and diffuse loads for WFD waterbodies
- Outputs
    - Agricultural pollutant reductions at WMC scale
    - Cost of scheme implementation at WMC scale
    - Pollutants loads at approx. 1km lengths along 1:50k river line
    - Reduction in total pollutant load at waterbody scale
- Validation
    - Harmonised Monitoring Scheme data
    - Existing national source apportionment and scheme impact assessments

Other requirements:

- Contact Chris Burgess to identify any synergies
- Inclusion of Adie Collins and Pam Naden PIs of the Defra-funded project WQ0223: Developing a field tool kit for ecological targeting of agricultural diffuse pollution mitigation measures.
- Economic work would be beyond scope due to scale of Case Study but to be discussed with Defra for priorities across Case Studies

Workplan:

- Extraction of existing SEPARATE data to determine the total loads and agricultural contribution at waterbody scale
- Scenario simulation with Farmscoper to determine reduction in the agricultural load at WMC scale and an assessment of the uncertainty in this reduction
- Development of a routine to link Farmscoper outputs with SEPARATE outputs

Milestones:

- Scope out Case Study (Feb 2015)
- Develop model documentation for the Platform (March 2015)
- Start conditioning and ingestion of data and models with documentation into Platform including model input and outputs (June 2015)
- Completion of first model application outputs and testing with Community Forum (Nov 2015)
- Start conditioning and ingestion of external data and models into Platform (June 2016)
- Iteration to identify benefits of model coupling (Nov 2016)
- Final report (Mar 2017)

Link to Enduser Questions:

Effectiveness of measures / mechanisms

- Capture uncertainty in effectiveness of measures – understanding timescales of response and implications for economics

Uncertainty, confidence and communication

- How does using different input datasets affect the model outputs and hence the evidence base upon which to base action?
- What is the uncertainty associated with modelling the different effectiveness of measures?

Integration / focus / scaling

- Integration of models across receptors / objectives to identify co-benefits and trade-offs; to help justify / prioritise action depending on local objectives, priorities and characteristics