An introduction to project LEAP – LEgacies of Agricultural Pollutants

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Widespread nitrogen (N) and phosphorus (P) fertilizer use threatens water quality and aquatic ecosystems. Agricultural best management practices (BMPs) have been implemented in an attempt to improve water quality, but significant time lags between BMP implementation and measurable water quality improvements are frequently observed, and the magnitude of the improvement is often uncertain. One reason is the slow release of N and P from legacy nutrient stores that accumulated in the landscape over decades of fertilizer application. At present, we continue to lack: (a) a comprehensive characterization of the nature, size and reactivity of agricultural N and P legacies, (b) integrated modelling tools to predict the timing and magnitude of water quality improvements achievable through BMPs, and (c) policy instruments that acknowledge time lags and balance trade-offs between short and long-term costs, benefits and risks.

Funded by the Water JPI programme in 2017 and with partners from Denmark, Sweden, Portugal and Canada, the 3-year research project LEAP aims to gain a predictive understanding of the release of nutrients over time and how they move and transform within water systems. This will be accomplished using an interdisciplinary approach involving both biophysical and socioeconomic modelling. By quantifying nutrient legacies and associated lag times, LEAP will help select appropriate (site-specific) BMPs and establish nutrient reduction goals within realistic time frames.

The specific project objectives are:

- Identify key controls on the accumulation and mobilization of agricultural N and P legacies, and predict time lags between implementation of BMPs and reductions in nutrient loadings to ground and surface waters, as a function of climate, land cover, land use, and land management;
- Assess outcomes of alternative management strategies by performing cost-benefit analyses within a hydro-economic modelling framework that explicitly represents nutrient legacies;
- Develop a Bayesian Belief Network (BBN) framework to evaluate uncertainties in both biophysical and hydro-economic modelling of nutrient legacies, and assess their implications for nutrient risk management;
- Create an agroecosystem typology – based on EU and Canadian exemplars– that links biophysical and socioeconomic drivers of non-point source pollution to water quality impacts; and
- Inform adaptive agro-environmental water management practices that target mitigation of water quality impacts of N and P legacies by assessing trade-offs between short and long-term costs, benefits and risks.

This presentation will first give a brief overall view of LEAP, and then more detail will be provided on the environmental economics research that will be conducted in the project during the coming year. This involves four full-scale stated preference surveys conducted simultaneously in selected case areas in Denmark (case area Limfjorden), Sweden, Portugal and Canada. Results from these will feed into subsequent Cost-Benefit Analyses that will be used for identifying the agricultural BMPs which best take time lags and uncertainties into account.