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Water quality at catchment scale: how a tiered monitoring approach can highlight multiple benefits

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Catchment management has increasingly become the chosen approach to reduce both point source and diffuse pollution from agriculture in freshwater. In the UK, water companies are, to some extent, driving this movement: investments in pollution reduction upstream are thought to provide a sustainable alternative to increased capital spending for water treatment downstream. However, evidence of both water quality improvement at catchment scale and of the potential financial benefits to water companies and their customers from diffuse pollution reduction are lacking. This knowledge gap is being addressed using the catchment management programme set up by South West Water, the water utility company in southwest England, as a case study.

Our work focuses on 9 catchments where the treatment and production of drinking water is being affected by water quality issues from a combination of parameters (i.e. dissolved organic carbon and colour, nutrients, sediments, pesticides, algae, geosmin and 2-MIB) and which are subject to a range of on-farm intervention measures. Overall, the monitoring programme aims to both quantify the extent of the catchment management measures (i.e. farm intervention mapping) and water quality change in associated watercourses. For each catchment, a bespoke, tiered, monitoring programme was set up to quantify water quality change at several spatial and temporal scales. Data collection included: (1) local, intervention-based, monitoring of water quality (i.e. before/after or upstream/downstream), (2) sub-catchment, in-situ and event-based, monitoring of reservoir feeder streams and upstream of abstraction in rivers, and (3) continuous monitoring using data that are routinely collected by the water utility company at catchment scale.

Our work shows that, as a first step, mapping of the type, cost, geographical location and extent of catchment interventions is required in order to link interventions and water quality change. However, it only provided a partial understanding of the impact of catchment management on water quality. We show that data at multiple scales (water treatment works and contributing catchments) are needed to evidence the effect of catchment management measures on water quality and inform water utility decision making. Therefore, an appropriate, tiered, monitoring strategy to capture change at these scales is needed. We propose that such strategy is tailored for each catchment and parameters of interest, using techniques that are appropriate depending on the change to be detected, and the type of data required.

Process-based modelling techniques of water movements through the catchment may help evaluate a catchment scale understanding of change. However, with sporadic or low-temporal and spatial resolution data, some catchment processes are poorly represented. In addition, change may take longer than expected. Therefore, results remain indicative in the short-term, and are potentially unrepresentative of long-term effects.

Overall, the tiered monitoring approach built around operational and regulatory monitoring by the water company and in-situ sampling provided a breadth of data at different spatial and temporal scales. Such a monitoring approach that combines different types and sources of datasets and monitoring strategies at different scales was found to be the most cost-effective way to provide a holistic understanding of change without duplicating efforts.