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A review of monitoring approaches and outcomes of surface water quality mitigation measures in meso-scale agricultural catchments

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Critical for an informative feedback loop from scientific monitoring of biophysical change, to making and implementing suitable policy to effect the desired change, are both accurate measurement of biophysical change, and measurement or modelling of the causes of change. For example the European Environment Agency uses the DPSIR framework to assess change in the state (S) of natural resources due to changes in specific drivers (D) and pressures (P) that can have an impact (I) and are the focus of policy responses (R). This paper provides a review of meso-catchment scale studies worldwide that have measured the impacts of agricultural land management practice on surface water quality. Approaches for measuring water quality impacts of agricultural mitigation practices in meso-catchments (1-100 km2) ranged from measuring water quality over a time series, such as before and after a land management change, or over a spatial series such as in paired catchments with and without agricultural practice change (or over a gradient of practices or catchment types), and by cause and effect studies that measure sources, pathways and impacts of practices. Agricultural mitigation measures had no measurable effect, or positive, or negative effects on water quality over periods of 3 to 20 years. In most catchments where beneficial effects of mitigation measures were successfully measured, combinations of measures that address nutrient or pollutant sources, pathways, delivery and impact have been implemented. Successful farm measures included substantial reductions in the intensity of the farming systems, improved engineering and crop management to reduce runoff and drainage transport of nutrients and sediment, as well as high rates of implementation of measures across the catchments. In many cases, the potential to measure improvement in one or more water quality indicators was limited by the impact of a few management or weather events. Reasons that water quality did not improve in some studies included the uncertainty inherent in most nutrient flux measurements and a lack of high flow water quality samples that limited the ability of practice impacts to be measured. In other catchments, it was difficult to verify whether a lack of effect was a result of ineffective measures, or because time lags for improvement of water quality were longer than the monitored period. Data on temporal and spatial nutrient source use was generally scarce in comparison with water quality data. Implications of the efficacy of measures and their monitoring programmes for researchers and policy-makers will be discussed.