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Reality check of socio-hydrological interactions in water quality and ecosystem management

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Socio-hydrological interactions in water management for improving water quality and ecosystem status include as key components both (i) the societal measures taken for mitigation and control, and (ii) the societal characterization and monitoring efforts made for choosing management targets and checking the effects of measures taken to reach the targets. This study investigates such monitoring, characterization and management efforts and effects over the first six-year management cycle of the EU Water Framework Directive (WFD).

The investigation uses Sweden and the WFD-regulated management of its stream and lake waters as a concrete quantification example, with focus on the nutrient and eutrophication conditions that determine the most prominent water quality and ecosystem problems in need of mitigation in the Swedish waters. The case results show a relatively small available monitoring base for determination of these nutrient and eutrophication conditions, even though they constitute key parts in the overall WFD-based approach to classification and management of ecosystem status. Specifically, actual nutrient monitoring exists in only around 1% (down to 0.2% for nutrient loads) of the Swedish stream and lake water bodies; modeling is used to fill the gaps for the remaining unmonitored fraction of classified and managed waters. The available data show that the hydro-climatically driven stream water discharge is a primary explanatory variable for the resulting societal classification of ecosystem status in Swedish waters; this may be due to the discharge magnitude being dominant in determining nutrient loading to these waters. At any rate, with such a hydro-climatically related, rather than human-pressure related, determinant of the societal ecosystem-status classification, the main human-driven causes and effects of eutrophication may not be appropriately identified, and the measures taken for mitigating these may not be well chosen. The available monitoring data from Swedish waters support this hypothesis, by showing that the first WFD management cycle 2009-2015 has led to only slight changes in measured nutrient concentrations, with moderate-to-bad status waters mostly undergoing concentration increases. These management results are in direct contrast to the WFD management goals that ecosystem status in all member-state waters must be improved to at least good level, and in any case not be allowed to further deteriorate.

In general, the present results show that societal approaches to ecosystem status classification, monitoring and improvement may need a focus shift for improved identification and quantification of the human-driven components of nutrient inputs, concentrations and loads in water environments. Dominant hydro-climatic change drivers and effects must of course also be understood and accounted for. However, adaptation to hydro-climatic changes should be additional to and aligned with, rather than instead of, necessary mitigation of human-driven eutrophication. The present case results call for further science-based testing and evidence of societal water quality and ecosystem management actually targeting and following up the potential achievement of such mitigation.