# Integrated water quality management – development of a social-ecological approach

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Humans and environment – a view at the current debates on problem areas such as climate, energy and water politics demonstrates the close entanglement of social and natural processes. Therefore, environmental problems are also social problems and a profound understanding of the relevant processes requires the analysis of the underlying complex social-ecological structures of cause and effect. This circumstance finds its special expression within the field of water research. Particularly in the integrated water resource management a multitude of utilization demands and conflicts of interests meet each other. The economic and social functionality of water – in quality and quantity – stand in opposition to its meaning for the conservation of the ecosystem. Hence, in the development of strategies for a sustainable management of water resources the consideration of the different dimensions of integration is of crucial importance. On the one hand the knowledge of different natural and social disciplines have to be brought together during a joint research process, on the other hand scientific results are to be translated in such a way that they open up the possibility for social action. Inter- and transdisciplinary integration should be part of this research process from the outset and not at the end.

In order to meet that challenge we will present in the following a future-oriented methodological approach for the development of an integrated water quality management. It takes up the problem of the so-called “new pollutants”, which refers e. g. to substances in the group of persistent organic pollutants (POP). The focus lies on the spectrum of chemical substances constantly extending by technical and economic progress. Their exposure into the environment results in a continuously growing and in their forms strongly varying anthropogenic endangerment of the surface waters and groundwater bodies. At the same time, the entry paths of most substances into the environment, their effects on water quality and relevant feedback mechanisms through the hydrological cycle back to the humans are understood only incomplete. This leads to the central problem of sustainable water

quality management: To investigate the emergence of risk potentials, the substantial propagation and distribution mechanisms must be identified and estimated in their relevance. Not only the natural framing conditions play an important role, but also the coupling to socio-economic processes. In addition, specific social processes of negotiation in handling conflicting interests and behavioural patterns have to be taken into account. All these aspects form a basis on which policy measures can be compiled and be assessed on their effectiveness in the context of a complex, multi-criterial decision problem. Also questions related to the Water Framework Directive (WFD), as the specification of what *good* ecological water conditions should be, can be addressed with that approach.

In the centre stands the methodological development of an integrated water quality management oriented on the sustainability principle and consisting of an interactive decision support system (DSS) in its core. Thus, the two dimensions of inter- and transdisciplinary integration are taken into account as central challenges. In the foreground we do not focus on the in-depth realistic description of individual processes, but first of all on the identification and analysis of the complex cause-effect-relations between the interacting components of coupled social, ecological and economic subsystems as well as secondly the management of the information flow between these components. Special attention will be given to the development of adequate modelling methods for the formal description of these interacting processes and on their integration into the context of the DPSIR concept developed by the European Environment Agency (1999). This is illustrated in Figure 1. The DPSIR concept with its five environmental indicators structures the model-based description of the observed complex phenomena and bridges the difficulty of an policy-oriented reduction of the available information to the most important elements.

It is beyond doubt that models form a crucial gateway to the system examined in each case. They represent a central link in the combination of different disciplinary and methodological competences and serve as important instruments for the transformation of scientific knowledge into socio-political decision-making. Therefore, we will face the important task of studying methods of implementation of intra- and interdisciplinarily developed models into the structure of an interactive DSS. Reflecting on the underlying assumptions in the models (e. g. substantial components and processes, relevant temporal and spatial scales) and of their limits we will develop criteria, which permit an adequate handling of uncertainties and ignorance in risk assessment.

Finally, the development of a water quality management which is oriented at the sustainability principle requires the establishment of new adapted procedures of risk evaluation in particular in the problem area of "new pollutants". Our contribution presents a concept for the development of an integrated, flexible and adaptive water quality management. It addresses the considerable dynamics of the problem field in a flexible manner, is open and adapts to varying demands and constantly increasing knowledge and connects different disciplinary and policy-oriented points of view adequately.

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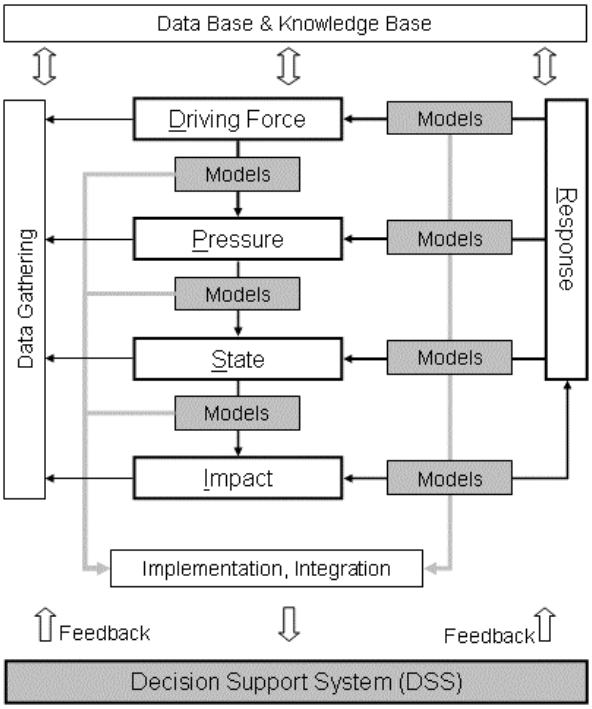


**Figure 1.** Integration through the interaction of models in the framework of the DPSIR concept. Disciplinary knowledge as well as policy-oriented requirements are represented within that scheme. The way of how models are implemented and combined as well as the reflection about their underlying assumptions and limits play a crucial role in understanding the significance of results and in handling uncertainties and ignorance.