A systems-based approach to catchment water management

Chief Scientist's Group report summary

Date: May 2021

This project explored an innovative, systems-based approach to water management. This should help organisations involved in water planning and management understand how different parts of the water system interact and develop ways of managing the water environment as a whole. This will help to bring about multiple benefits while avoiding undesired outcomes.

Method

The Systems Water Management for Catchment Scale Processes (CASYWat) project developed a conceptual understanding of catchment water management (Figure 1). Within this, the work developed a novel Systems Water Management (SYWM) framework which provides an overview of the many complex aspects of the water management system and their interactions, demonstrating the benefits of a systems-level analysis that looks at how the different parts of a system work together to achieve overall goals.

The framework incorporates water management, elements of natural capital (ecosystems including freshwater, land, soils), ecosystem services (benefits for people from ecosystems) and environmental footprints (people's impact on land and water). The framework shows that most parts of the water management system can be analysed by mapping 3 main feedback loops (these describe how change in one part of the system affects other parts of the system) and 7 high level components (subsystems) of the system. This structure is known as the 'SYWM meta-model' (Figure 2).

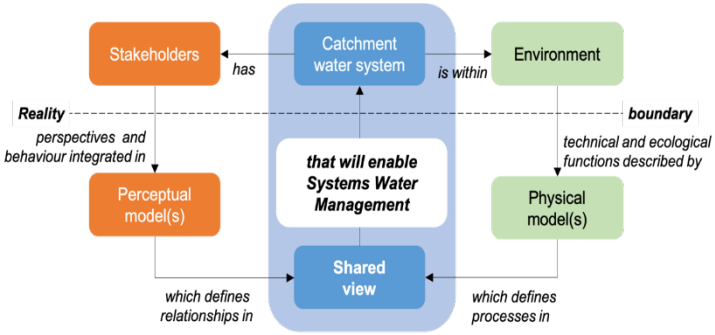

Figure 1: Conceptual representation of a catchment water management system

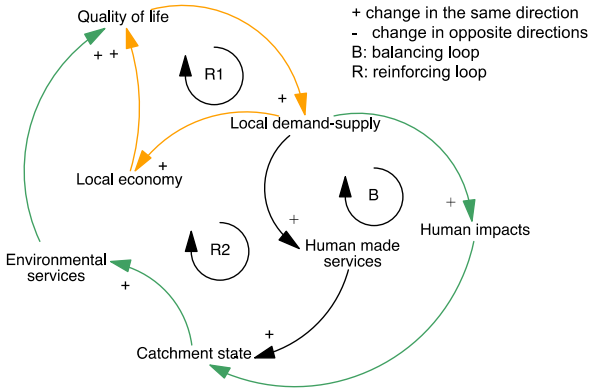

Figure 2: The SYWM meta-model for analysing water management sustainability

The SYWM framework and meta-model were applied in 2 case studies to demonstrate the analytical potential of a systems approach and make some illustrative observations from systems analysis. One case study was at a national/regional level to give an overview of the water system and draw conclusions, particularly in the context of development planning. The second was to address a variety of environmental problems as part of the Cumbria catchment pioneer (one of four pioneer projects set up to test the UK government's 25 Year Environment Plan approaches).

The national/regional case study illustrated analytical potential in relation to:

- identifying systemic drivers
- opportunities for systemic interventions and 'what if' analysis, including unintended consequences
- mitigation of planned development
- system monitoring and measurement
- identifying system actors and responsibilities to co-ordinate coherent system management

The Cumbria catchment case study identified potential interventions of increasing leverage ('power in affecting significant system change') across the water system in addressing Lake Windermere water pollution. Both studies identified the potential of using the developed system maps as a starting point for

open discussion about water management and to communicate and manage important feedbacks that may lead to undesired and unintended consequences.

Conclusion and recommendation
The SYWM approach developed in this work provides a first step towards increased understanding of water management system complexity. The approach provides a hierarchical view of the water management system, where second-tier variables are defined to support water management systems maps structuring.

By representing system links to account for water management decisions and information flows, as well as physical processes in the system, the SYWM framework lays the foundations for an operational approach to understand system-level interventions through causal relationship analysis.

It is recommended that the SYWM framework and meta-model is further developed to include a wider range of system types (such as coastal), sectors (services or transport for example) and ecosystem services and trialled in a number of strategic and operational case-studies.

This summary relates to information from the following project:

Title: Systems Water Management for Catchment Scale Processes: Development and demonstration of a systems analysis framework

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This project was a collaboration between the Environment Agency, the Royal Academy of Engineering and Dr Ana Mijic (Imperial College London) through a National Environment Research Council (NERC) Innovation Placement.

The project was funded by a NERC Innovation Academic Placement hosted by the Environment Agency's Chief Scientist's Group, which provides scientific knowledge, tools and techniques to enable us to protect and manage the environment as effectively as possible.

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