

# Water Resources Management: A Systems View

One would expect that “water resources management” is the management of water resources. But the language behind the concept is simpler than the complex social and ecological systems in which water resources and people that govern them live. Prof. Slobodan Simonovic explains how a systems view can make sure that we understand what it is that we are trying to manage.

Freshwater sustains life and all social and environmental processes. Yet freshwater systems are imperilled, and this threatens both human well-being and the health of ecological systems. This crisis is caused by the ways in which we mismanage water.

Mismanagement is caused by a faulty approach. First, we try to control our environments – the water, land, air and space that surrounds us. We then try to manage people within environments. It seems that every time we push at one point, unexpected changes come somewhere else. This should come as no surprise: it is the first fundamental systems rule.

## Seeing the water resources system

The application of the systems approach improves the basis for decision-making for complex water management problems. The system in our focus here is a social system, which describes the way water resources are used by people. This analysis helps clarify the best points for systems intervention.

The water resources system comprises of four linked subsystems: individuals, organisations and society, nested within the environment. To achieve sustainable water resources management, interactions between the four subsystems: individual, organisation, society and environment, must be appropriately integrated.

Individuals are the actors that drive organisations and society to behave in the

way they do. They are decision makers in their own right, with a direct role in water resources use and management. Organisations are the mechanisms people use to produce outcomes that individuals cannot produce. Organisations are structured to achieve goals. Structure defines information and resource flows and determines the behaviour of the organisation. Individuals and organisations are subsets of society, which is a system that contains the relationships people have with one another, the norms of behaviour and the mechanisms that are used to regulate behaviour. Society is nested in the environment. The environment includes concrete elements such as water and air, raw materials, natural systems, even the space beyond our planet. It also encompasses the universe of ideas, including the concept of “future”. This future is a hugely important in water resources management – it is the expectation of future scarcities and future impacts that drives concern for sustainable water resources management.

## The links: resources, information and value systems

All open systems require input of energies – resources – to produce outputs. Inputs and outputs can be placed into three categories:

resources, information and values. These connect individuals, organisations, society and environment, linking the four subsystems. Only information and resource flows link people and organisations.

Value systems – the means through which different values are attached to information and resource flows – are influenced by these two flows, but operate in a different way. Value systems are generated within the individual or organisation but feed off information and resource flows.

Subsystems constantly need access to resources from each other and the environment. This ongoing co-dependency for resources from one another sets the limit for how much the subsystems can exploit one another and the environment, and is a determinant of behaviour within the system. The ideal state, where all systems can continue to receive resources, requires that the performance of each subsystem towards its goals represent a gain for other subsystems. The physical environment exerts passive pressure on the subsystems to ensure fit. The environment can also limit action by running out of a resource or by changing circumstances to make the resource more precious (i.e. climate change).

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## Information flows

Information is used by each of the subsystems to make decisions required to ensure fit with other subsystems and the environment. Without flows of information from outside the system – or subsystem – the system must rely on its own internal information (knowledge) to make decisions. Such a circumstance increases the risk that the subsystem will drift out of fit with its context. Regardless, it constantly receives signals from the outside world, and it is itself sending signals to other systems. Well-functioning systems have structures built into them which capture relevant information and use that information to maximise chances of utilising resources to achieve their systems goals.

Data does not in itself have meaning. A process of interpretation occurs between information and meaning. Values provide meaning to information flows which are then used to determine resource use by subsystems. Value systems determine what individuals, organisations and societies find important; the sorts of resources they will pursue; and the interpretation of information received and used. Value systems are embedded in the culture of society and organisations, and in the values held by individuals. They determine how subsystems behave. Use of value systems may be triggered by information, and shaped by flow of resources.

The availability of resources largely conditions choice. It is information about availability which signals to the decision-maker (individuals, organisations, or society) whether it is implementing appropriate management strategies. It is through the process of optimising resource access that learning takes place and significant changes in culture and values are achieved.

The most effective management strategies for sustainable water resources management are those that condition access to resources. They go directly to resource access and will initiate signals that show which social or environmental performance will allow for access to resources on improved terms. But each subsystem utilises different mechanisms for maximising its access to water resources. Within each subsystem, there

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Photo: Jakob Grant, SIWI

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are many different interactions and many different options to optimise resource use.

### No “right” management strategy

Water resources management is a process of managing behaviour. There is no one strategy that will be optimal for any situation. Neither regulation nor economic incentives, nor education or shifts in property rights, is the “right” management strategy. What will work will vary with the social system being managed, in response to the information and resource flows and the value systems that are in place. The challenge for the water resources manager is to manage these elements within the environment and across individuals, organisations and the society to achieve the most effective outcome that is possible.

More intensive focus on the systems view of water resources management will accelerate understanding of which management strategies work, and particularly why they might work. For example, when one programme deals with economic incentives, another deals with improving information flows, and a third is focused on regulatory enforcement, it is very easy to believe that they are focused on different aspects with fragile links. What is necessary is a systems model to make sense of the interactions and dynamics which are being managed. This will allow us to learn from what we are so ‘clumsily’ doing, so that eventually we can do it better.

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## Further Reading

Simonovic, S.P. (2009), *Managing Water Resources: Methods and Tools for a Systems Approach*, UNESCO and Earthscan, Paris and London.  
Davies, E. G. R., and Simonovic, S. P. (2006). *The Importance of Social-economic-climatic Feedbacks for Water Resources Management*, XXIII Conference of the Danubian Countries on the Hydrological Forecasting and Hydrological Bases of Water Management, Belgrade, August 2006.