



Harmoni-CA

Monitoring System for Adaptive Water Management

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Abstract:

Policies and decision-making processes on environmental issues have to be based on appropriate information and modelling results. Thus, sound knowledge, reliable information and accurate data are vital for good environmental decision-making.

Increasing knowledge of the complexity of the processes in water systems has led to a growing demand of environmental information. Over the last two decades, water management has changed from a focus on distinct sectors, to a more integrated perspective. To construct and to select the most suitable alternatives for water management, an holistic approach has to be adopted. In water resources

management domain, increasing interest is posed to the integrated assessment that is emerging as a new discipline that integrates different kind of knowledge to be used in all phases of the decision process. The water management is a complex process involving many actors, with different knowledge and at different levels. The success of management initiatives in such a context is dependant on the capability to facilitate the cooperation between the actors and the integration between different sources of knowledge. Thus, the flow of information between these actors, the analysis of the ways in which networks of actors and institutions communicate internally and externally is vital.

The information to be used as basis of the decision process is mostly provided by the environmental monitoring networks that have been widely used to increase the knowledge of the state of the environment.

Traditional environmental monitoring is not very successful in providing timely identification and warning of emerging environmental problems; in delivering effective feedback on the adequacy of policies and programs; in providing policy-makers with a sound basis for action. But, above all, traditional monitoring systems are less successful in delivering information to the public, stakeholders, research personnel, and managers so as to raise awareness, educate and provide the basis for informed decisions and choices. The data collected by these systems are not always available to the public or are not easily understandable, limiting data access and consequently the public debate on the state of the environment.

Moreover, the usability of the monitoring information for the decision process has to be considered. Nowadays policy makers and water managers are overwhelmed with data and information that may or may not be of use of them. Therefore, there is a call today for less quantity of information and more targeted, tailor-made, information. The information needs is the crucial step in the information-producing process to decide what it's needed to know. The information needs are different for different stakeholders. This requires analysis with the stakeholders of the information they need.

The changing nature of the resource management towards a more adaptive approach is also changing the role of the information. In fact, in such an approach, the outcomes of the decision process need to be monitored closely during the implementation to confirm their effectiveness, and to help refine future actions. Thus the monitoring activities have to support the increase of the knowledge and the improvement of the management plan. The adaptive management acknowledges that the action is necessary or appropriate although knowledge may be imperfect. Knowledge far from perfect is likely to be the rule in ecosystem management. Accordingly, successful resources management must be based on the linked process of monitoring and adaptive management, or "learning-by-doing". The linked processes of monitoring and adaptive management are accepted as an integral component of decision-making.

To play this fundamental role in the adaptive management, novel monitoring systems are required to support the decision making process, able to provide timely identification and warning of

emerging environmental problems and effective feedback on the adequacy of policies and programs. Moreover, the novel monitoring systems have to be able to provide information also in data poor area integrating different sources of information.

In an adaptive perspective of the water management, the information cannot be considered just as an initial input for the decision process, but they have to be pervasive, supporting all the phases of the Adaptive Management cycle. Particularly, in the preliminary phases, the monitoring information should support the problem definition, the design of the alternatives and their evaluation.

After the implementation of the designed alternative, the monitoring information should support the decision-makers to assess the system responses, evaluating the efficacy of the management action. Moreover, the monitoring information should support the decision-makers in revising the selected policies, introducing some adjustments. Adaptive ecosystem management requires monitoring as essential feedback to management to ensure that necessary or appropriate action is taken, despite the fact that knowledge about the ecosystem being managed may be limited. Monitoring becomes the tool for learning about the system and assessing the management strategies.

An innovative monitoring system should: be relevant and decision supportive: it should be relevant to issue of concerns; be relevant to users, to fulfil its intended purpose; it has to provide in a timely manner information understandable for the decision makers or the targeted audience, so that early warning can avoid problems; take into account consideration of scale and type: it should cover a wide range of spatial and temporal scale, providing data at appropriate scale; it has to be sensitive to changes; be based on conceptual system model that explicitly recognise relationships between society and environment; allow for an overall integrated evaluation of the system, collecting different type of measures and integrating the human systems as a subset of the ecosystem which supports them.

Above all, an innovative monitoring system has to be adaptive and flexible, able to deal with environmental changes and to adapt to changes in political context and societal values, to incorporate new information, technologies and scientific researches, and it has to be tailored for specific ecosystems. Starting from the analysis of the existing monitoring system, this work aims at defining the architecture of an innovative monitoring system able to support the Adaptive Management, overcoming the limits imposed by data scarcity particularly in data-poor regions. To this aim, different sources of information have to be taken into account. In the definition of the Advanced Monitoring System, two main domain are combined: the technical domain and societal domain. On one side, the Remote Sensing technologies could play an important role in Adaptive Water Management providing frequently updated information on hydrology, land use, demographic data and other relevant data. Therefore, the Remote Sensing can contribute to fill the gap in the environmental data also in area with a not reliable monitoring system, providing low-cost information.

Another source of information is related to the community involvement in environmental monitoring activities. In this work, the architecture of a Community-based Monitoring System (CBMS) will be proposed. The involvement of community in environmental monitoring activities is recognized to have several advantages like the promotion of public awareness of environmental issues, the enhancement of collaboration and cooperation among all the stakeholders and the cost savings for the government agencies. Above all, the community-based environmental monitoring can support the integration between two different kind of knowledge, i.e. scientific and local, considered as a focal point in the Integrated Water Assessment.

Important issues have been addressed in this work: data credibility (data quality is often unknown); non-comparability of data (often the data collected by citizens are not easily comparable with other data); understandability of the information (the knowledge of local communities should be systematized, making it comprehensible for the decision-makers and functional for the decision process); integration of different sources of data in common GIS platform.

This work is based on the research activities carried out in NeWater project. The NeWater Project aims at the development and the implementation of methodologies and tools to support a stepwise change process in water management from the current management regimes to a more adaptive one.