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Integrating local and technical knowledge to support soil salinity monitoring in the Amudarya river basin

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ABSTRACT

The role of monitoring is changing due to the increasing awareness of complexity and uncertainty in environmental resources management. Monitoring systems are required to support critical reflection about the effectiveness of actions toward the achievement of management objectives. To this aim, monitoring should be based on a strong integrated and multi-scale approach. Monitoring costs could be prohibitive if the monitoring is only based on traditional scientific methods of measurements. To deal with these issues, the design of an innovative monitoring system should be based on the integration between different sources of knowledge and information. In this work the usability of local knowledge to support environmental monitoring is investigated. A multi-step participatory monitoring design process has been implemented aiming to design a program for soil salinity monitoring in the lower Amudarya river basin in Uzbekistan. Although there is an increasing awareness of the importance of stakeholders being involved in decision processes, the current socio-cultural and institutional context is not favourable to the participatory approach. The choice of method to be implemented in this work was influenced by such conditions. The analysis of the lessons learned from the experiences gained in this project revealed some important clues concerning the development of a locally-based monitoring program. These lessons can be subdivided according to three fundamental issues: the long term involvement of local community members in monitoring activities, the acceptance of locally-based monitoring systems by decision makers, and the reliability of monitoring information.

1. Introduction

Adaptive Management (AM) is one of the approaches developed to address the issues of complexity and uncertainty of environmental systems (Holling, 1978; Pahl-Wostl, 2008). AM emphasizes the importance of learning more about the resources or system to be managed and its responses under different management alternatives, in order to develop a shift in understanding (Walters, 1997; Fazey et al., 2005; Campbell et al., 2001). The development of a framework to support the transition of current management regimes toward more adaptive approaches is the main aim of NeWater, an integrated project funded by EU within the 6th Framework Program. It aimed to investigate the different aspects of AM for water resources. Among them, monitoring system plays a fundamental role. It should be able to support critical reflection about management actions, providing both negative and positive feedback in order to iteratively evaluate their effectiveness, and to detect unintended developments of the system being managed in the early stages in order to suggest adaptation (Lessard, 1998; Fazey et al., 2005; Pahl-Wostl, 2008).

The structures and processes in complex systems pose fundamental challenges to traditional monitoring. The non-linearity of causal relationships makes inadequate the traditional approaches based on linear impact chains. It requires a multi-variate and integrated approach to monitoring (Cundill and Fabricius, 2009). The impact of a given management action may vary at different scales (Campbell et al., 2001). Moreover, structures and processes are also linked across scales. Thus, the issue of spatial scale should be addressed when designing a monitoring system for AM. Time delays between management actions and impacts make it difficult to detect unintended side effects. Therefore, AM requires monitoring systems to gain reliable information about different parts of these spatial and temporal continua (Moller et al., 2004; Cundill and Fabricius, 2009).

When taking these issues into account, AM often results in a demand to monitor a broad set of variables, with prohibitive costs

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if the monitoring is only based on traditional scientific methods of measurement. This impedes the long term sustainability of the monitoring system. The resulting work may still be valuable as a series of one-off assessments, but it cannot provide the information on trends over time as required by AM to detect system changes.

In this work we argue that the integration between various kinds of knowledge could allow to develop a monitoring system for AM. Particularly, the integration between local knowledge and technical knowledge is proposed to address the scale issue and to enhance the long term sustainability of the monitoring program. The work also aims at dealing with three important research questions concerning the use of local knowledge for environmental monitoring, i.e. how to guarantee the long term involvement of local communities in monitoring activities? How to integrate locally-based information in the decision-making process? How to increase the reliability of locally-based information?

The work was carried out to support the monitoring of soil salinisation in the lower Amudarya River Basin (Uzbekistan) (Fig. 1). A participatory assessment of the research needs was carried out in the early stages of NeWater implementation in the case study. The process involved 60 stakeholders from the transboundary to the local levels. The "Development of local and basin level approaches to water and soil quality management" was selected by participants as one of the key issues to be addressed (Hirsch et al., in press). To this aim, the objective of this work is to improve the reliability of the monitoring information at the local level. This results in a more effective management of water required to slow down the salinisation.

This contribution describes the multi-step participatory monitoring design process. The process involved both information users (i.e. water managers at different levels) and information producers (i.e. members of the local farmers' community, managers and technicians of the monitoring system). The monitoring program obtained defines the variables to be monitored, the data collection methods, the protocol for data collection, and which data should be collected using the local knowledge and which using technical knowledge. A GIS-based monitoring and information system was developed that facilitates the storage, analysis, and visualization of the collected data.

2. An introduction to local knowledge for environmental monitoring

Local environmental knowledge refers to the body of knowledge held by a specific group of people about their local environmental resources (Scholz et al., 2004; Robertson and McGee, 2003). There is a wide range of literature about the relevance of local knowledge and its use for environmental management. Frameworks for the assessment of participatory approaches for local knowledge collection were proposed by Lawrence (2006) and Hayward et al. (2004). Two basic questions were used, i.e. what is the role of people participating and what are the results of the participation.

The first question provides a hierarchical typology of participation, characterized by different levels of participation, ranging from "passive" to "self-mobilization", in which communities take the initiative to change the system. According to the second question, a participatory approach could be conceived as a "mean" when aiming to achieve tangible results and outcomes – e.g. a management plan. Participation could be conceived also as the "result" of a process aiming to empower people and communities through a learning process leading to increased capabilities to self-manage their system (Hayward et al., 2004; Lawrence, 2006).

Fig. 1. Map of the study area.