Local knowledge to support environmental resource management in data-poor regions

10

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Abstract

The importance of shared decision-making processes in water management derives from the awareness of the inadequacy of traditional – i.e. engineering – approaches in dealing with complex and ill-structured problems. It is becoming increasingly obvious that traditional problem-solving and decision support techniques, based on optimisation and factual knowledge, need to be combined with stakeholder-based policy design and implementation. The aim of our research is the definition of a Community-based Decision Support System (CBDSS), able to facilitate integration of local and scientific knowledge. The system has been applied to support public involvement in the drawing up of the river Idro management plan.

Introduction

Today there is an ever-increasing interest in enhancing public participation in water resource management. Public participation is seen as a way to enhance the democratization of environmental resource management, allowing all possible stakeholders to participate in the decision-making process. The role of the participatory process in water management has also been established by the European Community Water Framework, which strongly encourages the active involvement of all affected parties in resource management (Pahl-Wostl, 2002).

One way for people to be involved is to provide *local knowledge* of their environment (Robertson and McGee, 2003). Local knowledge is increasingly recognized as an important source of information for environmental resource management. It can fill important information and data gaps, particularly in data-poor regions, contributing to a fuller picture (Ball, 2002). There is a wide range of literature on the relevance of local knowledge, its use and the importance of integrating local knowledge into more formal research activities (Oudwater and Martin, 2003). Local knowledge can be used to corroborate scientific data and to fill in gaps in scientifically-generated data

(Scholz *et al.*, 2004). Indeed, scientific knowledge cannot always provide satisfactory answers at the local scale, usually because of the site-specificity, which can lead scientists to ignore local macro-variation and to ask the wrong questions through a lack cultural understanding (Ball, 2002).

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). Local knowledge should not be seen as the simple counterpart of scientific knowledge; the two may be combined as fractions of all knowledge, leading to a broad, hybrid view of local resource management issues (Robbins, 2003).

Involving local communities in environmental management is not just a matter of using participatory approaches within a conventional monitoring framework. It's mainly about a radical rethink of who initiates and undertakes the process, and who learns and benefits from the findings. Incorporating local knowledge into the decision-making process and creating community-based resource management can have several benefits for both the communities and the water management agencies (Gouveia *et al.*, 2004). From the communities' point of view, the benefits obtainable through public involvement are mainly related to the promotion of public awareness of environmental issues, the enhancement of collaboration and cooperation, and the promotion of a "two-way" information exchange. On the other side, water management agencies can increase the available information and base their strategies on a more integrated knowledge; the implementation phase will also be facilitated, since conflicts would be reduced.

Many efforts have been made to utilize local knowledge in environmental management (see for example: Robertson and McGee, 2003; Scholz *et al.*, 2004; Hellier *et al.*, 1999; Danielsen *et al.*, 2000; Danielsen *et al.*, 2005; Oudwater and Martin, 2003).

Nevertheless, the use of local knowledge in environmental resource monitoring and management is still limited because of several shortcomings, such as data credibility, difficulties in comparing the knowledge collected by local communities with those coming from other sources, and the scale of local knowledge. The contribution of local knowledge is limited due to a general lack of understanding on what local knowledge is and how it can be explored and used (Oudwater and Martin, 2003).

Our research aims to define methods and tools to resolve the above-mentioned shortcomings of local knowledge. All of them are used to define the architecture of a Community-based Decision Support System (CBDSS) which can promote access to, and exploration of, pre-existing data and information; it can facilitate the input of local knowledge and the integration of community-based information with data from "scientific" monitoring systems. Moreover, CBDSS needs to enhance the accessibility of local knowledge for the decision makers.

Material and methods

Given the drawbacks of local knowledge described above, it is unrealistic to expect water managers to make use of it as generally presented, because it is not systemically set out and its contents are too vague for them to access and use easily. Therefore, a Community-based Decision Support System has to be able to both support the collection of local knowledge through the involvement of local communities in environmental management, and enhance the accessibility of this knowledge for decision makers. Concerning the latter group, structuring local knowledge is a fundamental step in overcoming their scepticism. Various methods for structuring qualitative knowledge are mentioned in the scientific literature. In our research, Problem Structuring Methods (PSMs) and GIS technology have been taken into account in terms of their potential in making qualitative knowledge suitable for the decision-making process.

Mostly, PSMs have been used to facilitate group work within business organisations. New approaches are attempting to apply these methods in more complex, shared decision-making processes such as participatory natural resource management (e.g., Hjorsto, 2004; Ozesmi and Ozesmi, 2003). PSMs aim to discover each stakeholder's point of view and knowledge on a particular issue, their perception of the related problems and which of the alternative solutions are suitable in their opinion.

To structure the knowledge expressed by the different stakeholders, making it comprehensible for decision-makers and functional for the decision process, we refer to SODA methodology. SODA is a general problem identification method that uses cognitive mapping as a modelling device for eliciting and recording individual views of a problem situation. The cognitive maps are defined using verbal protocols, allowing the contents of a discourse to be structured and the qualitative data to be analysed (Cerreta *et al.*, 2004).

The Cognitive Map aims to uncover individual perceptions of the consequences and explanations associated with concepts, and it is used by participants to communicate their understanding of the nature of the problem (Hjorsto, 2004). A Cognitive Map can be defined as a map made up of concepts, linked to form chains of action-oriented argumentation (Eden and Ackermann, 2004). Cognitive maps have been used to represent cognition at both individual and group levels.

Very often, local knowledge has a strong geographical connotation. Therefore, local knowledge has to be "spatially" represented, creating "indigenous GISs" (Robbins, 2003) that can support the use of local knowledge in the environmental resource management process.

Many efforts have been made to create GIS maps based on local knowledge (e.g., Oudwater and Martin, 2003; Anuchiracheeva *et al.*, 2003; Hellier *et al.*, 1999; Scholz *et al.*, 2004). The incorporation of local knowledge into a GIS can be used either to challenge the existing "scientific" spatial document, or to supplement the existing information (Robbins, 2003). In the latter case, the GIS is the platform to integrate local and scientific knowledge, leading to a hybrid and broad view of local resource management (Oudwater and Martin, 2003; Robbins, 2003). However, extending GIS access to grassroots groups and other non-traditional users is beneficial because it enables development of alternative knowledge and its inclusion in decision-making (Elwood, 2002).

Some researchers, recognizing the exclusion of certain types of knowledge, have sought ways of extending the representational capacities of traditional GISs to include "non-traditional" knowledge, such as narratives, alternative cartographies, videos, pictures (Elwood, 2002; Gouveia *et al.*, 2004). These "extended" GISs help non-traditional users to construct and to promote their own perspective or to re-examine those produced by others (Elwood, 2002). Most of the extended GISs have multimedia functions. The use of multimedia techniques can help non-expert users to understand GIS information, providing tools to read interactive maps and associated data (Ball, 2002). Moreover, they can assist the users in publishing their information, drawing other peoples' attention to their findings (Gouveia *et al.*, 2004).

The use of local knowledge in environmental management guarantees equal access to data and information for all sectors of the community, and equal possibilities of providing knowledge in a way that can be understood by other members (Ball, 2002). Therefore, a Community-based Decision Support System (CBDSS) should promote access to, and exploration of, pre-existing knowledge; it should facilitate the input of local knowledge and the integration of this knowledge with scientific knowledge. Moreover, the CBDSS should promote communication between stakeholders, facilitating cooperation and the creation of synergies. The creation of virtual monitoring communities should enable all stakeholders to share their perspectives on the state of the environment, increasing their knowledge and their desire to improve it.

Given the properties of a system able to incorporate local knowledge to be used in environmental management, the architecture of the CBDSS can be schematized as in figure 1:

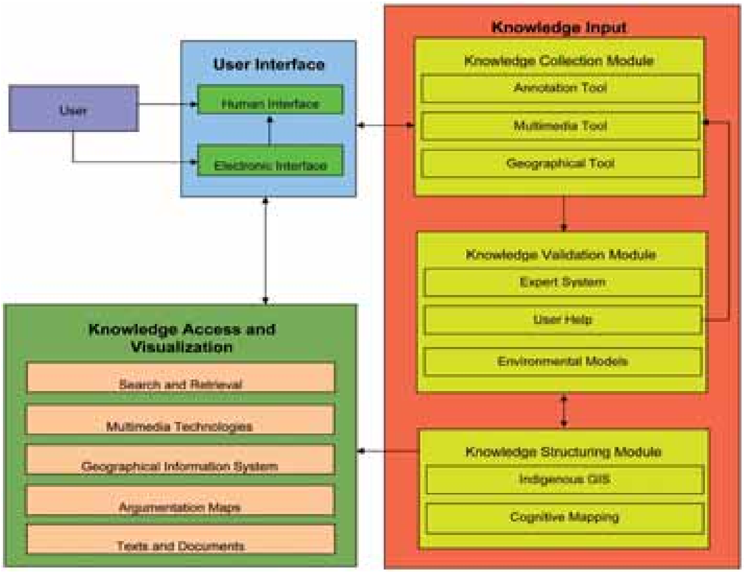

Figure 1 - CBDSS architecture

At the current state of the research, only knowledge acquisition and structuring have been implemented.

Results

The methods on which CBDSS is based have been applied to collect local knowledge in order to support the decision-making process in the recovery of the Idro river in Puglia (Southern Italy). The research was developed under the RiverNet project, focusing on the re-creation of links between the population and the rivers.

The experimental phase is divided into three main modules: Individual interviews and public forums to collect local knowledge; Structuring of local knowledge and conflict analysis; Negotiation. At the current stage of project implementation, only the first two modules have been implemented.

Concerning knowledge collection, many stakeholders have been identified, considering those who may participate in the decision-making process and those who may be influenced by the results of the decisions. Therefore, several individual interviews were conducted with: environmentalists, local cultural associations, tourism agencies, farmers' associations, local administrators, landowners, politicians, etc.

In accordance with the method described above, the knowledge expressed by the stakeholders has been structured into individual cognitive maps. Figure 2 shows an example of a cognitive map.

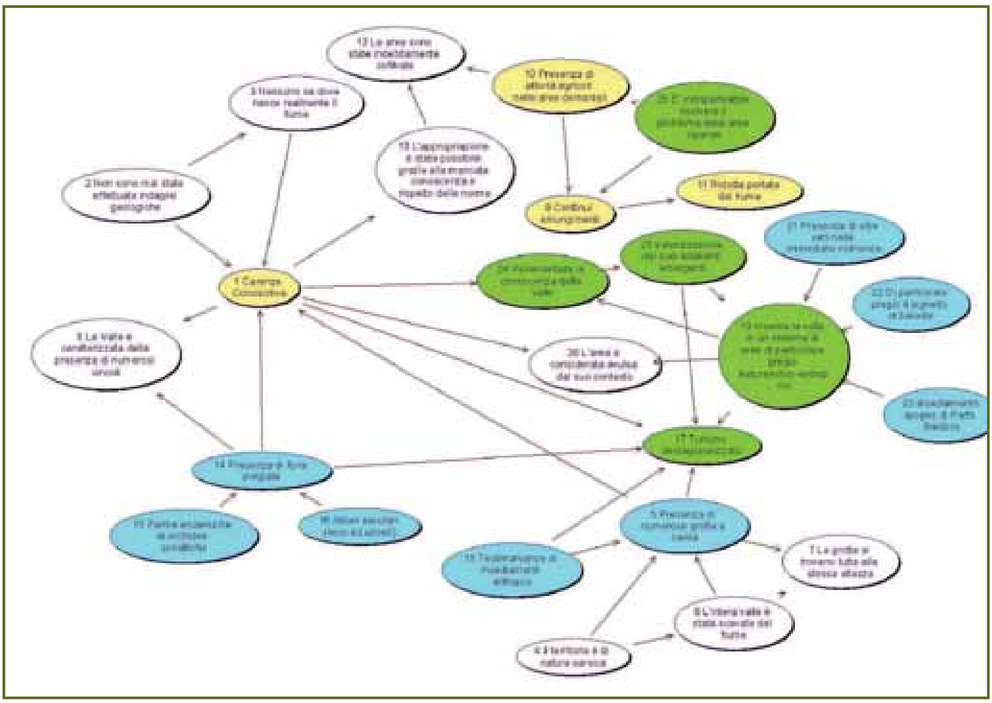

Figure 2 - Individual Cognitive Map

Four types of concepts were used:

- criticality (yellow): the most pressing problems in the study area;
- key elements (white): the elements characterizing the study area;
- potential (blue): the elements that need to be considered as the basis of the recovery project;
- Proposal (green): ideas to promote the Idro valley.

From the analysis of the cognitive maps it emerged that the Idro Valley is considered by the local community members as a “system”, composed of both natural-environmental resources and human activities. Specifically, most of the interviewees considered it important to take account of the archaeological sites in any plans concerning the Idro Valley. One of the most popular strategies was to create thematic itineraries leading tourists from the city centre to the most interesting sites in the valley.

There is no consensus on the agricultural activities. Indeed, many stakeholders consider these activities as highly damaging to environmental resources. They wish to re-naturalize the whole area. On the other hand, other interviewees consider agricultural activities as a fundamental aspect of the link between the local community and the territory. In their opinion the valley must not become a museum.

Conclusions

It is increasingly obvious that in order to face the complexity of water resource management problems, technical approaches are not enough. The nature of these problems and the approaches to dealing with them is changing. New management schemes combine the technological dimension with the social dimension, based on stakeholder involvement. Moreover, we are witnessing a change in the role of decision-support tools in the environmental domain, from a single decision-maker perspective to a process of debate with a number of stakeholders. The decision tools are becoming the shared platform through which the debate is organised and the different sources of knowledge are integrated.

In this perspective, the architecture of a Community-based Decision Support System, able to collect local knowledge to support environmental resources management, has been proposed. Different forms of knowledge are taken into account to obtain the complete picture of the local environmental, adopting a social approach to the construction of reality. According to the Soft System perspective, individuals continually negotiate and re-negotiate with others their perceptions and interpretations of the real world outside themselves. According to this assumption, each individual has his own perspective in defining and interpreting a problem situation. The expected outcome of an SSM study is a set of insights that emerge from the comparison of individual perspectives, forming the richest possible picture of the problem situation.

The integration of local and scientific knowledge leads to the achievement of hybrid knowledge and a nuanced understanding of environmental, social and economic system interactions, which are required to provide more informed inputs to sustainable local water resource management.

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