

## Executive Summary

The international think tank, the Resilience Alliance in 2006 set up a workgroup to explore the effect that mental models held by different stakeholders, and stakeholder groupings, might have on natural resource use and management, or in their more specific approach, on resilience of social-ecological systems. This study, conducted in South Africa, is intended to provide a relevant practical example on which to develop further understanding of mental models.

Mental models, put simply, are what people use to understand and interpret phenomena of everyday life. These models are frameworks of concepts and relationships that underpin how people understand, filter and process information and contribute to understanding, reasoning, prediction and action. These have been investigated across many fields and are of interest to natural resource management because of the need to understand stakeholders' constructions (mental models) of how systems function. This provides the opportunity to present alternative options, assist building shared understanding amongst resource users and managers, and thereby support negotiation for change towards more sustainable resource management.

This report reflects an attempt to try to understand issues of compliance with the water legislation by eliciting mental models which may underlie much of the intrinsic motivation of stakeholders to take particular collective actions, develop specific practices and ultimately behave in particular ways. Recent concern has been expressed that, in spite of world-acclaimed legislation such as the National Water Act 36 of 1998, the ecological condition of many South African rivers continues to deteriorate.

The Crocodile Catchment was chosen for this study as it is under the authority of the Inkomati Catchment Management Agency (ICMA), the first of 19 catchment management agencies to be established under the South African Water Act. It could also draw on the previous Kruger National Park Rivers Research Programme.

A multi-disciplinary team of researchers, representing various biophysical and social sciences, designed the process for testing the applicability and viability of two methods for eliciting and representing elements of mental models. These two methods, the Consensus Analysis method and the ARDI method, were tested with respect to their utility in identifying elements of mental models. Both methods were used to explore specific questions within the context of understanding whether differing views about the catchment would yield insight on non-compliance with environmental flows (the Ecological Reserve).

The Consensus Analysis method aims to understand the level of consensus among the different interviewees and stakeholder groups with respect to four key questions. The use of language as an indicator of understanding of content is central to the method's depiction of the level of consensus within and between a particular group of stakeholders. In this method seventy six people were interviewed in two phases. The first phase interviews were with water users and managers across the catchments. The second phase focused on irrigators and 'conservationists' to see if these groups shared similar beliefs or knowledge about water use and management in the catchment. Challenges with this method included the logistics of conducting sufficient interviews across a broad geographic area in the time available.

The ARDI method focuses on developing a schematic representation of individual or group understanding of key elements of the social ecological system. Ten individual mental models were elicited from water resource users and managers; the collective mental model process could not be completed in the time available. The ARDI assessment's systems diagrams provide insight into sustainability through showing how stakeholders and resources interact. It also illuminates drivers of the system, as understood by different stakeholders and the way in which these stakeholders understand the system to function.

This research found that with respect to sustainability, the Reserve and compliance with the Reserve, both methods suggested that the Reserve is a concept that is not well understood. If people were familiar with the Reserve as a tool, then more detailed understanding was often lacking or limited. In addition, both the CA and ARDI methods identified non-compliance as an important issue for stakeholders in the catchment. However additional work would be required to explore the actual nature and intent of the non compliance as this was beyond the scope of the current application of the two methods.

In many ways, CA could be seen as a screening technique to, for instance, define specific thematic areas that water management needs to address within the catchment. What is valuable is that both methods highlight the nature and extent to which stakeholders perceive problems relating to WRM in the catchment. This information is useful in engaging water managers and broader stakeholder groups in subsequent stages of collaborative work as it provides a basis from which to tackle problems.

This research found that with respect to the techniques for eliciting mental models, both methods accommodate high levels of representation and inclusivity and are therefore in accordance with participatory water resources management as required by the NWA. They both generate a sense of involvement and 'buy-in' in that they draw information and engagement from a broad spectrum of stakeholders. The demands of the methods for time and funds need to be carefully considered. Issues of resources and finances need to be factored into the broad application of the techniques so as to derive a clear picture of the costs and benefits.

As far as application of mental models in the South African catchment management context is concerned, clearly in the multiple-stakeholder arena called for by IWRM under the NWA it would be valuable to employ tools that set out to understand how, why and where differences in conceptual understanding, language use, meaning and practices might arise. It may be useful to identify a process that would contribute to the development of CMS and that built on the results of this work. We identified four processes that could contribute to the development of sustainable CMS, including:

1. Stakeholder analysis to identify major stakeholder groups and power relationships using social network analysis.
2. This could be followed by Consensus Analysis of key questions and actions related to the social, economic and ecological sustainability of water use.
3. Participatory modelling to explore action, outcome relationships using ARDI-like techniques to identify pathways to sustainability and a broadly acceptable vision.
4. Monitoring and learning to support progress to goals through techniques such as: Bayesian Belief Network (BBN) modelling to support ongoing monitoring and evaluation of key factors and progress towards goals