BUILDING AN ADAPTIVE AND STAKEHOLDER-CENTRED CATCHMENT MANAGEMENT AGENCY IN THE INKOMATI/USUTHU RIVER CATCHMENT

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by

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EXECUTIVE SUMMARY

The South African National Water Act emphasises “the need for the integrated management of all aspects of water resources” in ways that enable “everyone to participate” in an integrated and adaptive manner (p1 Preamble). This demands a major shift in thinking and acting from the old command (bureaucratic) and control (technological) approach to water management.

Integrated Water Resources Management (IWRM) has become the dominant water management concept over the last few decades. IWRM is a process which promotes the participation of stakeholders in the coordinated management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

Although IWRM is rich in concept, it lacks any clear implementation framework. In this study we look to practices in natural resource management for such a framework. Natural resources, however, cannot be understood or managed in isolation from the social systems in which they are embedded. The emergent concept of integrated “social-ecological systems” has therefore become a powerful tool in natural resource management, including for water.

“Adaptive management” is widely accepted as the primary tool for the management of social-ecological systems. Adaptive management differs from traditional management approaches in that it recognises the inevitability of unexpected change and surprises and encourages management activities to proceed despite the resultant uncertainty.

Strategic Adaptive Management (SAM) is a local derivative of adaptive management. It is a simple but robust system for participatory planning, decision-making and review in complex social-ecological systems. Well executed cycles of operational and strategic review track and integrate the changing Social, Technical, Economic, Environmental, Political and Practice (STEEPP) context of the management environment leading towards a shared future of sustainable resource use.

In this project academics from the Centre for Water in the Environment at the University of the Witwatersrand worked with staff of the Inkomati-Usuthu Catchment Management Agency (IUCMA) in a process of action research with the following aims:

1. The overall aim of the project was to advance the understanding and practice of Strategic Adaptive Management (SAM) as a framework for Integrated Water Resources Management (IWRM) in complex social-ecological systems.
    a. This was to be achieved by partnering with the IUCMA, as they implemented the Inkomati Catchment Management Strategy, to develop an adaptive and stakeholder centred catchment approach to IWRM.

b. In the process the research team would assist the IUCMA staff to develop sustainable and independently functioning participatory decision-making systems.

2. Gain broader international experience and understanding of IWRM and adaptive management practices in order to further advance SAM and IWRM in South Africa.
3. Undertake a programme of knowledge and skills transfer within the South African water sector. This would include developing a sound working relationship with the Department of Water and Sanitation (DWS) in order to integrate planning and decision-making systems into the broader process of Catchment Management Agency (CMA) establishment.

This project (2011-2015) on the use of SAM in the implementation of IWRM was based on three primary sets of activities:

- Fostering a culture of structured learning within in the IUCMA
- Multiple use of the Adaptive Planning Process (APP) of SAM under a range of contexts at different scales to test its robustness.
- Fostering a culture of sharing of knowledge about, and experiences with, SAM-based IWRM for CMAs.

This report builds on a previous project conducted between 2009 and 2010 (WRC Report No. KV 245/10) and is about the changes in thinking and decision behaviour that took place in the staff of the IUCMA between 2009 and 2015 while the project team was facilitating the use of SAM as a framework for implementing IWRM in the Inkomati-Usuthu Catchment.

In South Africa society is working in the face of revolutionary new legislation which requires profound transformation in decision behaviour and completely new, unprecedented institutions. Public engagement activities face wide gulfs in social circumstances, in education and in language, in expectations of a better future on one hand and in fears of losing identity and past privilege on the other. These stakeholder disparities demand extraordinary focus on issues of equity and the potential for conflict, especially in areas of public engagement required by a new democratic Constitution. It is imperative that techniques of public engagement are developed and used with the requisite simplicity to level the playing field.

In 2009 the IUCMA staff had been struggling for two years in this unchartered environment to build an institution for IWRM. They were bogged down and demoralised in policy-based bureaucracy, and too many people outside the organisation trying to “help” by each suggesting what they thought needed to be done. Despite this, it was clear that the research team were working with highly dedicated people and this was indeed a privilege.

In a very general sense the project purpose was to bring new ways of thinking and doing to the IUCMA and their stakeholders when and where they might be useful. Our medium for

creating an enabling environment for developing this thinking was Strategic Adaptive Management.

The new ways of thinking are summarised in Figure (i) which has become known as the "yellow brick road".

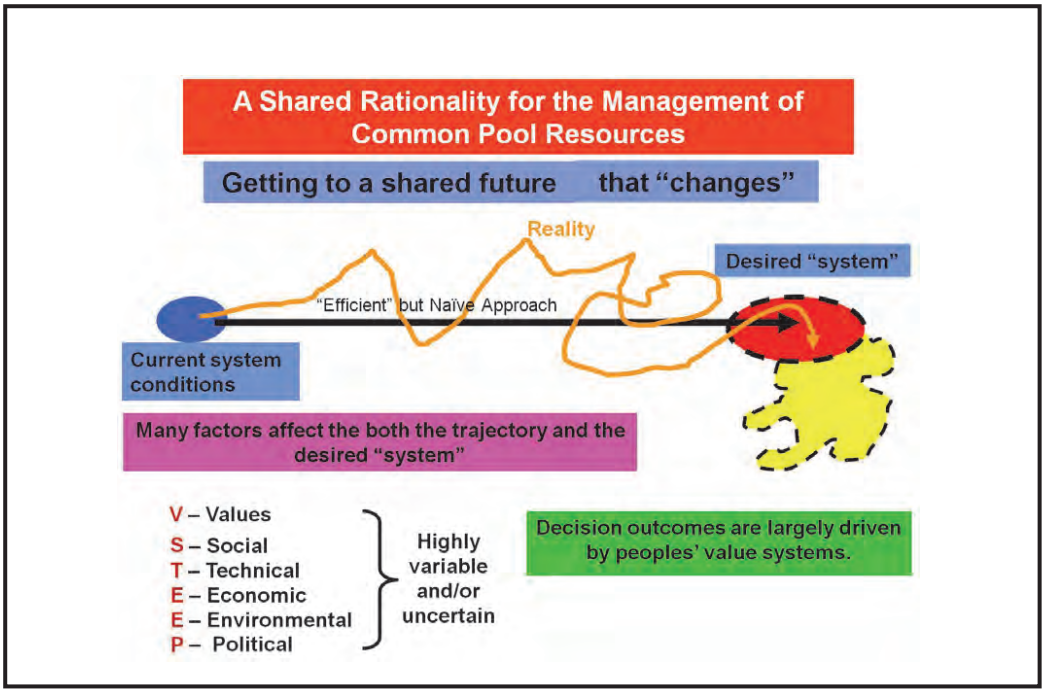

Figure (i). The "yellow brick road" usually presented as an annotated slide leads many stakeholders to say: "Now I understand what IWRM is all about!"

The primary elements of the new thinking include the acknowledgement that management is dealing with a common pool resource and thus needs to move toward a future designed and shared by all stakeholders. IWRM takes place in an environment full of uncertainties which will cause delay, redirection and rethinking (wiggly yellow line) about the future that can be achieved; hence the need for adaptive management! Many STEEPP (Social, Technical, Economic, Environmental, Political and Practice) factors affect a journey along the yellow brick road and finally *all* decisions are strongly influenced by people's value systems. This means developing a shared value set is critical to decision-making about common pool resources.

An effective process of engaging stakeholders that minimises conflict and maximises cooperation is absolutely critical to effective IWRM. Unfortunately the processes generally recommended and used in this country have serious flaws. Together the research team and IUCMA staff wrote a guide to facilitating stakeholder engagement that was based on five key principles:

- Never do a DAD (Decide, Announce, Defend)! Always do an ALIDA (Ask, Listen, Integrate, Decide, Act).
- Always build a systems (V-STEEPP) perspective/context with stakeholders.
- Collect everyone's input/perspective, emphasising that all are equally legitimate.
- Develop and use shared values to guide direction and decision-making.
- Seek consensus (win/win) not compromise (lose/lose).

It is important to understand that the research team's mode of thinking and decision-making was the most critical aspect of our approach to this project. This dictated *how* the project team and the IUCMA staff conducted all activities and was central to the project's success. These activities were very simple ways of getting people to interact and learn new things. It was *how* they were carried out, not what was done, that defined the project and its outcomes. The ALIDA (Ask, Listen, Integrate, Decide [together], Act) style of facilitation and interaction was a very important component of this "how".

The research team became involved in many different activities during the project. Most of these were agreed to and designed with IUCMA staff on a needs basis but the foundation of action research was laid in three sets of activities that were carried out each year.

- Application, at different scales, of the Adaptive Planning Process.
- Learning/unlearning workshops and assessment of learning.
- Knowledge sharing workshops and activities.

The task of the project team was to build an adaptive and stakeholder-centred CMA for the Inkomati-Usuthu catchment; one that was durable and would carry the new thinking about water resource management and SAM through the trials and uncertainties of a future yellow brick road. This report details the progress that has been made in adoption of the major components of SAM and areas of new thinking at different levels within the organisation.

The APP, and its outcomes, proved their usefulness many times across the range of scales from a Division within the IUCMA, to institution itself and to the catchment. Major elements of both the Catchment Management Strategy (CMS) and IUCMA planning processes that this project facilitated have proved durable through many challenges, over many years (six years in the case of the agency, and five years for the CMS). The IUCMA staff also plan to use the APP for integrating the Usuthu catchment, and revising the whole Inkomati-Usuthu CMS, proving that the APP has been adopted by the agency and should be carried through to future operations.

Post-APP, repeated formal learning and reflection, and development of an adaptive decision framework, are probably the most important subsequent steps in SAM. Although there was limited progress to these steps they have been established for River Operations which is a critical aspect of IWRM. The authors hope that this provides enough of an example for other sectors of the IUCMA and other CMAs to move in this direction.

Feedback from formal and informal learning opportunities have shown the IUCMA developing a deep understanding of IWRM as a complex V-STEEPP process, and learning to apply this understanding to IWRM practice. Although complexity is a difficult paradigm to formally come to grips with, the concept and diagram of the yellow brick road has appealed to people across the IWRM spectrum, both within the Inkomati catchment and beyond. It certainly changed the dialogue that takes place within the IUCMA and also between the IUCMA, its stakeholders (including DWS, municipalities and mines) and Governing Board.

Feedback from staff about the change from DAD to ALIDA approaches to stakeholder engagement clearly shows the acceptance and sincere, persistent application of ALIDA which will hopefully be adopted as strongly by other CMAs and government agencies across the board. South Africa certainly needs a complete revolution in its public participation processes if it is to deepen democratic behaviour in government and across society.

Perhaps the most promising signs of the IUCMA taking up the new thinking and SAM has been that in the last few months many staff, especially senior members, have begun to critique their own progress and the likely challenges to further advances in adaptive and stakeholder centred IWRM. The issue at the end of this project is: whether the new thinking and Sam are now sufficiently embedded in the IUCMA for them to continue to dominate decision-making well into the future? Time will tell!

Processes of knowledge sharing have highlighted that the IUCMA is a leader regionally (e.g. the Usuthu catchment), nationally (e.g. DWS and emerging CMAs seek IUCMA advice; a suma cum-laude MSc thesis for an IUCMA staff member) and internationally (2nd prize for a presentation at an international conference; Dutch partners realising that in Holland in general they are doing DADs and adopting the ALIDA principle).

The process of building an adaptive and stakeholder centred IUCMA has had strong beginnings but there is a way to go yet. Specific recommendations that arise from this project are:

- In general the IUCMA needs to take SAM beyond Adaptive Planning and build adaptive decision frameworks for more Divisions, MANCO (IUCMA Management Committee) and the Governing Board.
- The Institutions and Public Participation Division has made huge strides in adopting an ALIDA approach to stakeholder engagement but they need two advances.
- Firstly, they need to develop formal guidelines for stakeholder engagement that they can embed across the Division and can convey to the rest of the IUCMA and to new CMAs.
- Secondly, they need to develop an overall framework for planning and decision-making within the Division that will broaden and more effectively embed the new thinking within their ranks.

- The Resource Protection and Waste Division used Adaptive Planning to develop a strategic plan of their own. The key now is to ensure that it is internalised and used by all their staff, and that processes of monitoring, reflecting, and learning are developed.
- Many official documents of the IUCMA claim that they practice Strategic Adaptive Management. Although great strides have been made this runs the risk of becoming an empty statement unless the practical requirements of SAM are explicitly accepted and promoted at the highest levels of senior staff and MANCO.
- Similarly, MANCO and the Governing Board need to develop clear and effective means for expounding the IUCMA's SAM approach to IWRM to government and other stakeholders.
- There is an urgent need for the appointment of SAM/new thinking champions, and for regular formal learning opportunities to be embedded in IUCMA practice at all levels.
- There is a similarly urgent need for champions of integration across IUCMA Divisions and also between the IUCMA and the many other STEEPP institutions involved with water resources management in the catchment (i.e. for co-operative governance).

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The authors are deeply indebted to all the staff of the Inkomati/Usuthu Catchment Management Agency for their fortitude, stamina, strength of character and deep commitment to the CMA cause. They have truly set a pioneering example for all CMAs in the country. It has been a privilege working with them.

Wendy Midgley worked tirelessly to hold bureaucracy at bay and ensure we could work as smoothly as possible.

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LIST OF ABBREVIATIONS

ALIDA	Ask, Listen, Integrate, Decide, Act
AMD	Acid Mine Drainage
APP	Adaptive Planning Process
CEO	Chief Executive Officer
CMA	Catchment Management Agency
CMS	Catchment Management Strategy
DAD	Decide, Announce, Defend
DWS	Department of Water and Sanitation *Formerly the Department of Water Affairs and Forestry, (DWAF) then the Department of Water and Environmental Affairs. For consistency, DWS is used throughout this report.*
IWRM	Integrated Water Resources Management
IUCMA	Inkomati-Usuthu Catchment Management Agency *Formerly the Inkomati Catchment Management Agency. IUCMA is used throughout this report for consistency,*
MANCO	Management Committee
NGO	Non-Governmental Organisation
RQO	Resource Quality Objective
SAM	Strategic Adaptive Management
STEEPP	Social, Technical, Environmental, Economic, Political, Practice
V-STEEPP	Values – Social, Technical, Environmental, Economic, Political, Practice
VA	Vital Attribute
Wits	University of the Witwatersrand

PART 1

BACKGROUND AND APPROACH

1. INTRODUCTION

It is now widely recognised that most water crises worldwide are primarily crises of management and governance, rather than of scarcity (Turton et al., 2006). The crises have arisen from past water management approaches which were characterised by site-specific management, and centralised decision-making with a focus on issues of water supply. Water was seen as something to be exploited and tamed by technology and managed by command (bureaucratic rule sets) and control (technological) decision-making (Rogers et al., 2000). Although such management approaches have at times initially been successful, in the longer term they always result in unforeseen consequences for both natural ecosystems and human welfare. These consequences come in the form of a reduction in the quantity or quality of the resource, and social and economic strife that comes from reduced access to the resource and losses of biological diversity (Holling and Meffe, 1996).

Water professionals now understand water as a common pool natural resource which means it belongs to all, and that any use by one person has consequences for use by others. They also recognise that water needs to be managed at the catchment scale (hence the need for Catchment Management Agencies) to encourage a broader systems view of the resource, the problems experienced and solutions needed. The concept of Integrated Water Resources Management (IWRM) has emerged over the last few decades, reflecting these new understandings. IWRM is advocated by a wide range of Non-Governmental organisations (NGOs), researchers and practitioners, including many prominent international players – such as the Global Water Partnership, the World Bank, the United Nations, and most bilateral donor agencies – as the only feasible approach to address current water crises.

The Global Water Partnership (GWP) defines IWRM as “a process which promotes the coordinated management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (GWP, 2000). The overarching goals of IWRM are “ecological sustainability”, “social equity” and “economic efficiency” (GWP, 2000). These same goals of sustainability, equity and efficiency are at the heart of the National Water Act (NWA, 1998), emphasising the need for IWRM as a concept and practice in water management in South Africa. Prof Kader Asmal (2000) recognised that a critical element of IWRM is that in engaging stakeholders in decision-making it could be used to pursue “both equitable access to water for all citizens and the deepening of democratic behaviour in society”.

Although IWRM is recognised for its richness of concept it lacks a clear implementation framework. Many tools exist for addressing elements of resource management and

stakeholder engagement, but holistic frameworks which can integrate these tools across sustainability/equity/efficiency divides are still lacking. In this study the research team looked to practices in participatory natural resource management for such a framework to compliment the IWRM concept.

Natural resource management has already undergone the shift from command and control management and decision-making. In this case it was underpinned by the, now discredited, concept of a "balance of nature" which led managers and scientists to assume that if nature was changing it was out of balance and needed to be corrected. Over the last two to three decades it has become clear that nature is constantly changing in complex unpredictable ways and trying to constrain it (e.g. by engineering river channels or building dams to control floods) is counter-productive ecologically, socially and economically. Furthermore, it has been clearly demonstrated that natural resources cannot be understood or managed in isolation from the social systems in which they are embedded (Berkes and Folke, 1998). The emergent concept of integrated "social-ecological systems" has become a powerful tool in natural resource management including for water.

"Adaptive management" is now widely accepted as the primary tool for the management of integrated social-ecological systems in the face of the high levels of uncertainty that both natural and social systems present. Contrary to common belief, adaptive management is much more than simply "adapting as you go". It is a systematic approach for building knowledge and improving decision-making by learning from management actions and outcomes. It involves exploring alternative ways to meet management objectives, predicting the outcomes of each alternative based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn which alternative best meets the management objectives, and then using these results to update knowledge and adjust management actions to achieve a better outcome for the resource and society.

There are six main steps to an adaptive management process (after Williams et al., 2007):

Step 1: Frame the problem including building a model of the system.
Step 2: Design objectives and develop a management plan for action.
Step 3: Implement the management plan.
Step 4: Monitor the system response to management actions.
Step 5: Use monitoring results to evaluate achievement of objectives and lessons learnt.
Step 6: Adjust or revise the objectives and management plan on the basis of this evaluation.

Adaptive management is a bold approach to management, which requires long term creative commitment to explicitly structured learning which is used to reduce uncertainty. It differs from traditional management approaches in that it encourages management activities to proceed despite uncertainty regarding how best to achieve desired outcomes, and despite inevitable change and surprises that will happen along the way. Not only does adaptive management acknowledge uncertainty but it specifically targets it: it compels ecosystem

managers to be open and explicit regarding what is not known about how best to achieve objectives, and provides a science-based learning process characterized by using outcomes for evaluation and adjustment (Murray and Marmorek, 2003). It therefore has the potential to overcome much of the implementation inertia that has bedevilled attempts at IWRM.

Strategic Adaptive Management (SAM) (Rogers and Bestbier, 1997; Rogers and Sherwill, 2008; Rogers and Luton, 2011) is a local derivative of adaptive management designed to achieve the consensus-based "future building" envisaged by our legislation. It is a simple but robust system for participatory planning, decision-making and review in complex social-ecological systems. Well executed cycles of operational and strategic review track and integrate the changing Social, Technical, Economic, Environmental, Political and Practice (STEEPP) context of the management environment. SAM continually assesses progress in delivery and keeps stakeholders, including government, on a sustained journey to a shared future of sustainable resource use.

The National Water Act (NWA, 1998) emphasises "the need for the integrated management of all aspects of water resources" in ways that enable "everyone to participate". It further requires the development, by Catchment Management Agencies, of Catchment Management Strategies that promote the management of catchments in a "holistic and integrated manner". Both the Act and National Water Management Strategy (NWRS 2) propose that water resource management should be developed and implemented in an "adaptive manner". Thus, although neither the Act nor the National Water Policy explicitly refer to IWRM or adaptive management, their tenor relies heavily on the underlying principles of both concepts and they are firmly embedded in many policy guidelines, such as those for developing Catchment Management Strategies (DWS, 2007). Hence the motivation, in this project, to use SAM as a framework for implementing IWRM in the Inkomati Catchment Management Agency.

Like any other management system the success of IWRM and SAM depend on how well they are embedded within the organisational culture and governance structures of the management agency. This is an absolutely critical component process of any change management exercise, including advancing IWRM and SAM in a Catchment Management Agency. There are many change management approaches that can be used for this purpose but since this exercise was to be conducted in a partnership between an academic institution and a public agency an action research approach was adopted.

"Action research" is a term used in the social sciences to help scientists and practitioners recognise that they can learn from combined action that is aimed at achieving mutual goals (Hart and Bond, 1995).

In this action research exercise, academics from the Centre for Water in the Environment at the University of the Witwatersrand, Johannesburg (Wits) worked with staff of the Inkomati Catchment Management Agency (which later became the Inkomati/Usuthu Catchment Management Agency, IUCMA) to use SAM as a framework to operationalise IWRM as envisaged by the Water Act.

The Inkomati Catchment Management Agency (IUCMA) was established in 2006 and in late 2008 the Chief Executive Officer (CEO) at the time approached Prof Rogers to assist the small initial staff to use SAM to operationalise IWRM in the IUCMA. A project of action research, funded by the Water Research Commission (WRC) and the Centre for Water in the Environment, was then initiated to:

- Build capacity in SAM in IUCMA staff;
- Embed SAM as the central decision-making system for the IUCMA; and
- Achieve institutional change from a focus on “building an institution” to one of "IWRM implementation".

The final activity of this phase of action research was the development of an Inkomati Catchment Management Strategy (CMS) through extensive public participation using the Adaptive Planning Process (APP) of SAM.

A second phase of action research continued the use of SAM by the Wits/IUCMA team in the implementation of IWRM as envisaged by the Inkomati Catchment Management Strategy. The three primary sets of activities were:

- Fostering a culture of structured learning within in the IUCMA;
- Multiple use of the APP of SAM under a range of contexts at different scales to test its robustness;
- Fostering a culture of sharing of knowledge about, and experiences with, SAM-based IWRM for CMAs.

This report is about the changes in thinking and decision behaviour that took place in the staff of the Inkomati (Usuthu) Catchment Management Agency between 2009 and 2015 while the project team was facilitating the use of SAM as a framework for implementing IWRM in the Inkomati Usuthu catchment.

2. THE ENVIRONMENT IN WHICH THE PROJECT WAS STARTED

Although IWRM and adaptive resource management are internationally accepted concepts and practices, the contexts in which they have been discussed and applied globally are worlds apart from operationalising a CMA in post-apartheid South Africa. When this project began the research team was acutely aware of the uniqueness of the situation they were about to encounter but many unpredicted issues and circumstances emerged as the research progressed. The narrative below is an integration of both foresight and hindsight.

South Africans are working in the face of revolutionary new legislation which requires profound transformation in decision behaviour and completely new, unprecedented institutions. This contrasts dramatically with the policy reforms or adjustments and the reorganisation of institutions that developed countries normally face. South Africans need to reinvent ourselves in a climate of expectation and uncertainty, differentially manifest across the huge social chasms that exist between the historically marginalised and historically privileged sectors of society. These stakeholder disparities demand extraordinary focus on issues of equity and the potential for conflict, especially in areas of public engagement required by a new democratic Constitution.

Equity, for example, is just one short word for a goal which has many complex ramifications that spread throughout societal decision-making. Equity cannot be achieved by any number of individual activities because it is not an easily bounded “thing” but rather an emergent property of a vast number of interacting societal activities, values, and perspectives. It is a typical wicked problem (Rittel and Webber, 1973) that has no definitive definition nor definitive solution, and no outcomes of activities can be definitively right or wrong. What constitutes equity in one context, e.g. housing will not translate to another, e.g. access to water for agriculture. However, as with the concept of sustainability, we have to keep striving for it regardless.

The potential for conflict also presents a wicked problem. For the first time in South African history, people with world views that are worlds apart, are being thrust together as nominally equal citizens. Suddenly, they must form stakeholder bodies to guide the formation and functioning of an unprecedented institution, a Catchment Management Agency. Public engagement activities face wide gulfs in social circumstances, in education and in language, in expectations of a better future on one hand and in fears of losing identity on the other. In any one workshop there could be people across the spectrum from those who live below the poverty line, are illiterate and do not speak English (the de facto medium of communication) to very wealthy professionals with post-graduate degrees and years of experience in one or other form of management and negotiation. It is imperative that techniques of public engagement are developed and used with the requisite simplicity to level this playing field.

Scientists, engineers, administrators, public servants and previously empowered or disempowered citizens, need to reinvent themselves if they are going to design a new future

in water management. This future had, for the first time, to be democratically inclusive and highly equity orientated in an institution with a mandate that was without precedent!

Unfortunately in the eight year period between promulgation of the Water Act and the establishment of the IUCMA the fundamental management axiom of "form must follow function" was largely ignored. Rather, much emphasis was placed, by government and the IUCMA Governing Board, on the form the institution should take. The way it was to function in catchment management received scant attention. This was especially evident in the early business plans drawn up by consultants. These were tightly structured around high level policy statements, which would take years to achieve, at the expense of the basic activities of IWRM. Consequently early focus by the Department of Water and Sanitation (DWS) and IUCMA was structured around putting sequential effect to high level policy statements (e.g. first determine the ecological reserve, then verify and validate existing use, bring in compulsory licensing and "do" water allocation reform) as if they could be achieved in a vacuum of everyday management of the water resource itself.

This led members of the aquatic science community (e.g. Rogers et al., 2000 and many professional presentations) to warn of the dangers of the narrow emphasis on "implementing policy" and to propose that the focus should rather be on managing stakeholder use of the resource, making sure that actions are in sympathy with, or guided by, policy.

When this research began in 2009:

- IUCMA staff had been building an institution for two years;
- The CEO and Governing Board wanted to change direction and operationalise the staff in IWRM;
- Staff were involved in activities that they reasoned to belong in IWRM but were doing so in traditional silos (primarily water quantity, water quality, and public participation) and with no integrative framework;
- Staff were bogged down/demoralised in policy-based bureaucracy and many people outside the organisation wanting to "help" by providing their insights/expertise (later called "grannies"). There was no framework for these people to fit into so each was doing/providing their own thing and swamping the staff further;
- Nobody had expertise in participative IWRM let alone experience!
- It was also clear that many of the public servants the researchers had to deal with were bogged down by a paranoia of omission which led to overly complex rules, regulations and plans for just about everything;
- Despite all of the above it was clear very early on in the project that we, the authors, were working with highly dedicated people and this was indeed a privilege.

Our purpose was to bring new ways of thinking and doing into the institution when and where they might be useful and our medium for doing this was Strategic Adaptive Management.

3. NEW THINKING FOR DOING IWRM

Without a clear implementation framework, attempts at IWRM have generally been approached from the disciplinary perspectives of the team members or leader, or at least with these perspectives having much influence on the process. By definition these perspectives come from the past era of management thinking and most often they lack critical elements of "new thinking" that have emerged over the last 10-15 years. The contrast between the "old" and "new" thinking is illustrated broadly in Figure 1 which depicts the changing environment in which natural resource management is taking place.

Many people have argued that in the past, resource management globally has been dominated by a top down command and control mind-set (Holling and Meffe, 1996). The command-and-control approach implicitly assumes that the problem is well-bounded, clearly defined, relatively simple, and generally linear with respect to cause and effect. Under this scenario managers and decision-makers have relied on so-called experts for advice on what the problems are and what needs to be done to fix them (Hardin, 1968; Rogers et al., 2000; Rogers, 2006).

This scenario is described by the bottom left hand intersection of the three axes (societal decision-making, organisational behaviour, and operational interpretation) in Figure 1. The management approach described above becomes manifest in attempts to control the natural ecosystems that supply the resource and also the socioeconomic institutions that respond to and utilise the resource. Command and control usually results in reduced levels of natural variation in ecological, social and economic systems and this leads to the systems becoming less resilient to external perturbations, resulting in crises and surprises. Ultimately resource use becomes unsustainable with unforeseen consequences for both natural ecosystems and human welfare in the form of collapsing resources, social and economic strife, and losses of biological diversity. The situation in South Africa is not unlike the rest of the world in this respect in that the quality of our resource and the health of our ecosystems have steadily declined over the last decades (Department of Water Affairs, 2011) despite all the old style management attention they have had.

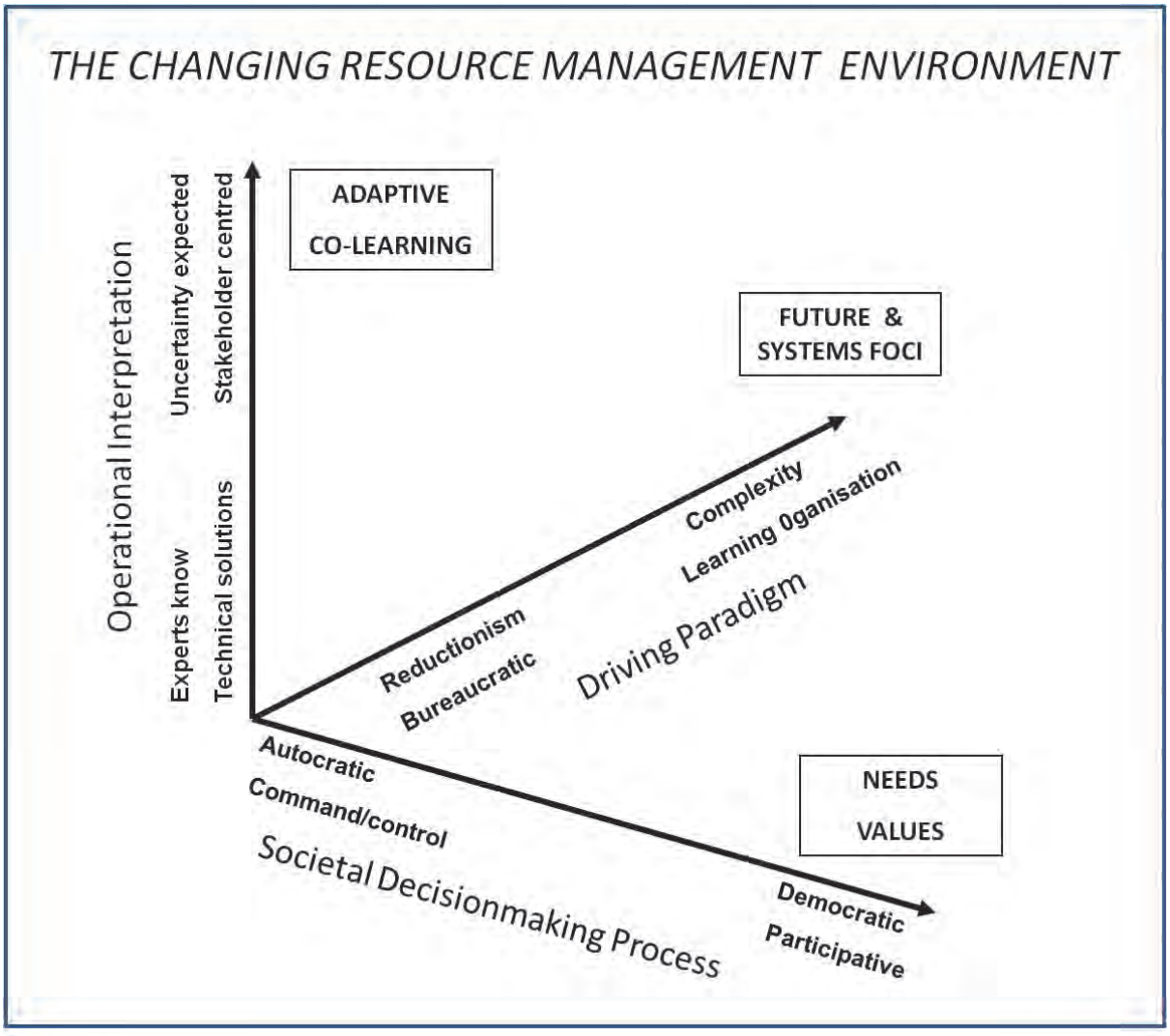


Figure 1. The complex environment in which resource management takes place

Repeated experiences of resource collapse in aquatic and terrestrial systems has led scientists and managers to build new understandings of how to approach decision-making for more sustainable use of natural resources (Berkes and Folke, 1998; Rogers et al., 2000). As described in Figure 1 this new understanding leads to three new spheres of thinking.

- Firstly, command and control are swopped for democratic and participative decision-making which incorporates the experiences and perspectives of stakeholders to ensure a richer decision-making environment in which shared values, instead of fixed rules, guide decision-making.
- Secondly, reductionist bureaucracies are replaced with organisations that recognise the complexity of social-ecological systems and the need to continually learn from our actions to design a better future. This switch requires a shift from disciplinary to integrative science and decision-making which recognises the complex interactions between the various components of the social-ecological system (see Rogers et al.

(2013), Cilliers (2008) and Morin (2008) for more in-depth discussion of the change in mind-set required to adopt this sort of thinking).

- Lastly has come the recognition that "one size does not fit all" so the heavy reliance on disciplinary specialists or experts, is replaced by stakeholder centred and cooperative learning for decision- making that can adapt to variations in context, new knowledge and unexpected surprises (Rogers and Luton, 2011).

South Africa's new democracy demands major changes of thinking but it is hard to make the switch. First and foremost a democratic dispensation requires that citizens/stakeholders must participate in planning and decision-making so that they have a say in designing their own futures. In this project the research team devised a way to quickly and effectively get stakeholders to understand IWRM from an integrative systems perspective, without drowning them in theory.

3.1 A Shared Rationality for Catchment Management

Because water is a common pool resource it is essential that everyone involved in decision-making shares a common understanding of what they are dealing with and that understanding must be based on the new thinking described above. They do not have to agree on all the details but they do need a common rationality of how to view the management of a catchment as a complex social-ecological system.

Without any doubt the most influential diagram used in SAM is that describing the basis of a rationality that needs to be shared by all participants from the start. It has broadly become known as "the yellow brick road" (Figure 2) and is always used to explain to participants the reality of what they will be dealing with when managing water (natural) resources for a better future in a complex social-ecological system. The term "yellow brick road" comes from the story "The Wizard of Oz" but has generally become known as a course one might travel in search of a better life even though the road is full of challenges and surprises that must be overcome. It is a very apt description of the real life picture of IWRM.

Generally, because one is dealing with a very diverse set of stakeholders, it can be counterproductive to attempt to explain the concept of complexity per se. The research team found that it is better to use this simple diagram to illustrate the complex issues of IWRM.. Components of the diagram are described, using an annotated slide and the facilitator uses the collective "we" to reinforce the fact that everyone is affected by and affects IWRM, as follows:

- We are dealing with a common pool resource which demands different approaches from privately managed resources. The key issue is that as soon as any one person uses some of the resource, it affects everyone else's potential use thereof. Water must be viewed as a shared resource and that we all have a stake/share in its future health and availability.

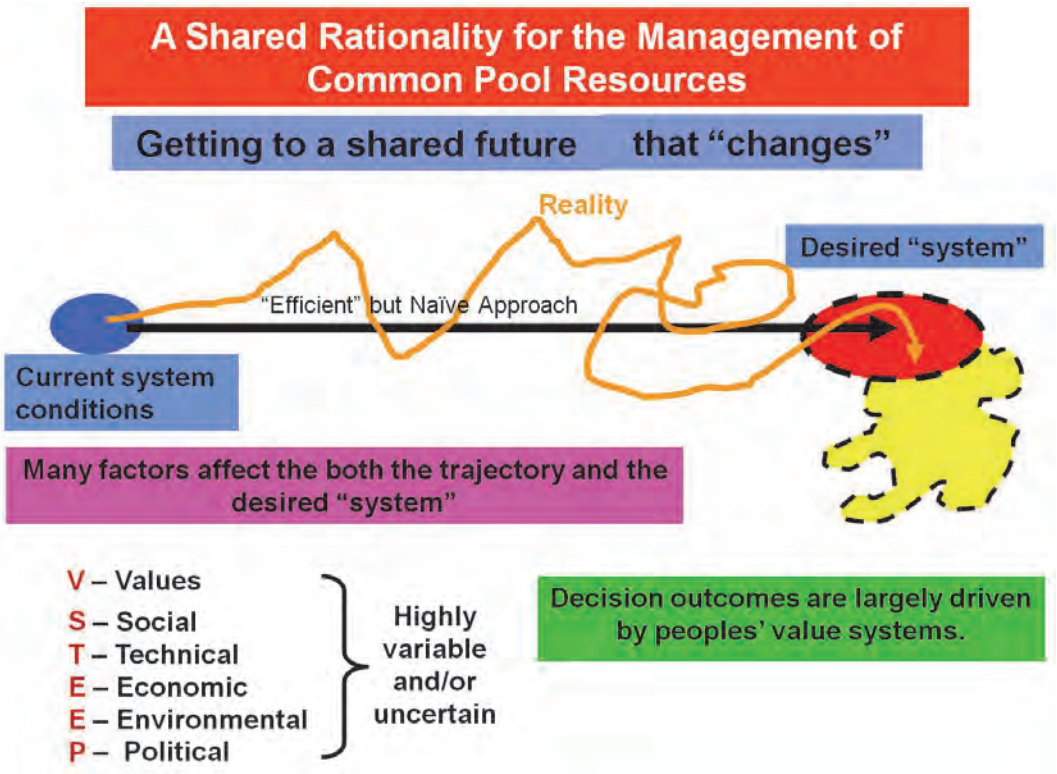


Figure 2. The "yellow brick road". This diagram, usually presented as an annotated slide, depicts, in an unthreatening way, the complexity of managing common pool resources. It generally has much appeal with stakeholders and civil servants, who often say: "Now I understand what IWRM is all about!"

- We are faced with a current resource (blue ellipse) with which, for many reasons, we are not satisfied and we want to manage the resource in a way that provides a better future (red ellipse) for society.
- Broadly speaking people (bosses, stakeholders, funding agencies, etc.) want this future to be achieved as quickly and efficiently as possible, as represented by the black line between present and future. However, it is extremely naive to think that the process of getting to a better future can be achieved in a linear fashion; it simply never happens. The reality is more like what the wiggly yellow line represents, with uncertainties causing many surprises and deviations from the naive black line. The rhetorical question is asked: "why insist on planning and decision-making as if we could follow an efficient straight line trajectory to the outcome we want when such a trajectory is never found in the real world?" It is better that we understand from the start that, in moving towards a better future, we will always be faced with unexpected challenges which will cause delay, redirection and rethinking about the future we can achieve.
- Very importantly, if we learn from the deviations and changes made in actions to reach the future, the envisioned future will change as we begin to understand more about the path to get there, what is desired, and what is achievable. (Red ellipse shifts

down and yellow curvy shape replaces it. At the same time the words “that changes” drop in front of the words “Shared future”.) The reality of the yellow brick road as a path to a “changing future” makes it easy to impress on participants that explicit learning and adapting of our decisions along the way is critical to managing a natural resource. Hence the need for adaptive management!

- The importance of a “future focus” in planning and decision-making is explained thus: At any one point in time we, individuals or collectives, are faced with many problems we want to solve and challenges we want to overcome, so much so that many people become overwhelmed in their search for a better future. Simply put, if we spend all our time trying to solve all the problems of the present all we can expect is to stay in the present. It is far better to “design” a better future and to metaphorically “look back” at the present to see which problems need to be solved to get to the future. These are usually a fraction of the total set that we face in the present. So designing and working towards a better future becomes a critical activity in IWRM.
- There are many factors that affect our journey along the yellow brick road and we categorise them with the acronym STEEPP (Social, Technical, Economic, Environmental, Political, and Practice). All of these are variable and uncertain in time and space but we must understand how they affect the water resource and our journey to a better future. IWRM is not just about water but about water as one component of a complex social-ecological system. We ignore the STEEPP components at our peril.
- Lastly, the facilitator points out that ALL decisions anyone makes are structured by their value system. It is therefore imperative that we develop a shared value set to guide decision-making in the system we will manage together.

Presentation of the yellow brick road slide always has a major impact on participants’ thinking and they immediately relate to, and so automatically share, the reality it presents. It has proved a very powerful tool in creating the shared rationality for planning and decision-making needed to proceed with SAM. From this point on a facilitator can easily steer participants by using the imperatives the yellow brick road presents: common pool resources; the route will always be somewhat tortuous and we must learn and adapt along the way; our expectations of the future will change; and the imperative of a V-STEEPP systems view of the catchment to be managed.

3.2 Stakeholder Engagement

An effective process of engaging stakeholders that minimises conflict and maximises cooperation is absolutely critical to effective IWRM. Unfortunately the processes generally recommended and used in this country have serious flaws so the researchers had to design their own process of public participation in decision-making. This process is described in full in Section 5.2. Here the five guiding principles of stakeholder centred facilitation and decision-making that emerged in this project are set out:

- Never do a DAD (Decide, Announce, Defend)! Always do an ALIDA (Ask, Listen, Integrate, Decide, Act).

A DAD happens when people or institutions, usually with the best intentions, develop a plan that they believe will be in the stakeholders' best interests. When they "announce" the plan to stakeholders it appears that they have already "decided" what is best. The stakeholders' reaction is always to attack the plan which the planners then try to "defend" in a cycle of discontent, or even serious conflict. No matter how well you think you understand an issue you cannot experience it in the many legitimate ways that stakeholders do, so never assume you ***know*** what either the problem or the solution is.

When doing an ALIDA one first "asks" the stakeholders how they experience/ understand the issues and potential solutions, and what they need of you. Be sure to listen carefully and empathetically to their views. Do not try to convince the stakeholders differently, and do acknowledge the legitimacy of their perspectives. Once all the views are on the table (not debated) the facilitator must "integrate" them into a systems perspective and integrate them with any policy or management mandate. This process will include participative feedback with stakeholders to reach a shared "decision" and "action" program for who will do what, when, and where. The APP presented later (section 5.2) will describe an effective way of doing this.

- Always build a systems (V-STEEPP) perspective/context in which stakeholders can see their issues in the context of the broader picture which includes other peoples' equally legitimate views. Avoid looking at the problem just through a "water lens" because the issues are always broader than that.

- Never allow debate about who is right and who is wrong, who has the best idea/solution, etc.! Collect everyone's input/perspective, explicitly emphasising that all are equally legitimate. Questions may be asked for clarification, but challenges to the "correctness" of an individual's perspective are not tolerated. A shared and legitimate perspective of the issues/problem/solutions will always emerge from such a process.

- Develop and use shared values to guide direction and decision-making and avoid setting fixed "rules" for decision-making.

- Seek consensus (win/win) not compromise (lose/lose). Consensus WILL emerge, without exhaustion, if you follow these guiding principles properly.

3.3 Important Frames of Mind for Working in Complex Systems

Knowing that one is working in and with a complex system is not enough, it is also important to know how to think and make decisions in such a system. The research team actively worked on developing three broad frames of mind (openness, situational awareness, and a healthy respect for the restraint/action paradox) in themselves, and in IUCMA staff. These proved extremely useful.

Psychological openness

This is the willingness to accept, engage with, and internalise the different perspectives encountered among diverse participants in an interdisciplinary situation. An open frame of mind requires conscious acceptance that notions such as ambiguity, unpredictability, serendipity, and paradox will compete strongly, and legitimately, with knowledge, science, and fact.

Situational awareness

One must be continuously aware that each issue can appear quite different, and interactions have quite different outcomes, within different contexts. Recognising that "one size does not fit all" and that one must expect problems and solutions to be different in different V-STEEPP contexts is critical. A solution or even a way of thinking will not always be applicable in different social or environmental situations, and different participants' value systems are likely to lead to different outcomes. Hence situational awareness is critical to effectively navigating through complex systems.

A healthy respect for the restraint/action paradox

Leadership and decision-making in a complex system constitute a balance between the risks associated with practicing restraint and those of taking action. If the context requires it, one might need to consciously practice restraint so as to create space that allows ideas, trust, and opportunity to emerge. On the other hand, one needs the courage to take action in a mist of uncertainty because the consequences of our actions are never entirely predictable, and no matter how good our knowledge, there is never a single, or objective, "right" decision. Being conscious of, and comfortable with, this paradox is critical to practicing adaptive leadership in social-ecological systems.

These frames of mind and the habits of mind that support them are explored in more detail by Rogers et al. (2013 and Appendix 1). The research team practiced them in all engagements with the IUCMA and tried to embed them in IUCMA thinking.

4. APPROACH AND METHODS

It is important to understand that the research team's mode of thinking and decision-making was the most critical aspect of their approach to this project. This dictated ***how*** they and the IUCMA staff conducted all activities and was central to the project's success. As will be shown below, the activities were very simple ways of getting people to interact and learn new things. It was ***how*** things were done, not what was done, that defined the project and its outcomes.

4.1 The Art of How

First, it was critical that the basic concepts of the yellow brick road were kept in mind when planning, conducting and reviewing any activity. To summarise, facilitators would always be reminding themselves and participants that:

- "We" are dealing with a common pool resource in a complex social-ecological system.
- "We" must at all times maintain a future focus while recognising that "our" understanding and expectations of the future will change.
- The yellow brick road will be full of surprises and unknowns which will challenge progress
- "We" must always examine the V-STEEPP characteristics of a challenge to ensure that an integrated systems perspective is developed.
- "We" must provide regular and structured opportunities to reflect, learn, and adapt in response to learning.

The second critical aspect of how the research team did things was to practice what they preached. Thus, they stuck to the five guiding principles of stakeholder engagement and the three frames of mind for complex systems which are as applicable to everyday meetings and workshops as they are to broad public engagement. Consequently, the team never did a DAD on the IUCMA staff and always followed the ALIDA approach in which they sought the staff's perspectives and ideas about what to do next. The team was also constantly juggling with the constraint/action paradox so as not to push IUCMA participants and ourselves too far or too fast.

As the research team had a clear mandate they were not simply passive participants. They had to stick to our basic task of helping the IUCMA operationalise IWRM in the Inkomati catchment using SAM principles and the new thinking. This was not done blindly or rigidly and both SAM and the thinking evolved along the way.

In practice, adherence to these mind-sets translated into the research team doing the following:

- A project, or an activity, was never approached with specific expected outcomes (as "experts" or consultants might have done). Planning, and trying to implement, some

kind of step-by-step intervention would have been ignoring the reality of the yellow brick road.

- The unexpected was always expected. Change and surprise were inevitable and always provided opportunity rather than a setback.
- The team knew that they would learn as they went along, and that their perceptions of "good" outcomes could change as a result.
- The team knew that they could have no control over the *outcomes* of their interventions (because outcomes are emergent, resulting from interactions), but that they could plan *processes* carefully and thoughtfully. Essentially, this meant planning *how* to do something (e.g. run a workshop or deal with a disgruntled stakeholder) within the new thinking and SAM principles.
- The research team, knew they were just one partner in the project, and they had to "walk the talk" of being co-learners. They never tried to do a DAD.
- The team explicitly looked out for windows of opportunity, with the view to exploiting them when they arose.
- The research team always acknowledged that a key role of theirs was to create "safe spaces" where IUCMA staff could honestly and frankly voice their concerns, needs, and aspirations.

The team openly voiced their own belief in, and commitment to, SAM principles and the new way of thinking. These ideas were explicitly and regularly discussed with the IUCMA, exploring them in each new situation, and unashamedly encouraging IUCMA staff to use SAM and the new thinking to guide their reflections, decisions, and actions.

In action research (Hart and Bond, 1995; Hult and Lennung, 2007) researchers and stakeholders design the research cooperatively and face to face. Their mutual aim is to define a desired future and undertake well informed actions that will expand their knowledge, enhance their competencies, and overcome challenges for moving to that future. Action research is therefore very much a process of generating personal and institutional change (Reason and Bradbury, 2001) and with it comes the need for deep trust between all parties. That trust will not emerge if the parties themselves do not adopt a common frame of reference for decision-making and "walking-the-talk" along the path that takes them forward.

The research team became involved in many different activities associated with our mandate. Most of these were agreed to and designed with IUCMA staff on a needs basis but the foundation of our action research lay in three sets of activities that were carried out each year.

4.2 Adaptive Planning Processes

The Adaptive Planning Process is a component of SAM which is described in detail in the next section. The project used the APP under a range of contexts and at different organisational levels, to test its robustness and to improve it where necessary. It was used:

- For the initial planning for the IUCMA itself;

- To help individual Divisions within IUCMA to plan strategically for stakeholder centred IWRM;
- Outside the IUCMA with the DWS Division of Institutional Oversight to consider their problem of implementing seven more Catchment Management Agencies;
- Within the catchment to develop a stakeholder centred Catchment Management Strategy and to assist catchment forums with their strategic planning.

4.3 Learning/Unlearning Workshops and Assessment of Learning

The culture and practice of structured learning must be at the core of any adaptive management process and SAM is no exception. Peoples' learning patterns are strongly influenced by previously accumulated knowledge and the more a person's worldview is shaped by learning within a defined field, the harder it becomes to associate with new knowledge that emerges from other fields. At the same time our current worldview puts us on a path of "selective exposure" along which we unconsciously protect our existing knowledge by disregarding conflicting or unrelated information too quickly. The research team's challenge was to enable IUCMA staff and catchment stakeholders to become sufficiently confident in the new thinking, the yellow brick road and SAM that they could unlearn their long-imposed path of selective exposure to old thinking and practices.

One of the ways the research team ensured that everyone learnt from project activities and did not just experience them, was to hold formal learning/unlearning workshops. These workshops took a number of forms covering different subjects and experiences but they were all underlined by two simple activities. The first was to construct and regularly update a narrative timeline of events and experiences of the IUCMA staff, upon which they could reflect and discuss to expose what they had learnt, how, and why. After this activity staff would simply discuss and document what they individually and collectively should unlearn if they wanted to be more productive and focussed.

The processes by which people learn and the assessment of what they have internalised and can use in practice, are critical components of building adaptive capacity in participants. In addition to the workshops a particular study of how people learn in complex systems was made and applied in this project. A detailed paper on this can be found in Appendix 1 (Rogers et al., 2013) and a very brief introduction is given here.

Learning is a very personal behaviour and each individual will have their own approach but it essentially starts with becoming aware of something new, such as new knowledge, a new technique or new technology. The learner must then embrace that new something and develop a level of competence in it before they can use it. There are three "levels" of use in this context. Level one is simple repetition in the same context as it was learnt, while level two is modifying the new something so that it can be used in a different context. At the third level the learner questions what has been learned and what they know to the extent that they generate another completely new something. This project largely dealt with level two

learning where IUCMA staff and stakeholders could become competent in SAM and the new thinking to the extent that they could modify it for application in the unique context of IWRM in the Inkomati catchment.

Although actual learning is achieved by individuals, people – especially in a catchment management context – largely learn within social or professional groups and encouraging this is essential for developing the new thinking across a catchment. The concept of social learning has gained much popularity in recent years and has been described as a process which must: (1) demonstrate that a change in understanding has taken place in the individuals involved; (2) demonstrate that this change goes beyond the individual and becomes situated within wider social units or communities of practice; and (3) occur through social interactions and processes between actors within a social network (Reed et al., 2010). In designing various components of SAM and in embedding them in the IUCMA much emphasis was placed on creating multi-stakeholder environments to stimulate social learning in and for IWRM. The learning/unlearning workshops provided one such environment.

It is crucial to provide social learning opportunities but equally critical to find out if individuals have indeed managed to move beyond their personal levels of selective exposure. Consequently it was important for all involved that the research team assess the extent of learning among the IUCMA staff and how well they were applying it. The learning/unlearning workshops were one means of doing this but the research team also used written surveys and one-on-one interviews to assess the depth and extent of learning.

4.4 Knowledge Sharing Workshops and Activities

The culture and practice of knowledge sharing is at the core of SAM and is vital in the current context of IWRM in South Africa. IWRM is new to South Africans and many individuals and institutions are planning to practice it. The IUCMA is the pioneering institution and it was vital that it shared its experience and knowledge with others. Activities ranged from formal two day workshops and conference presentations to one-on-one meetings between the research team or IUCMA staff and other local and international institutions.

This report does not cover each activity in detail but their outcomes are integrated into this report.

Achieving the mandate of getting the IUCMA to operationalise IWRM through SAM processes and thinking could not be achieved by the above three sets of activities alone. Many other formal and informal interactions between the research and IUCMA teams took place. These ranged from visiting overseas institutions together to popping into someone's office to improve communications and build a trusting relationship. Indeed building trust was probably the single most important activity of the whole project.

5. STRATEGIC ADAPTIVE MANAGEMENT: THE ART OF DOING

"Adaptive management" was first introduced to the sphere of natural resource management by Holling (1978) with his concept of "Adaptive Resource Management". It was originally defined as: "The process of treating resource management as an experiment, such that the practicality of trial and error is added to the rigour and explicitness of the scientific experiment, producing learning that is both relevant and valid" (Walters and Holling, 1990; Meffe et al., 2002). Scientists often term adaptive management "learning by doing", and place experimentation at the centre of learning. Many managers, on the other hand, assume that this implies that learning, and not doing, is the primary objective and they balk at the idea of experimenting on the natural systems under their care. These different perspectives have led to much debate about what is, and what is not, adaptive management, and whether or not it has been successful. This debate is often highly academic and is beyond the purposes of this report.

Despite this debate, the concept of adaptive management has no real challengers in the world of natural resource management in social-ecological systems. In practical terms, adaptive management has become an approach to natural resource management that acknowledges the complexity, and hence uncertainty, inherent in natural and social systems, and that one can never have complete understanding of their responses to human interventions. Adaptive management offers a means of dealing with this uncertainty by integrating planning, management, monitoring and structured learning (not only by means of research), which are used to adapt decision-making to achieve an improved outcome. Adaptive management only succeeds when it becomes a socially robust means of getting decisions made and actions taken, from a continually improving knowledge base, so processes of public participation are central to its practice.

In the late 1990s a group South African scientists, water managers and conservation practitioners developed the concept of Strategic Adaptive Management (Rogers and Bestbier, 1997). SAM was originally designed to support river and catchment management but the delay in formation of Catchment Management Agencies meant it was not applied in that context until this project was initiated in 2009. In the interim, SAM was developed and honed as a decision framework for National Park management (Biggs and Rogers, 2003; Pollard et al., 2011).

Strategic Adaptive Management (Rogers and Bestbier, 1997; Biggs and Rogers, 2003; Rogers & Sherwill, 2008; Rogers and Luton, 2011) was designed to suit the particular circumstances of resource management in social-ecological systems in an emerging democracy. It is fundamentally stakeholder centred, and its "future building" processes have been designed to achieve consensus and cooperation between diverse and divergent stakeholders. SAM is a framework that includes a number of different components (Figure 3), and should be practised as iterative cycles of planning, implementing, monitoring, reviewing and learning.

Rather than being simply described as “learning by doing” it would be more accurate to describe modern adaptive management as “doing to learn, to achieve a better future” and this is how the term adaptive management was used in this study.

The four primary components of SAM (Figure 3) are:

- A down to earth rationality of how attempts to achieve a better future in social-ecological systems really function and the factors/processes that affect future building in real life (the yellow brick road).
- An APP which generates a complex systems perspective of the challenges of future building. The APP includes a V-STEEPP analysis of the system to be managed and an objectives hierarchy that traces the decisions made and the objectives set during planning.
- A decision-making framework for implementation phases that connects all decision-making with the envisioned future and actions taken to reach it.
- A protocol for integrating research, decisions, actions and monitoring outcomes in a process of review and reflection that provides the basis for adaptive transformation in thinking, understanding, and doing.

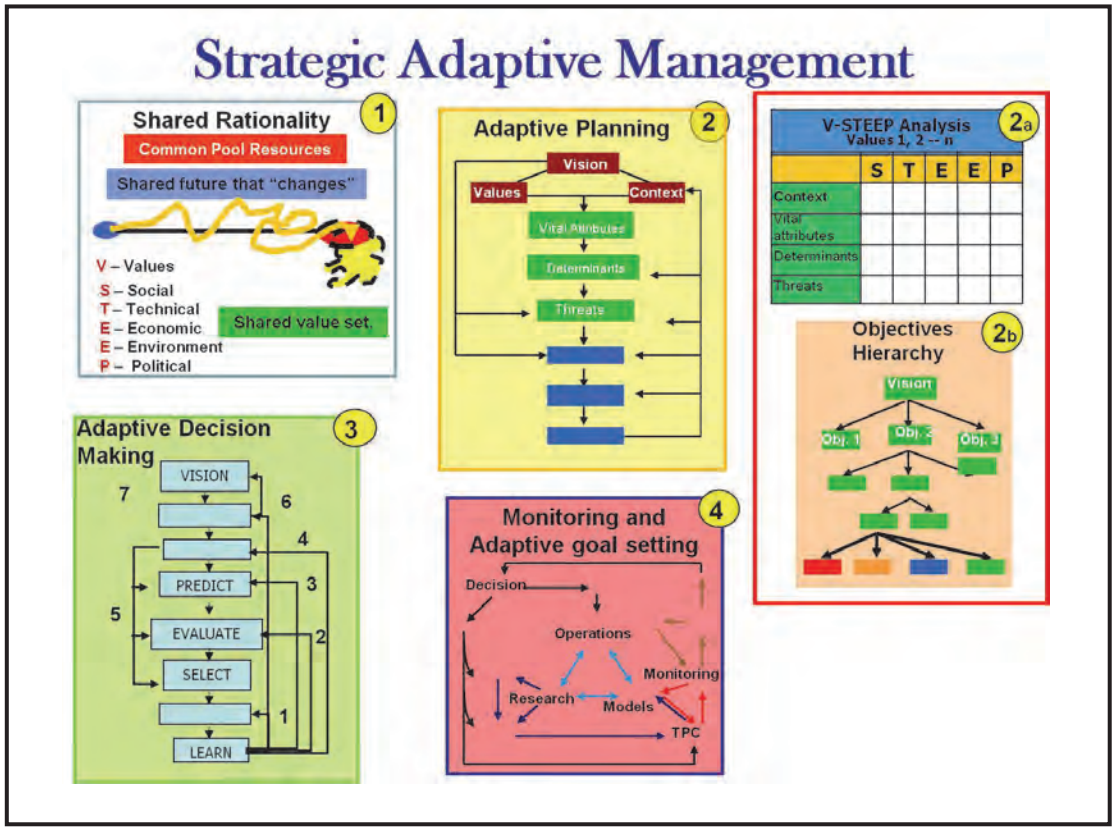


Figure 3. The Strategic Adaptive Management process (V-STEEP = Values – Social, Technical, Economic, Environmental, Political, and Practice)

Activities in this action research project concentrated on the first two components of SAM because it was a project to get the IUCMA started with adaptive IWRM. The Division of

River Operations however took SAM further to develop its own formal decision-making and integration frameworks (Section 8.1; Figure 6).

5.1 A Shared Rationality

Developing a shared rationality amongst participants for understanding the system to be managed and for decision-making is the critical first step in SAM. The diagram and concept of the yellow brick road (Section 3.1) formed the basis for developing this shared rationality about IWRM in complex social-ecological systems. The yellow brick road was used on many different occasions in many different contexts to explain the environment in which the IUCMA worked and the sort of thinking that was needed for integrated water management at the catchment scale.

5.2 Adaptive Planning

The APP is an "all in one", holistic planning tool that promotes shared and integrative learning and consensus building. It is explicitly designed to draw participants towards a requisite simplicity of knowing and doing in a complex V-STEEPP environment. Its strength is in the simple way that, when facilitated properly, it removes participants from their preconceived ideas about the present and exposes them to every other stakeholder's view, which they soon learn is just as legitimate as their own.

There are three main phases to Adaptive Planning:

- Scoping the decision-making environment;
- Understanding the V-STEEPP system that will be "managed";
- Setting objectives and actions to move towards the desired future.

A full manual for conducting an APP is contained in Appendix 2.

The decision-making environment is bounded by three main issues: the desired future that management will aim for, the context in which management is taking place and the principles or value set that should guide decision-making about a common pool resource in a complex social-ecological system. It is critical to generate a common understanding of these issues up-front! The better you know where you are heading the more likely you are to get there, so spend time laying out what future participants want to head for. No great detail is required.

People soon forget something that consists of more than five succinct points so don't let the description exceed that. Setting out the context helps participants understand the starting point and ensuring it is described as a V-STEEPP system has participants compiling, usually for the first time, a holistic systems level view in which they can situate their own issues and those of others. This passive exercise of listing components and issues goes a long way to avoiding conflict over whose individual perspective is right or wrong. The need to develop a shared value set has been argued above.

Understanding the V-STEEPP system to be managed is partly covered by "context" but here the facilitator must aim for a requisitely simple view that links to the desired future and paves the way for setting objectives of how to get there. The range of social, technical, economic, environmental, political, and practice facts, conditions, causes and surroundings that define the circumstances relevant to a problem, provide the "context" within which decisions are made. The context is therefore a fundamental element of any decision-making environment.

People often get bogged down in describing the system in too much detail and with too many technical tools such as mathematical models. Given our disparate stakeholder environment such tools critically disadvantage large segments of the citizenry but they also

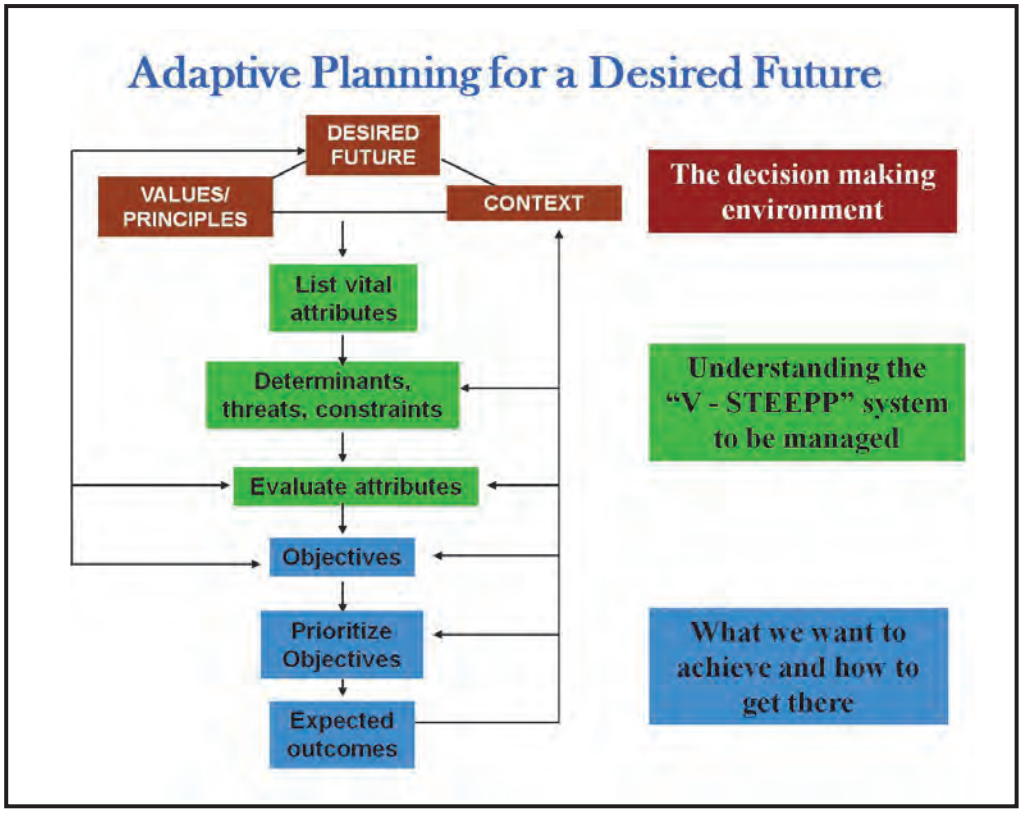


Figure 4. The Adaptive Planning Process of Strategic Adaptive Management

insult them because their legitimate views are not brought to the fore but buried in "clever people's" wizardry. A facilitator must try to arrive at a requisite simplicity by focussing attention on the vital attributes of the system to be managed and factors that determine or threaten them. Vital attributes are the few most important characteristics/properties of the system to be managed. They may be technical, ecological, legal, historic, social, economic, institutional, or political.

A determinant is a factor or process that ensures the persistence of a vital attribute.

Threats are factors within, or outside, a social-ecological system that undermine its values and inhibit the pursuit of the desired future. Threats are also factors or processes that inhibit determinants or vital attributes.

It is useful to produce a table that describes the analysis of the system to be managed. This has been termed a V-STEEPP analysis (Figure 3, diagram 2a). Such a table also makes setting objectives a straight forward but structured process.

Objectives are aimed at achieving the desired future within the current catchment context. They are set in order to overcome threats and so ensure the persistence of vital attributes and/or their determinants.

To set objectives the facilitator simply takes the participants through the list of vital attributes in the V-STEEPP analysis table and for each, asks the question: "what do we need to do to overcome threats to the vital attribute and its determinants?". The answers form the objectives and in this way management becomes highly focussed on the most important issues and actions for achieving the desired future. Some objectives must be achieved before the next one can be tackled, so it is useful to set them out in a hierarchy that provides both a sequence of rationale for why each objective is needed and also a sequence of "doing" to achieve them.

In many cases there will be overlap and redundancy in the initial set of objectives, so it is necessary to sort and prioritise objectives before designing action programmes and then explicitly laying out what outcomes are expected from the actions.

This project discovered that participants, especially public stakeholders, are more than satisfied with what has been achieved by the time high level objectives are set and they are reluctant to go through the somewhat tedious task of developing a hierarchy of lower level objectives. In such instances the facilitator suggested that they use the objectives to design the most essential and urgent action programmes. Individual participants then take on specific action programmes and develop them further.

5.2.1 Facilitating an Adaptive Planning Process

As has been said and implied many times in this report it is not what you do but how you do it that is critical to successful operationalising of IWRM. Negotiations for change in patterns of water resource use need to be aimed at achieving consensus on a shared, but uncertain (Rogers and Breen, 2003) future. The research team used a process that is based on that used in the successful negotiations for a transition from apartheid to democracy in South Africa (Rogers and Bestbier, 1997). Their reasoning was that if it can work for a nation then surely it must have the potential to work for catchment management (Rogers et al., 2000).

The ability to metaphorically look back from the future to the present is very powerful in deciding what needs to be done to get there. There is also less chance of getting bogged down

in people's day to day problems and more potential to be both strategic and pragmatic in planning.

A practical guide for facilitating participatory workshops and capitalising on multi-stakeholder diversity is presented in Appendix 3 (The Art of Stakeholder Facilitation) and must be followed when conducting an APP. It provides guidelines for setting up the workshop, starting the meeting, what to do during the workshop, advice on how to deal with tricky situations and on how to ensure you are following the ALIDA process. Here are some details of what to do when engaged directly in the APP itself.

5.2.2 Basic step-by-step guide to the Adaptive Planning Process

Step 1: Pre-APP

- Before starting with any of the APP components that appear in Figure 4, it is a good idea to start with an initial exercise in which every single stakeholder can voice their concerns or problems they want solved.

- Start by asking everyone to write down their three primary concerns or needs for the workshop, and inform them that each of them *will* be asked what they are. After a couple of minutes of writing time – or until you, as facilitator, judge that around 50% of stakeholders have finished writing – start asking individuals what the first concern is on their list.

- Go round the room and ask *every single stakeholder* for the first concern on their list. Write their concerns up on a flip-chart or computer/projector screen at the front of the room where everyone can see them.

- This is an important trust-building step – trust in the facilitator and the way they record things at the front of the room, and trust that no one stakeholder or set of stakeholders will be favoured in the process. It also helps stakeholders to relax, because their key concern/problem has been recorded.

- This step of probing/asking for clarification of peoples' concerns begins to expose hidden agendas that stakeholders might have but it does so in a none threatening way that has these people quietly backing off from such agendas.

- This exercise will generate a long list of perceived concerns/problems/needs, which cannot all be addressed individually. Point this out to stakeholders: "Here you see that we have such a long list of problems that if we tried to address them one by one we would never get through them." Then point out that you have this process, the APP, which will structure how this information is captured so that it will help us move forwards. Explain that you will come back to this list at the end of the APP and check if there is anything that has not been covered. Finally ask "Can we proceed with the APP and see where it takes us?". The APP is a compelling process and we have never had someone refuse to continue with it.

Step 2: Context

- When starting the APP itself, you can begin anywhere in the top triangle, i.e. vision, values, or context. If you have not done the previous exercise, however, it is good to start with context, as this will begin to build the V-STEEPP story.

- Context includes the 'givens' about the current state of affairs.

- Again ask the participants to write down their top three impression of "context" and go around the room while collecting their responses on a flip chart.

Step 3: Values

- If you have done the exercise of collecting peoples' concerns/problems, starting with vision or values is a good idea so that stakeholders do not feel like they are repeating what they have already done.

- Introduce values as "the principles we use to evaluate the consequences of actions (or inaction), to propose and choose between alternative options and decisions" and then ask that everyone writes down the three values that they think are most important. Stakeholders will probably get uncomfortable with this lack of guidance, and will often ask for extra clarity about what they 'should' be writing. Stick to the vagueness! Tell them to "just give me whatever is in your head". If you give them too much guidance they give you what they think you want and not what is truly important to them. It is VERY important to remember this throughout the process.

- Again, wait until at least 50% of stakeholders have finished writing and then start asking for input.

- Ask people to put up their hands if they would like to contribute, and systematically get input from each of these people. Keep going round like this until either everyone who wants to has spoken, or until the inputs start getting repetitive. Write each input up at the front of the room, where everyone can see them.

- Once you judge that the inputs have become sufficiently slow/repetitive to stop, ask two questions:

    - Is there anything important missing from this list?

    - Is there anything up here that anyone feels strongly is inappropriate and should not be here?

- If one stakeholder/some stakeholders think that an idea should not be on the list, but others disagree with them simply ask permission to flag it (e.g. with an asterisk) as something about which there is disagreement and move on.

A facilitator can now proceed with each of the steps in the Adaptive Planning diagram above using the same facilitation techniques. After a while participants begin to trust the process and that their voice will be heard but they tire of doing the rounds of each participant. When

you see this happening ask them if “we” can dispense with that and simply open up to giving people who want to say something an opportunity under the assumption that if someone doesn’t speak up they have nothing additional to contribute and are in agreement with what has been said.

Note: Do not try to solve problems during this workshop. That is tantamount to staying in the present. Simply remind participants that “their” primary purpose is to collectively design a future and how to get there. Refer back to the yellow brick road presentation to explain again the need to focus on designing a future.

5.3 Adaptive Decision-Making, Monitoring, and Adaptive Goal Setting

The final two phases of SAM are adaptive decision-making and implementation and adaptive monitoring and revision of goals or objectives (Figure 3, components 3 and 4). The form these take is usually very specific to the particular circumstances for which SAM is being used. Adaptive monitoring of spatially and temporally explicit V-STEEPP responses to management actions is required as feed back into explicit learning, and iterative decision-making, operating, and research processes (Figure 5; Figure 3, component 4). SAM, therefore, is not focused on “experimenting” but rather emphasises multiple modes, sources and pathways of learning to improve understanding.

In this project these two phases were only well developed in two instances:

- Management of river operations on the Crocodile River within CROCOC. See the example below (Figure 6; Section 8.1).
- The Equity Working Group of the Institutions and Participation Division.

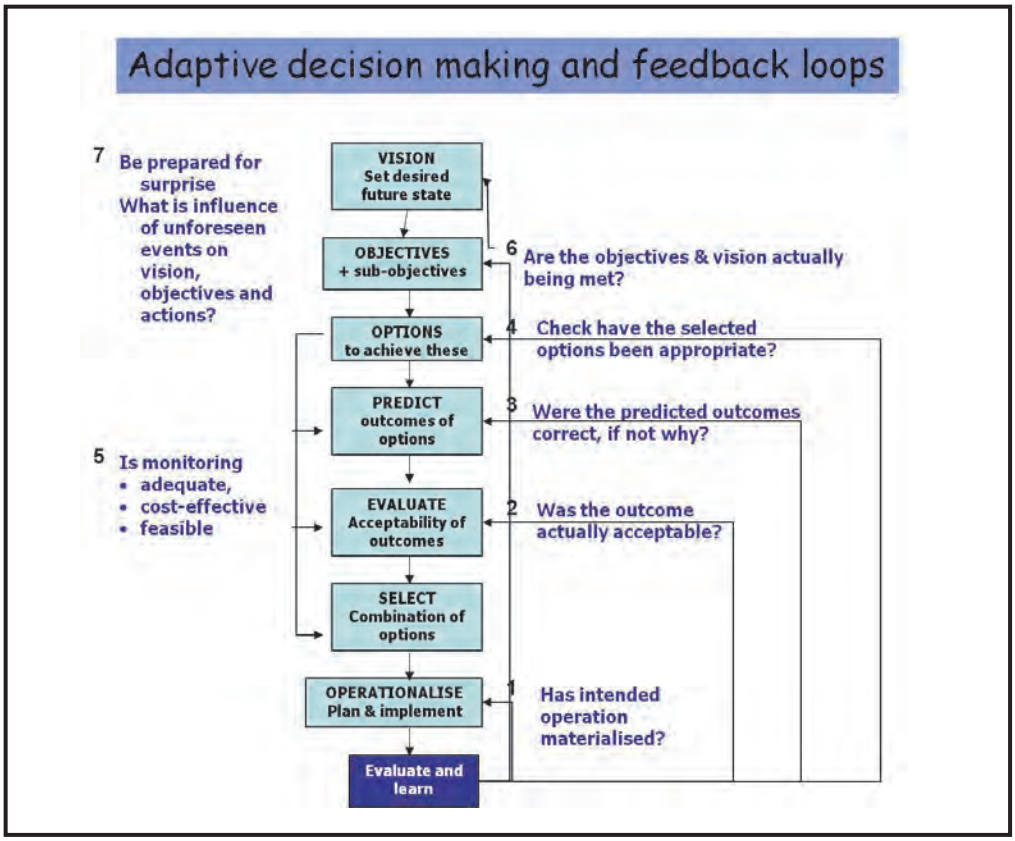


Figure 5. A generalised model of the adaptive decision cycle used in Strategic Adaptive Management.

PART 2

OUTCOMES

Part two of this report presents examples of the outcomes of the processes and activities described above. They are of course specific to the IUCMA action research project but they give information on the type of outcomes one can expect from relatively simple planning, decision-making, reviewing and learning activities using the new thinking and SAM processes. It is these activities and learning that defined the successful adoption of new thinking and SAM by the IUCMA.

6. NARRATIVE OF CHANGE IN THE INKOMATI CATCHMENT MANAGEMENT AGENCY

An important tool in the learning processes central to this project was the collective documenting by staff of a narrative of change in the institution from its inception (see Appendix 4). Here, this narrative is used as a basis for summarising the integrated action research process of the project by inserting descriptions of the key tools, interventions and processes used by the research team to embed SAM as a planning and decision tool for practicing IWRM by the IUCMA.

This summary, in essence, illustrates the yellow brick road that the IUCMA and project team inevitably travelled, and also where and how SAM activities influenced implementation of IWRM in the IUCMA. The narrative has been divided into five time periods to facilitate the discussion:

- Setting up the institution (2005-2008)
- Using SAM as a vehicle for IWRM planning (2009-2010)
- Implementing the Catchment Management Strategy (2011-2012)
- IUCMA asserts its legislative authority with humble cooperative governance and the top leadership changes (2013)
- IUCMA cements its position as respected leader in IWRM in South Africa (2014-mid-2015)

6.1 Setting Up the Institution (2005-2008)

The IUCMA was Gazetted in March 2004 and the Governing Board established in 2005. There were no operations staff in the IUCMA for the first two years (2005-6) while the Governing Board found its feet and similarly, nothing noteworthy happened in 2007 as the new staff settled in. However, 2008 saw the start of two severe problems which were to dog the IUCMA for the next 3-4 years. Firstly, despite the fact that the establishment of CMAs was legislated in the Water Act of 1998, a debate emerged within DWS as to the need for such institutions. This debate raged for at least three years holding the legitimacy of the IUCMA in limbo during the formative years of its IWRM planning. Secondly, DWS forgot to include CMAs in their 2009/2010 budget. This was only discovered in mid-2009 so will be dealt with in the next section.

Another defining issue during this period was that the IUCMA was given very limited powers of operation, leading to confusion about just what they could and could not do. All in all the initial years were uncertain and frustrating for staff who became focussed more on setting up the institution than on IWRM per se.

Lastly, there was quite some emphasis on stakeholder engagement in these early years and a number of river forums were set up. These acted primarily as vehicles for awareness

campaigns as there was little structure to IWRM activities to which they could connect. By 2009 they had become primarily talk shops and stakeholder fatigue was setting in.

6.2 Using SAM as a Vehicle for IWRM planning (2009-2010)

The year 2009 was a turning point for the IUCMA. It had to change direction and begin actively pursuing IWRM.

In January Kevin Rogers was engaged by the CEO, with the approval of the Governing Board, as scientific advisor for adaptive management and capacity building. His primary task was to change the focus from "setting up the organisation" to "conducting IWRM" and he was to use Strategic Adaptive Management as an IWRM implementation framework. He began with participatory seminars on SAM and then used four Adaptive Planning workshops to assist the IUCMA senior staff in the development of a new strategic plan for IWRM. The outcome is presented in Appendix 5 and the process is described in detail in Rogers and Luton (2011). Action programmes of the plan can be found below.

Notes:

- During these early days the research team faced many external threats to the process of operationalising the IUCMA.
- Every time they met a new set of unexpected issues, peripheral to the main task ,they had to be dealt with if the project was to proceed. See for example the description of the "farmhouse meeting" below.
- Consequently workshops were never planned too rigidly and rather went with the flow.
- Settled self-focussed minds were more important for making progress than were deadlines

Critically, the planning phase was conducted outside the bureaucratic policy box which had prescribed a series of sequential steps for policy implementation. The problem with this was that within government and the Governing Board, policy became an end in itself and not a means to the IWRM end. The SAM Adaptive Planning Process provided a neutral framework for planning the integration of the many facets of water resources management and for the development of practical objectives for achieving stakeholder centred decision-making.

This process of switching our thought processes from top down policy implementation to participatory integration of practical IWRM activities was absolutely critical in freeing up the minds of the IUCMA staff and giving them the confidence to do what they believed was appropriate. The importance of working with the principles of SAM, not just the structured processes, and with the new thinking became clear. The strategic planning did not take place in a vacuum but rather in a tumultuous

The six Action Programmes of the first Strategic Plan for IWRM in the Inkomati catchment.

- Achieving Equity
- Managing flow
- Managing water quality
- Generating and managing knowledge
- Achieving compliance and enforcement

environment of political infighting, ineptitude and the uncertainty which comes from a nation doing this "stuff" for the first time. Because DWS could not provide financing for the IUCMA, all operational activity for the 2009/2010 financial year was frozen and staff did not know from one month to the next if they would be paid. This, on top of the CMA debate within DWS, continually battered staff morale and keeping the spirits up became an important component of engagement within the project. Maintaining single minded focus on the Adaptive Planning Process was an important part of keeping our heads above the turbulence.

Despite the fact that neither the DWS, nor the Governing Board engaged this SAM process, and indeed initially resisted accepting its outcomes, the IUCMA staff pulled together and won over both the Minister of Water Affairs and the Parliamentary Portfolio Committee for Water with their professional approach to IWRM planning. The Strategic Plan arising from Adaptive Planning was the instrument that provided the energy and persuasive arguments in this process.

The year (2009) ended with the Minister calling on the IUCMA to produce, at short notice and on a very limited budget, the full Catchment Management Strategy that a consultant had failed to do over the previous three years with a budget six times the size.

Between mid-January and the end of March 2010 (10 weeks) the IUCMA held Adaptive Planning workshops in each of the three sub-catchments to assist stakeholders in developing a Catchment Management Strategy. This strategy received the unqualified backing of stakeholders in a fourth workshop to integrate the desires of stakeholders from the three sub-catchments. The CMS which defined the future of water resources management in the Inkomati catchment was delivered to DWS at the end of March and was passed by the Minister for the mandatory 90 days for public comment later in the year. This CMS now provides a stakeholder driven blue print for IWRM in the Inkomati catchment. The stakeholder centred Adaptive Planning approach used in developing the CMS is described in full in Rogers and Luton (2011).

The 2009/10 period was ground breaking and turned the IUCMA staff around from demoralised inertia to a collective that was humbly confident that they had the ability to fully operationalise the IUCMA through the implementation of the CMS. This change centred around two critical Adaptive Planning exercises:

1. Senior IUCMA staff developing an institutional Strategic Plan with IWRM projects that could be immediately implemented on extremely limited resources;
2. Development, in 10 weeks, of a Catchment Management Strategy with thorough stakeholder participation and acceptance.

6.2.1 Key learnings

- The Adaptive Planning Process proved successful at both the internal institutional level and at the catchment level where it facilitated a very diverse stakeholder community to design its own future. It is critical to stick to the principles of SAM in engaging within the

IUCMA and with broader stakeholders. The principles are absolute, but the processes by which they are applied can be flexible and adapted to suit different contexts.

- Collective creation of an integrated, uncomplicated (requisitely simple) IWRM framework through the APP was a critical starting point for many positive outcomes, including: (1) building individual, Divisional, and organisational confidence; and (2) creating clarity of objectives and context which provided a base from which to justify decisions and actions to DWS, stakeholders, and the Governing Board.
- The APP proved to be a forceful and robust tool for empowerment for everyone involved, including the research team. It pulled the IUCMA staff into an integrated and cohesive whole capable of the complex task of Integrated Water Resources Management at the catchment scale.

6.3 Implementing the Catchment Management Strategy (2011-2012)

During these two years the IUCMA began to vigorously implement the action programmes defined in the CMS. This was a period of rapid expansion in staff and many new exciting developments in which the research team played a range of different roles.

The Institutions and Participation Division asked the research team for a "course" on facilitation of public participation meetings. Instead, Rogers facilitated a workshop in which the Division staff and research team interacted in the development of guidelines for facilitation (Section 5.2). The staff knew what to do, they just needed some help to organise it, confirming the role of the research team as facilitators and empowerment agents.

The five golden rules of stakeholder centred facilitation and decision-making (section 3.2) emerged.

The Institutions and Participation staff also recognised that despite the centrality of achieving equity of access to water in the CMS and that there is a specific action programme for this, there was no formal equity champion or process. They asked Rogers to facilitate a workshop that would plan a specific intervention. The highly successful Equity Working Group (EWG) grew out of this workshop and Luton became an active member.

In January 2012 a major Acid Mine Drainage pollution incident contaminated the drinking water in the town of Carolina in the Upper Komati River Catchment and catapulted the Water Quality Division into operational mode. They conducted themselves admirably but it later became clear that they needed a more strategic view of water quality issues in the Inkomati catchment and Rogers began an Adaptive Planning Process with them in early 2014 to achieve this. (See the outcome in Section 7). The Acid Mine Drainage incident also made clear to the IUCMA, and particularly the Water Quality Division, the centrality of stakeholders to IWRM and the need to actively collaborate with the Institutions and Participation Division. The need to break down IUCMA silos became painfully clear (once again)!

The Water Resources Division had for some time been building the modelling capability required for run-of-river management of the Crocodile River and the CMS gave this further impetus. Most importantly stakeholders were engaged to form the Crocodile Catchment Operations Committee (CROCOC) which brought together previous antagonists such as commercial irrigation farmers, the Kruger National Park and developing farmers. The whole process from hydrological modelling to consensus decision-making for day to day river operations was highly innovative and developed a ground breaking approach to participative "run-of-river water resource management" of the heavily utilised Crocodile River.

All of the activities/projects described above were approached with a SAM perspective of stakeholder engagement (section 5) and set the benchmark for an institution wide process of stakeholder involvement in decision-making and action.

The marked progress in participative IWRM made during this period was achieved despite the fact that the DWS continued to ignore the reality that the IUCMA was now an independently functioning entity with rigorous decision and operating protocols derived from the SAM Adaptive Planning Process. The IUCMA staff also felt that the Governing Board continued to disrupt their day to day working lives by engaging too much at the operational level. Both processes lowered morale once again and the learning/unlearning workshop in November 2012 was initially dominated by frustrations rather than real learning. However, when the workshop did begin to reflect on the year's events, in the context of past achievements, the staff soon recognises that SAM had given them the IWRM planning and decision-making tools to surge ahead. The SAM activities to that point had clearly generated an inner resilience in the IUCMA team that allowed them to rise above the inevitable politics and focus on practical IWRM.

6.3.1 Key learnings

- The centrality of stakeholders for IWRM! IWRM cannot be achieved by one organisation or Division – even the "technical aspects" thereof; CMAs must facilitate participative future building, decisions, and actions.
- When CMA staff/stakeholders are confident about the principles of SAM and adaptive planning they are empowered to move forwards together in the face of potentially immobilising external forces.

6.4 IUCMA Asserts its Legislative Authority with Humble Cooperative Governance and the Top Leadership Changes (2013)

After many attempts to negotiate changes in water quality related practices with mines and municipalities some of these institutions showed no or very limited action to rectify their pollution management practices and the IUCMA decided that it now needed to test its legislative authority. For the first time the IUCMA issued legal notices and directives for water quality transgressions by municipalities, mining operations and other transgressors but, in line with SAM stakeholder engagement principles, they tempered these with face to face offers of collaborative ventures to deal with the problems. This cooperative governance approach was a

deliberate manifestation of the central value system expressed in both the CMS and IUCMA institutional level Adaptive Planning.

During 2012/13 a marked change began to develop in the perspective of a team of Dutch collaborators from the Groot Salland Waterschap. Whereas the initial engagement had been one of benevolence towards the IUCMA, the collaborators began to express the view that the IUCMA and research team had much to offer IWRM attempts in Holland. The Dutch team acknowledged that, although they initially engaged the IUCMA to provide guidance in water management, the tables have been turned and they were now learning about stakeholder centred IWRM from the IUCMA. Consequently they invited IUCMA senior staff and the research team leader to Holland. Rogers presented the IUCMA/SAM story to a nationally advertised IWRM symposium where it received wide acclaim and immediate consequences for decisionmaking in the Groot Salland catchment.

A new IUCMA Governing Board, populated by members with appropriate professional experience, was established in mid-2013 and they appointed a Chief Operating Officer as the most senior staff member. He was immediately made Acting CEO.

6.4.1 Key learnings

- The best way for someone to get what they want is to help others get what they want!
- Collective, directed action towards desirable IWRM outcomes will not happen if some stakeholders are perceived to attack and blame others, or to be self-serving at the expense of others. It is the CMAs responsibility to see that this does not happen.
- CMAs must help all stakeholders to meet their needs, even those who are breaking laws, in order to move towards a future that is better for all. (Clearly a CMA would not help the people break laws but, where they are willing, help them work within the law).

6.5 IUCMA Cements its Position as Respected Leader in IWRM in South Africa (2014-mid 2015)

Evidence that the IUCMA was becoming recognised for its pioneering leadership role in IWRM had been accumulating over the previous couple of years but two main events in this 2014/15 period demonstrated that it is widely recognised as such a leader in the South African water sector. First, a major swing in attitude of DWS staff was seen when the new Public Participation Directorate of the Institutional Oversight Division adopted IUCMA SAM-based practices for public participation in general and for Catchment Management Strategy development in particular. This swing came after some months of discussions between the two institutions during which the IUCMA explained their “stakeholder centred” approach to IWRM. This swing in attitude led to approaches from a number of new, or proto, CMAs for learning and assistance. The second event was when stakeholders of the Usuthu forum publically congratulated the IUCMA for its professionalism in participative IWRM. This was just a few meetings after the IUCMA had taken over the running of the forum from the DWS Regional Office.

This research project came to an end in mid-2015 with a final set of interviews with a range of IUCMA staff members who were asked: “When you think about the whole project, since 2009, what stands out in your mind?” The following quote sums up the general sentiment expressed: “Personally, I was deeply capacitated and empowered by the work we have done together [the IUCMA and the research team]. I have productive working relationships with stakeholders now, because of the training I have received in both SAM and stakeholder engagement”.

When asked “What does the IUCMA need to do to take SAM forward?” the response was twofold. First, strategic thinking and planning about IWRM needs to occur at executive level where meetings are currently dominated by institutional governance issues. Second, formal learning and reflection activities must be introduced to replace those conducted by the research team up to this point.

6.5.1 Key learnings

- Institutionalising SAM culture and practice does not “just happen”, even if the people concerned are taught everything about SAM. It must be actively and explicitly cultivated over an extended period within both the IWRM institutions and the broad stakeholder base.

Overall this narrative illustrates the “yellow brick road” that the Wits/IUCMA team followed over a six year period. Nothing was predictable and events, people and issues caused many changes to our trajectory. In the end the desired future of an adaptive approach to stakeholder centred IWRM was mapped out, even though there remains much to be done to ensure that this approach is durable into the unpredictable future. Throughout, adherence to the “new thinking”, the Adaptive Planning Process and its products provided the anchor around which the Wits/IUCMA team could “swivel” while navigating the yellow brick road.

The following sections describe in more detail how this was achieved and make recommendations for taking the process forward.

7. ADAPTIVE PLANNING PROCESS OUTCOMES

Over the course of this research the APP was used on many occasions in order to ensure a systems approach to planning. It was successfully used at the Division, CMA, DWS, and sub-catchment and catchment (for the CMS) levels. Many examples of the outcomes are presented in Rogers and Luton (2011). One example is presented here.

7.1 Adaptive Planning for the Resource Protection Division of the IUCMA, 2014/15

The most recent adaptive planning exercise was to develop a strategic plan for water quality management with the Resource Protection Division. Many of the staff that participated were new and had no previous exposure to SAM and the new thinking so the planning was preceded with a workshop dealing with these. The APP outcome presented below was the result of two, five hour workshop sessions. The presentation below is the typical format that the research team strove for in an APP; a small number of headings taken from the guidelines, bullet points below headings provide easy reading and remembering and they should not exceed seven. The whole document is usually no more than 5-6 pages

7.1.1 Vision/desired future

A vision is a concise statement describing the desired future conditions of the catchment and the institution.

- The water resource is effectively protected to ensure fitness for use (river health) that supports equitable access to water for sustainable development.
- Stakeholder centred decision-making (local to international) which is consensual and in which our and stakeholder roles are clearly defined.

7.1.2 Values

Our values are the principles we use to evaluate the consequences of actions (or inaction), to propose and choose between alternative options and decisions.

- The 1.5 million stakeholders in the Inkomati catchment are our “shareholders”. This drives us to ensure water resources are sustained for future generations.
- We are passionate but also as critical of ourselves as we are of others.
- We are transparent, objective and trustworthy, and we test our values against principles of practice.
- We practice Ubuntu and Batho Pele.
- We are committed to working across boundaries of all types at all scales.
- We see uncertainty and change as opportunities for adaptive decision-making.
- We have the courage to navigate the yellow brick road and know that it requires flexible acceptance, tenacity and perpetual learning.

7.1.3 Context

The range of social, technical, economic, environmental, political, and practice facts, conditions, causes and surroundings that define the circumstances relevant to a problem,

provide the "context" within which decisions are made. The context is therefore a fundamental element of any decision-making environment.

Social

- Major power imbalances exemplified by the commercial/emerging farmer divide.
- Generally poor awareness of all water issues and catchment activities, especially of their impacts and dependency on the water resource.
- Greed, corruption, finger pointing and poor planning are ever-present.
- A rapid population growth generating rapid growth in water demand and use.
- Widespread poverty and poor service delivery means that many people are dependent on rivers.
- Public participation is undervalued in the catchment as a decision mechanism with implications for the effectiveness of forums.
- Mining is seen as "dirty".
- Implicit and explicit racism, tribalism and gender discrimination continues to have major effects on public engagement.
- Stakeholder centeredness is not yet common/habitual (patchy, fragmented) practice in IUCMA.
- Cultural (e.g. religious) activities depend on good quality water but can also pollute (fish kills) when toxic substances such as Jaye's fluid are used in these ceremonies.

Technical

- The rivers are already over allocated, there is still no water allocation plan and the link between quantity and quality is not explicit or procedural.
- Resource Quality Objectives (RQOs) have not been set and in their absence people are using the wrong procedures.
- Poor technical skills across municipalities and the accompanying poor maintenance and upgrading of infrastructure.
- There is a widespread lack of skills and/or will for interpreting policy/legislation and claims of ignorance are often used as excuse for pollution.
- Current limited water storage options limit options for water quality management.
- There is a broad lack of insight into the meaning of water quality data and their use in decision-making.
- There are no aquatic scientists or geohydrologists in the IUCMA.
- Irrigation systems are not up to date on latest technical advances for crop specific or context dependent watering regimes.
- General lack of land use management means there is a lot of non-point source pollution.
- The wide range of people involved in IWRM decision-making operate in well-established silos and in many cases there isn't even a planning base from which they can operate.

Economic

- The waste discharge charging system has not been implemented.

- Poor water quality is already impacting negatively on markets/profits (is there evidence to back this up?).
- The diversion, by stakeholders, of budgets away from water infrastructure and monitoring.
- Agriculture: The allocation priority is to forestry, sugar and citrus but there is no long term agricultural strategy that considers crop value vs water use, and pollution potential of fertilizer and pesticide use. There are still unbalanced power relations and poor socio-economic responsibility in commercial/emergent farmer relations.
- Coal (Upper Komati), gold (Kaap River) and sand mining, paper (SAPPI Ngondwana) and other industries (Manganese Metal Company) all have very significant influences on water quality management. There is no budget or plan for dealing with abandoned mines.
- A thriving eco-tourism industry underpinned by the Kruger National Park's high quality water needs.
- There is no shared culture of working towards a balance between environ and economic development.
- The demands and effects of strategic water demands are not yet factored into decision-making.
- Load shedding has negative consequences for waste water works and hence water quality.

Environmental

- Generally there is little understanding among stakeholders of the importance of long term and synergistic effects in water quality and river health management.
- Our knowledge about the effects of geology and socio-economic context on water quality at different scales is limited. Ground water is not high enough on the agenda.
- The reserve, RQOs and classification have not been finalised and are inadequately implemented therefore we do not have a good understanding of associated issues, such as resource directed measures, source directed controls, ecosystems services, and their management.
- Disposal sites are not regulated or compliant and there is a general lack of investment in technical improvement in environmental monitoring and management. The IUCMA is not engaging this issue as directly as it should.
- There is minimal knowledge (present and long term) and management of toxicants (pesticides, etc.) and they are poorly monitored.
- The main water quality problems are: Acid Mine Drainage, faecal pollution from Waste Water Treatment Works; sediment/silt from poor land use practices and the long term increase in salts arising from many activities. Blue-green algal blooms in the lower Crocodile suggest that eutrophication is also becoming an issue.

Political

- A number of political factors frustrate decision-making and keep political will to implement IWRM low; political deployment overrides the need for skills; political power plays overshadow catchment needs; interference in issuing water use licenses; political

parties and bureaucrats use pollution incidents as political footballs; political influences in protests and vandalism.
- Regional and local governments are characterised by silo management and there is little cooperative governance.
- The Upper Komati and Crocodile River forums function well but there is now uncertainty about their role and that of Water User Associations.
- International water needs require constant attention.

Practice
- IWRM practice is variably understood and uncoordinated across the catchment and its stakeholders.
- Adaptive decision-making is not yet institutionalised in the IUCMA.
- There is a general willingness in the IUCMA water quality group and among stakeholders to engage with new practices.
- The CMS provides a shared, albeit broad, vision for water quality but we need a clear process to get there.
- Weak databases, with little management and sharing.
- We have yet to come to grips with our operational role in disaster management, the budget needed and the grey area between following procedure and getting the required result.

7.1.4 Vital attributes of individuals, the catchment/resource and the Division

The few most important characteristics/properties of the system to be managed are its vital attributes. They may be technical, ecological, legal, historic, social, political, practice related, or economic.

Individuals
- We display individual and collective courage in achieving our water management desired future.

Catchment
- The wide range of elevation, geology and rainfall provides a basis for a very high spatial diversity of context for water quality management (diversity of ecosystems, agricultural practices, socio-economic conditions and activities, etc.)
- The resource is fit for diverse and sustainable uses, including the delivery of international obligations.
- Land use practices do not negatively affect soil salt/mineral balances (e.g. current high P and K in irrigated area of Croc) which would have negative effects on water quality
- Well-structured and functionally integrated forums and associated institutions (e.g. operating committees).
- A stakeholder base that engages with river operating systems, shares data and is self-monitoring/policing.

The Division

- Vital attributes of water quality variables are described by RQOs which meet water quality requirements for both ecosystems and users.
- A vital attribute of flow is one that gives meaning to water quality conditions such that bio-monitored outcomes are congruent with the RQOs.
- Managers and users know what they need for water quality (to protect ecosystem and fitness for use) in terms of concentration, duration and frequency of water quality events (how much [load and concentration], for how long and how often).
- Division can effectively monitor for protection, compliance and enforcement.
- Division knows what actions are linked, at which scale, to the conditions of variables which are monitored for concentration, duration and frequency.

7.1.5 Determinants of, threats to, and objectives to maintain Divisional vital attributes

A determinant is a factor or process that ensures the persistence of a vital attribute.

Threats are factors within, or outside, a social-ecological system that undermine its values and inhibit the pursuit of the desired future. Threats are also factors or processes that inhibit determinants or vital attributes. Objectives are aimed at achieving the Desired Future within the current catchment "Context". They are set in order to overcome threats and so ensure the persistence of vital attributes and/or their determinants.

VA1: Vital attributes of water quality variables are described by RQOs which meet water quality requirements for both ecosystems and users.

Determinants:

- Finalisation of river classification and setting of RQOs is aligned to our values and objectives
- Having an implementation plan for management towards RQOs (how to start!!)

Threats:

- Continuation of the current unstructured development vs resource protection debate which provides fertile ground for political interference in resource allocation to water management. This will be a serious problem for the Division if we do not focus fully on our mandate of Compliance, Monitoring and Enforcement.
- Lack of, or poor, cooperation by users in implementation of the RQOs.
- The lack of any plan to deal with abandoned mines.

Objectives:

- Get stakeholders (internal and external) to understand the issue of common pool resources.
- Bring the abandoned mine issue firmly into the IUCMA cooperative governance programme.
- Roll out the Crocodile catchment's Water Quality Management Framework to other sub-catchments.

- Get the backing of the CEO and the Institutions and Participation Division to table the framework with councils across the catchment.

VA2: A Vital Attribute of flow is one that gives meaning to water quality conditions such that bio-monitored outcomes are congruent with the RQOs

Determinants:

- Integration of all quantity, quality and bio-monitoring activities in the IUCMA

Threats:

- People working in silos both within IUCMA and without (in the broad stakeholder base)

Objectives:

- Make compulsory licensing a priority within the IUCMA
- Develop a standard procedure which integrates water quality and quantity issues in the authorisation of licenses.
- Work with Brain Jackson's Division to rollout/operationalise the dashboard of their modelling system.
- Stimulate a cooperative governance initiative/programme within the IUCMA to address the internal silos which still hamper the licensing process.
- Engage the process of developing a Waste Water Discharge Charge so that it can be embedded in the "quantity" model and implemented as an integrated process.

VA3: Managers and users know what they need for water quality (to protect ecosystem and fitness for use) in terms of concentration, duration and frequency of water quality events (how much [load and concentration], for how long and how often).

Determinants:

- A system of monitoring that follows up to see that implementation has happened and has led to the desired outcomes
- An institutional culture that nurtures, supports and stimulates cooperation amongst and between staff and stakeholders (cooperative governance)
- Explicit structures, processes and resources to ensure integration within and without the IUCMA
- Conditions of licenses that meet our values, objectives and desired future
- Implementation of the waste discharge charging system (adaptive courage)

Threats:

- Implementation plans are not attuned to potential political and economic needs and influences
- Lack of skills for implementation including no culture of learning-by-doing (adaptive management)
- No or poor alignment between thinking at the different levels of management and governance required for effective water quality management

- The classification of the resource and setting of RQOs is not completed or integrated into decision-making.

Objectives:

- Ensure everyone has appropriate access to information databases so as to promote integrated communication and participation.
- Ensure more resources are put into finalising and implementing the RQOs.
- Implement the Waste Water Discharge Charge system

VA4: Division can effectively monitor for protection, compliance and enforcement.
Determinants:

- Solid understanding and record of what water quality related activities take place where in the catchment
- There is a comprehensive implementation plan that links monitoring to compliance and enforcement for explicit objectives for protection
- A budget is assigned and the personnel have the courage to become appropriately skilled
- The legislative framework (legal backing to enforcement) is understood and effectively used

Threats:

- Delegated functions remain incomplete or with certain sections still fragmented
- Cutting of the budget allocation in the IUCMA
- Lack of cooperation between stakeholders and between IUCMA
- Working in silos

Objectives:

- Put more explicit effort and resources into breaking down silos
- Support Advocate Boshoff's efforts to ensure full delegation of necessary powers
- Build cooperation with the Green Scorpions

VA5: Division knows what actions are linked, at which scale, to the conditions of variables which are monitored for concentration, duration and frequency
Determinants:

- All user activities and authorisations are listed, geographically located and authorised
- There are guidelines to follow
- There is capacity to implement Compliance, Monitoring and Enforcement, and the Resource Monitoring Programme is implemented

Threats:

- Unauthorised water use remains undetected
- No explicit record of what actions are to be taken under what context

- No or delayed RQOs
- Lack of appropriate access to information databases
- Uncontrolled and unknown activities continue in the catchment.

Objectives:

- All water use activities are authorised and licensed
- Conduct knowledge sharing sessions with stakeholders about the action taken, to be taken and how to apply for licenses.
- Finalise the water resource classification and setting of RQOs.

7.1.6 Critical actions required to follow through on what has been learned and planned

1. Break down silos between us and other Divisions. Actively work together. First task: This document and its implications are discussed at the next Divisional meeting. Second task: We implement a plan to foster a culture of integration across IUCMA

2. Get the backing of the corporate Division for this plan.

3. Have a workshop on Hugo's Water Quality model to familiarise and train IUCMA staff and identify the resources needed to integrate it effectively and fully into the model being developed by Brian Jackson's Division.

4. Begin a project (based on Geographic Information Systems?) to understand context at different scales (looking for contextual solutions). Acquire the integrated understanding (beyond the silos) of what STEEPP characteristics and water quality related activities (waste management practices of stakeholders) occur where in the catchment.

5. Develop a procedure, and acquire the resources to follow through fully on pollution incidents and report to stakeholders.

This adaptive planning document has been enthusiastically adopted by the Resource Protection Division and is proving valuable in engaging other researchers and stakeholders, especially in issues of water quality management. Its real value will, however, depend on how well this Division formally adopts an adaptive learning approach. Without that, the document will soon lose relevance as the STEEPP environment they operate within changes. Having a plan is one thing. Keeping it alive and relevant is quite another!

8. SAM BEYOND ADAPTIVE PLANNING

Given that this project took place in the early stages of establishment of the IUCMA the first two components of SAM – the yellow brick road and Adaptive Planning – received most attention. However, the third (adaptive decision cycle) and fourth (monitoring and adaptive goal setting) components were strongly incorporated into river operations management on the Crocodile River.

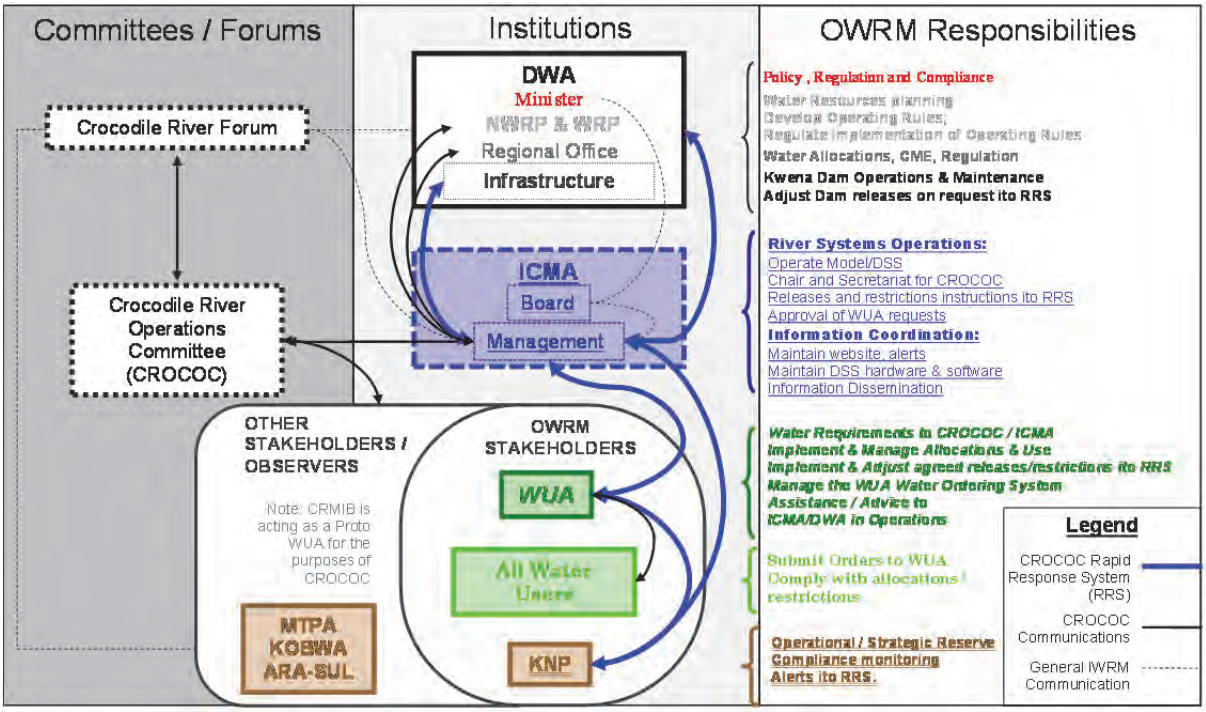
8.1 The Crocodile Catchment Operations Committee

The Crocodile Catchment Operations Committee (CROCOC) established and met for the first time in October 2009. Although the CROCOC has no formal decision-making mandate or powers under current legislation, its role as a coordinating and advisory body is exceptionally important in the broader decision-making process. It serves the relevant decision-making authorities defined in the National Water Act (DWS, IUCMA, Water User Associations) as the platform for stakeholder driven decision-making.

The reader is referred to Jackson (2014) for a detailed exploration of the management of river flow in the Crocodile River and the work of this committee in that process. Figure 6 presents the various institutions, role players, responsibilities, forums and committees related to operational water resources management and how they interact in adaptive decision-making. It recognises that operational water resources management is only one aspect of IWRM and that any institutional arrangements around it must fit into the broader IWRM realities:

- The CROCOC began with a distinctly technical focus, and meetings were primarily about explaining to stakeholders (well-resourced, technical types) the new decision support systems used to monitor irrigation water use and ensure delivery of both the ecological reserve and international obligations.
- Over time, the focus has changed. Technical knowledge is now made socially robust through discussion with all stakeholders who closely follow and critique the action plan. The records of what action was actually taken and what context led to the flows in the first place, are also deliberated. Thus, focus is on having all stakeholders understand the system in a holistic way.
- Partnerships have also been developed with conservation agencies, especially the Kruger National Park, and bio-monitoring data they collect to assess river health are now fed back into the CROCOC.
- A partnership is also being generated with the IUCMA Resource Protection Division to develop an integrated plan for water quality and quantity management.

The CROCOC is a thoroughly SAM centred operation and has received high praise nationally and internationally. The leader of the CROCOC also received a Masters degree suma cum laude for a thesis he wrote on how the CROCOC was set up and operated.



DWA = Department of Water Affairs; ICMA = Inkomati Catchment Management Agency; NWRP = National Water Resource Planning; WRPS = Water Resource Planning Systems; DSS = Decision Support System; RRS = Rapid Response System; WUA = Water User Association; KNP = Kruger National Park; MTPA = Mpumalanga Tourism and Parks Agency; IWRM = Integrated Water Resource Management; CRMIB = Crocodile River Major Irrigation Board

Figure 6. The institutional arrangements, role players, responsibilities, forums, communications and feedback loops for operational water resources management in the Crocodile River. Note how the feedback decision loops integrate the various components and promote adaptive decision-making. From Jackson (2014).

9. DOING AND LEARNING

The process of building an adaptive and stakeholder centred Catchment Management Agency took much more than just Adaptive Planning and developing decision systems such as that for the Crocodile River (Figure 6). Throughout the project a range of other IWRM related processes were being implemented and a great deal was being learnt in the process about how to use the new thinking and SAM. There were far too many of these to recount them all here but a few are presented to illustrate the journey along the yellow brick road of building an adaptive, stakeholder centred Catchment Management Agency.

These narratives are largely specific to the IUCMA case but in general they illustrate the sorts of "things" people who embark on this type of project can expect to encounter. They should also stimulate thoughts about how to react to the inevitable surprises that await one in these projects.

The first examples are of learning from doing (undertaking certain activities to promote adaptive stakeholder centred IWRM; Section 9) and second set of examples (Section 10) are about learning that arose more from structured processes of reflection to stimulate collective learning in the organisation.

9.1 The Equity Working Group

In early 2011 a small group of staff from different Divisions realised that the whole concept of achieving equity had been treated rather implicitly since the inception of the IUCMA. There was no definitive plan and no one was explicitly championing the equity cause. It was as if everyone, DWS, the Governing Board and IUCMA staff were simply expecting equity to be achieved when all else was done. However, by this stage "achieving equity" was an explicit action programme in the CMS. The IUCMA staff and the Wits team met to collaboratively plan how to rectify this oversight, in one of the first activities that integrated across Divisional silos. A dedicated Equity Working Group was formed, with explicit objectives, guiding principles, group membership, and deliverables (Appendix 6).

The EWG acknowledged that "equity" is much more than just the allocation of a quantity of water to historically disadvantaged communities. The IUCMA needed to work more holistically with resource-poor farmers and historically disadvantaged stakeholders to empower them to derive socio-economic benefits from their use of water resources. This group of stakeholders had to be empowered to articulate their needs and aspirations and participate meaningfully in IWRM decision-making.

Three means-objectives were developed to meet this aim:

- To develop and implement project based empowerment programmes;
- To promote transformation of IWRM decision-making processes and structures, in order to redress current imbalances in empowerment, access and resource use;

• To claim the IUCMA's political and governance space as mandated leaders of catchment-wide cooperative governance.

A set of deliverables was integrated into the CMS operational plan and work began to fulfil the objectives. This initial set has been adapted over time on the basis of internal EWG review and reflection processes. Such processes quickly became the modus operandi of the EWG, with frequent meetings to provide feedback on individual mandates and discussion of the realism and desirability of the deliverables. This continual discussion and adaptation of deliverables clearly indicates an understanding on the part of the EWG members that, as "we" start taking action, "we" inevitably learn, and that as a result of this learning "our desired future" is likely to change.

9.2 The Intricacies of Establishing the Upper Komati Forum

Acid Mine Drainage (AMD) contaminated the drinking water of the town of Carolina in January 2012, creating an opportunity for much doing and learning in the Upper Komati catchment. Before the AMD crisis, there were two perceptions among stakeholders. One was that the forum was just another talk shop and would not be able to achieve anything. The second, primarily among municipalities and mines, was that the forum was a "monster" that would attack anyone with water quality problems. However, when the IUCMA began taking action on the AMD crisis and created a "safe" environment for mines and municipalities to participate, the forum began to build credibility. This is the story of how the community officer turned things around.

Initially, the community officer accompanied field workers from the Resource Protection Division so that he could meet and gain the trust of mine managers and environmental officers. His strategy was to be empathetic towards them and their AMD/pollution problems. Once these people were comfortable with him and trusted him, he invited them to present their issues and management plans to the forum. Braam Fouche of Northern Coal was the first person to present to the forum and he had a good reception/experience from other stakeholders who admired his courage and the steps being taken to mitigate AMD. Once this breakthrough had been made it became much easier to encourage other personnel from other mines to present at forum meetings and indeed host the meetings. After a while the research team helped the forum develop a charter (Appendix 7) to guide their activities. Three years later the forum is well attended and stakeholders support each other in making excellent progress with the complex problem of AMD in a complex social-ecological landscape.

Municipalities: It was very hard to gain the confidence of municipal employees and they would not attend forum meetings. Eventually the forum sent a delegation to the Carolina Municipal Manager and the community officer engaged the Town Councillor responsible for Technical Development in an attempt to dampen the Municipal Managers' fears. The Director, the Technical Manager and Municipal Manager still avoid coming to meetings but the community officer eventually found someone who, although a relative junior, was confident enough both to speak for his seniors at the forum and to feed back to them. The

relationship with municipalities could be better but for now there are regular and sustained processes of communication and trust is slowly being built.

The lesson from this story is that the tenacious patience of a community officer, who put the wellbeing of his stakeholders first, regardless of whether they were responsible for pollution or not, won the day. He never did a DAD on anyone and always asked them how he could assist them in collaborating with peers. Above all he created a forum environment, captured in the charter, that allowed stakeholders to engage each other without fear or favour.

9.3 Learning/Unlearning DAD

An example of overcoming selective exposure is illustrated by events in a workshop to develop a framework for facilitating public engagement in decision-making. The first day was spent discussing all the things that should not be done, such as a DAD, and should be done, such as ask the stakeholders for their views. Everyone was very excited about what they learnt and it was decided that each participant would choose a topic and facilitate a short workshop on it the next day. Every single participant essentially did a DAD and tried to get the audience to accept their view of the topic. Despite having felt the day before that they had learnt a lot, they had not replaced the old habits that came from their selective exposure to poor facilitation practices. They were shocked when this was pointed out to them and quickly resolved to unlearn doing a DAD. This exercise became an important turning point in stakeholder engagement practices.

9.4 Unlearning Saying "Yes" to Grannies

Another example of unlearning was the decision to unlearn saying "yes to grannies". Early in the project IUCMA staff found themselves overwhelmed by the many researchers and consultants who wanted to conduct projects that would "help" this pioneering CMA in achieving its mandate. IUCMA staff felt rude turning people away and would therefore end up accepting almost all projects. While discussing the problem participants realised that these people all had good intentions but actually sought to convince the CMA that they had the answers and many were trying to do a DAD. Furthermore they did not have to take the responsibility of implementation which would lie with the IUCMA. The analogy of how well-meaning grandmothers "interfered" with how parents were bringing up a child was developed, hence the term "grannies" for these researchers and consultants. After first engaging the APP, the IUCMA designed three cross-cutting priority projects, and had built enough confidence in their planning and decisions to start saying "no" to grannies whose projects did not contribute to IUCMA plans and priorities.

9.5 The Problem with DAD: Lower Komati Water Meters

The Water Resource Protection Division contracted a consultant to meet a DWS directive that water meters had to be installed on farmers' pumps to improve water allocation management. The consultant called a public meeting to explain this to the farmers and make

arrangements for the installations. There was massive resistance from farmers and the meeting disintegrated into chaos. What was a logical solution to a technological problem was rejected because the consultants did a DAD on the stakeholders. A week or so later an Institutions and Participations Division staff member facilitated a meeting with the same farmers using the ALIDA principle. The farmers voiced a number of concerns that the consultants' DAD meeting had not given them a chance to express. The IUCMA listened to the concerns, without responding that their predetermined technical plan would offer a solution. They ensured that the farmers felt heard and knew that the IUCMA perceived their concerns as valid and important. The Institutions and Participation staff followed up with site visits and work with individual farmers, ensuring that each farmer and every concern was addressed. Another meeting was then facilitated by the IUCMA and the farmers, whose initial reaction to the project had been so hostile, now proposed themselves that installation of meters, along with a programme of repair and maintenance of existing pumps, would be the best solution to their water management challenges. The Water Resource Protection and Institutions and Participations Divisions now always work together when stakeholder engagement is required.

9.6 The Farmhouse Meeting: Building Confidence

This was one of the defining events of the whole project. The initial Adaptive Planning Process with the IUCMA was completed in mid-2009 and about a month later the Wits research and IUCMA teams met at a farmhouse near Machadodorp to consider "where to from here?". This was to be an especially important meeting because DWS had forgotten to budget for the CMAs, so the IUCMA had no operating budget and even salary payments were not guaranteed. The research team was driven to ask "How are we going to implement IWRM with a demoralised and fearful staff and no budget?".

The staff arrived in a very agitated state. The research team realised that the source of this agitation needed to be interrogated before the meeting could continue productively, even though it was a somewhat emotionally driven divergence from the planned agenda.

It turned out that the Adaptive Planning outcomes, and the new business plan that emerged from IUCMA Adaptive Planning, had been proudly presented to the Governing Board a few days previously but there was some critique from the Board. The staff took the critique to be a rejection of all they had achieved and an indication that the Board wanted the plan to better reflect the old bureaucratic plan they had drawn up before the staff were appointed.

After a number of hours of teeth gnashing that brought everyone together in solidarity over their position, the research team managed to steer them to the realisation that no matter what they felt about their situation, they had to either knuckle down or quit. They chose the former and decided to take strong ownership of both their new thinking, SAM and IWRM, and to strategically use them to counter the Boards' objections. They had to find ways to circumnavigate the policy-based to-do list that they had previously been lumped with by the Governing Board. In the end the criticisms were dealt with by some rewording and reordering

of text that had no material consequences for the new business plan. The Governing Board accepted the new version at their next meeting and from then on adopted the “Big 5” IWRM objectives from the Adaptive Planning document as their own. These five IUCMA strategic objectives have proved extremely durable and are still used today (mid-2015)!

The farmhouse meeting was the first time the IUCMA staff realised they were now empowered to take a stand and do things they believed in. Before this their perception had been that they were constrained entirely by directives from DWS and the Governing Board. Now they came to see that their own APP-derived IWRM framework/plan was holistic and fully in line with policy, although it embodied a new approach to implementing it. This allowed the IUCMA to take the actions they believed in and serve DWS/Governing Board directives simultaneously. For the first time, they had designed a desired future – shared by the whole institution – and they could justify their decisions and actions based on this desired future and their understanding of how to get there. This meeting was where the power of “future building” really started showing and at the end of the project many staff recognised this workshop as a critical turning point in their lives, and for the IUCMA.

This confidence propelled the staff through the process of developing their stakeholder centred Catchment Management Strategy in 2010 under very tough circumstances (see Rogers and Luton, 2011).

10. REFLECTING AND LEARNING

While traditionally adaptive management has been focussed on learning by doing in order to do better, it is just as important that people learn by reflection (thinking) on what has transpired over time. Reflecting over a time period provides the opportunity to integrate what people have learnt from all their experiences be they practical or mental. The learning/unlearning workshops and surveys of staff responses to the research team interventions provided the IUCMA staff a number of formal opportunities for learning through reflection.

The following two quotes from staff demonstrate the value of these reflection sessions.

- These reflection sessions are really great for helping to motivate staff, and seeing that we really are achieving things.
- Learning/unlearning workshops give the institution the opportunity to reflect on itself and find out if we are still on the right path.

The overall value, usefulness and achievements of reflective learning exercises in this project are illustrated by the following quotes from staff during surveys and feedback sessions over the course of the project. These quotes also provide the reader with insight into how thinking and learning changed over the course of the project.

2011

- Equity and sustainability are not possible without planned and programmed stakeholder empowerment.
- We learned a new strategy of stakeholder engagement [ALIDA] from the CMS process.
- We must identify any gaps that stakeholders have and adjust our engagement plans to deal with them.
- We must look for opportunities in the midst of adversity.
- We now know that we must plan, manage, and implement in a systematic way – things don't just happen.
- Practical actions can always be taken even if resources are limited

2012

- The level of cooperative governance with DWS, municipalities, and the Department of Agriculture and Land Administration has improved a lot and we work together in the interest of stakeholders.
- Initially we had the assumption that stakeholders, especially the HDIs [Historically Disadvantaged Individuals], know very little so we should tell them what was important to raise in forums. Now we realise that stakeholders are able to articulate their issues eloquently, without equivocation.
- When it comes to running forums we have a mandate and stakeholders have their needs. We don't impose our mandate on their needs, we first assess their needs then find a way to use our mandate to help.

- The EWG has developed a culture of critical discussion, assessment, self-criticism, introspection, review and reflection. This was not previously happening as a deliberate practice in the IUCMA.
- SAM is about change management and acknowledging that we live in a dynamic environment. You don't necessarily influence the change, you work within it.
- What convinced me of the value of SAM was when we did the APP for ourselves and then with stakeholders for the CMS. We really got good results. The convincing is in the doing.

2013

- The AMD task team needed a terms of reference. We already had thoughts on what should be included but we did not go straight to stakeholders with those thoughts. If we had given them a document, they would have torn it apart. Instead we let them speak first, and when they were unsure they asked us for guidance.
- The fear of being wrong is the major problem for creativity. If one wants to be creative, they must be prepared to be wrong.
- I loved the concept that in order to change, I need to look into the future.
- The SAM refresher workshop opened our eyes to realise that there is no special Division or person. We need each other to be a successful organisation.
- From three different admin staff: I have been employed by the ICMA for 1.5yrs/13 months/since 2006 and I didn't really understand what it did until you gave us all the SAM "refresher" course!

2015

- I think all new CMAs should use SAM. Other CMAs, proto-CMAs and the new DWS Institutions and Participation department are coming to us to ask for help with stakeholder engagement.
- Learning and unlearning were new concepts to me, but I now see how they always assist us as we adapt to new ways of doing things.
- Like with any new ideas, some people have internalised SAM and some have not.
- Personally, I was deeply capacitated and empowered by the work we have done together [the IUCMA and the research team].
- SAM is really happening in the CROCOC. I think that's because it has been a sustained process with frequent discussions for five years now, so SAM principles have been reinforced constantly. Stakeholder relations are central for every issue.
- Lately, we are not taking the time to reflect and learn. We really need two sessions a year of reflection on adaptive management and IWRM.
- MANCO [the IUCMA's management committee] and the IUCMA have become too focussed on institutional governance. We are top-heavy with admin staff, and governance takes precedence over IWRM. It is hard to get IWRM meetings off the ground.

The above comments illustrate growing self-awareness and confidence in the IUCMA team. In 2011 the predominant themes were an awakening to ALIDA and that being proactive was desirable, not that difficult, and rewarding. The growing self-confidence is evident in feedback during 2012 and supported by the embracing of change as inevitable and a source of opportunity. In 2013 the SAM refresher workshop drew enthusiasm for the new thinking from administrative staff, many of whom were exposed to it for the first time.

A maturation and growing self-confidence was evident from 2015 feedback. Staff now realised they had something to offer other people and institutions in the water sector and were engaging these people. Even more importantly, perhaps, was that these first signs of self-reflection and critique translated into a feeling that "we can do even better but we must not drop the ball". We also need to ensure that IWRM does not get swamped by the admin granny.

11. CONCLUSIONS AND RECOMMENDATIONS

The research teams task was to build an adaptive and stakeholder centred CMA for the Inkomati catchment; one that was durable and would carry the new thinking about water resource management and SAM through the trials and uncertainties of a future yellow brick road. The Wits team felt strongly, backed up by the new thinking, that it would be futile to try to force SAM and the new thinking on the IUCMA and the catchment stakeholders. It would have been tantamount to doing a DAD, the undesirable consequences of which have been demonstrated in this project and elsewhere. Instead the research team facilitated the adoption of new thinking and SAM at a pace they judged would allow people to learn them at their own pace. Consequently SAM and the new thinking have manifest at different rates and to different degrees across the IUCMA. Here the report describes what progress there has been in adoption of the major components of SAM and areas of new thinking at different levels within the organisation.

The APP, and its outcomes, have proved their usefulness many times across the range of scales from Division to institution to catchment. Major elements of both the CMS and IUCMA planning processes have proved durable through many challenges, over many years (six years in the case of the agency, and five years for the CMS). The IUCMA staff also plan to use the APP for integrating the Usuthu catchment, and revising the whole Inkomati-Usuthu CMS, proving that the APP has been adopted by the agency and should be carried through to future operations.

There is much more than Adaptive Planning to setting up a fully adaptive institution. Repeated formal learning and reflection, and development of an adaptive decision framework, are probably the most important subsequent steps in SAM. Although there was limited progress to these steps they have been established for River Operations which is a critical aspect of IWRM. Hopefully this provides enough of an example for other sectors of the IUCMA to move in this direction.

The narrative of change and feedback from other formal learning opportunities have shown the IUCMA developing a deep understanding of IWRM as a complex V-STEEPP process, and learning to apply this understanding to IWRM practice. Although complexity is a difficult paradigm to formally come to grips with, the concept and diagram of the yellow brick road has appealed to people across the IWRM spectrum, both within the Inkomati catchment and beyond. It has certainly changed the dialogue that takes place within the IUCMA and also between the IUCMA, its stakeholders (including DWS, municipalities and mines) and Governing Board.

Feedback from staff about the change from DAD to ALIDA approaches to stakeholder engagement clearly shows the acceptance and sincere, persistent application of ALIDA. ALIDA is here to stay and hopefully will be adopted as strongly by other CMAs and government agencies across the board. South Africa certainly needs a complete revolution in

its public participation processes if it is to deepen democratic behaviour in government and across society.

Processes of knowledge seeking and sharing have highlighted that the IUCMA is a leader regionally (e.g. the Usuthu catchment), nationally (e.g. DWS and emerging CMAs seek IUCMA advice; a suma cum laude MSc thesis for an IUCMA staff member) and internationally (2nd prize for a presentation at an international conference; Dutch partners adopting the ALIDA principle).

Perhaps the most promising signs of the IUCMA taking up the new thinking and SAM has been that in the last few months of the project many staff, especially senior members, began to critique their own progress and the likely challenges to further advances in adaptive and stakeholder centred IWRM. The issue at the end of this project is: Have the new thinking and SAM been sufficiently embedded in the IUCMA for them to continue to dominate decision-making well into the future?

Time will tell but a few specific recommendations have emerged from the research that will assist in this regard.

- In general the IUCMA needs to take SAM beyond Adaptive Planning. More Divisions, including the administration, executive/MANCO and the Governing Board need to develop adaptive decision frameworks that will allow them to deal with the inevitable vagaries of the yellow brick road that lies before them. The CROCOC is there to provide a successful example.
- The Institutions and Public Participation Division has made huge strides in adopting an ALIDA approach to stakeholder engagement but they need two advances. Firstly, they need to develop formal guidelines for stakeholder engagement that they can embed across the Division (there are still components that do not really understand ALIDA). They also need formal guidelines that they can convey to the rest of the IUCMA and new CMAs. Secondly, they need to develop an overall framework for planning and decision-making within the Division that will broaden and more effectively embed the new thinking within their ranks. In part this is because they have many new staff, some very senior, who have almost no grounding in either SAM or the new thinking.
- The Resource Protection and Waste Division has recently used Adaptive Planning to develop a strategic plan of their own. The key now is to ensure that it is internalised and used by all their staff. In particular they need to develop processes whereby staff regularly report back on how they are implementing this plan and reflect on what they are learning in the process. Without this, their efforts will simply result in the Division having yet another plan sitting on the shelf.
- Many official documents of the IUCMA claim that they practice Strategic Adaptive Management. Although great strides have been made this runs the risk of becoming an empty statement unless the practical requirements of SAM are explicitly accepted and promoted at the highest levels.

- The most recent feedback from senior IUCMA staff has suggested that bureaucratic governance issues have come to dominate MANCO and that how the IUCMA practices IWRM is not discussed at this level. If adaptive and stakeholder centred IWRM do not soon become a central element of the MANCO agenda there is a risk that the IUCMA will be swamped by government bureaucracy and it will lose its reputation and even identity as the pioneer of catchment level IWRM in the country.
- It would appear that MANCO and the Governing Board do not currently have a means of relaying to government and other stakeholders just what their approach to IWRM is. Feedback suggests that this ability lies with the operational Divisions but there is an urgent need for everyone to be able to expound the IUCMA's approach to IWRM with one voice.
- There is an urgent need for the appointment of SAM/new thinking champions, and for regular formal learning opportunities to be embedded in IUCMA practice at all levels. Without them both, SAM and the new thinking will wither on the vine.
- There is a similarly urgent need for champions of integration across IUCMA Divisions and also between the IUCMA and the many other STEEPP institutions involved with water resources management in the catchment (i.e. for cooperative governance). Integrated Water Resources Management doesn't just happen. There has to be an explicit focus on "integration". This was an important focus of the research team and it needs to be explicitly picked up in their absence.

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APPENDIX 1: FOSTERING COMPLEXITY THINKING IN ACTION RESEARCH FOR CHANGE IN COMPLEX SOCIAL-ECOLOGICAL SYSTEMS

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Abstract

Complexity thinking is increasingly being embraced by a wide range of academics and professionals as imperative for dealing with today's pressing social-ecological challenges. In this context, action researchers partner directly with stakeholders (communities, governance institutions, and work resource managers, etc.) to embed a complexity frame of reference for decision-making. In doing so, both researchers and stakeholders must strive to internalize not only "intellectual complexity" (knowing) but also "lived complexity" (being and practicing). Four common conceptualizations of learning (explicit/tacit knowledge framework; unlearning selective exposure; conscious/competence learning matrix and model of learning loops) are integrated to provide a new framework that describes how learning takes place in complex systems. Deep reflection leading to transformational learning is required to foster the changes in mind set and behaviors needed to adopt a complexity frame of reference. We then present three broad frames of mind (openness, situational awareness and a healthy respect for the restraint/action paradox), which each encompass a set of habits of mind, to create a useful framework that allows one to unlearn reductionist habits while adopting and embedding those more conducive to working in complex systems. Habits of mind provide useful heuristic tools to guide researchers and stakeholders through processes of participative planning and adaptive decision-making in complex social-ecological systems.

Introduction

As the world around us becomes more complex our understanding of how to behave in it is changing fast, fundamentally and with major consequences for our approaches to addressing present day problems. Most researchers of social-ecological systems recognize the paradigm shift accompanying the advancing wave of complexity thinking that emphasizes non-linear, context and contingency specific interactions among emergent entities. Complexity thinkers eschew, to greater or lesser extents, traditional reductive thinking that assumes linearity in causal interactions between independent entities but to what extent does the complexity "movement" go beyond this narrow frame of reference and what are the implications for embedding complexity thinking in the management of social-ecological systems?

The discourse on complexity can be found in the literature of many academic and professional disciplines (Urry, 2005) from economics (Ostrom, 1990, 2002; Scharmer, 2010) to philosophy (Cilliers, 1999; Ulanowicz, 2009), education (Grimmet et al., 1990), business

(Ostrom, 2002; Snowden and Boone, 2007), public service (Raelin, 2001), warfare and crime (Ward, 2007, Habtemichael and Cloete, 2010), planning and policy (Mitchell, 2009), leadership (Arther et al., 2002; Wheatley, 2006); health (Zimmerman, 1999; Jayasinghe, 2011) and the natural and social sciences (Kay et al., 1999; Levin, 1998; Holling and Allen, 2001; Funtowicz and Ravetz, 1992 Nowotny et al., 2001; Mazzocchi, 2008, Ulanowicz, 2009). Strong discipline and cross-discipline peer groups now debate, embrace and advocate complexity thinking as imperative to understanding and dealing with the pressing socio-ecological challenges of the day. Most of the literature, especially the academic literature, however is about what the complexity philosopher Edgar Morin (2008) would call "intellectual complexity" and much less about "lived complexity" which together provide a social ecology of knowledge and being, respectively (Montuori, 2008). Morin goes on to assert that "Scientists who do not practically master the consequences of their discoveries, do not control the meaning and nature of their research, even on an intellectual level" (Morin, 2008, p4). In other words real or full understanding, including that of complexity, can only come from an internalised intersection of understanding (intellectual) and practicing (lived).

This duality of knowing and being has important implications for the study of social-ecological systems under a complexity frame of reference (sets of assumptions and expectations that bound meaning, our mind-sets, perspectives and habits of mind (Mezirow, 2003). In these early times of complexity thinking it is likely that many have yet to internalise it and intellectual complexity probably dominates over lived complexity. The understanding that emerges is likely to be quite different for the two. When complexity thinking is used as a frame of reference for the interpretation of the results of case studies of social ecological systems there may be little need to distinguish between the two forms. However, the growing awareness of the need to adopt a post-normal (Funtowicz and Ravetz, 1992) or mode 2 (Nowotny et al., 2001) approach to "science in the service of society" (Rogers and Breen, 2003) is more and more encouraging action research approaches which require researchers and their stakeholder partners to "live" complexity as a new paradigm for decision-making in communities and institutions.

The difference between "case study" and "action" research is important in this context. Case studies are well established as a means for researchers to gain a better understanding of how other people experience and respond to real life situations. Despite the fact that case studies are very context dependent, the research process advocated in the literature (Stake et al., 2005, Simons, 2009 and Yin, 2009) is one in which the researchers first define the research questions they wish to address and then seek cases in order to generate an empirically based understanding.

Action research (Hart and Bond, 1995; Hult and Lennung, 2007) is different because researchers and stakeholders design the research cooperatively and face to face. Their aim is to define a desired future and undertake well informed actions that will expand their knowledge, enhance their competencies and overcome challenges for moving to that future. Action research is therefore very much a process of generating personal and institutional change (Reason & Bradbury, 2002) and with it comes the need for deep trust between all

parties. That trust will not emerge if the parties themselves do not adopt a common frame of reference for decision-making and "walking-the-talk" along the path that takes them forward. The researchers must practice what they preach if they are not to "mutilate knowledge and disfigure reality" as Morin (2008, p3), somewhat belligerently but cogently, phrases it.

How then do action researchers practice the complexity thinking they want to share with the other participants (stakeholders)? Many would brush this off as a simple matter of knowledge transfer (Roux et al., 2006) from researchers to users/stakeholders. Write a guide and give it to them to read! In action research however both researchers and stakeholders must actively engage new knowledge and its attendant behaviours, if they are to transform their decision-making styles and skills.

Three main challenges arise for action research in this context. Firstly, both researchers and stakeholders must be conscious of their current frames of reference and how they are located within reductionist or complexity paradigms. Secondly, the process of assimilating and internalising new knowledge to the extent that it transforms world views is itself complex, and an intellectual acceptance of the characteristics of complex systems is only the foundation on which to start building a new set of thinking patterns and behaviours. In this paper, we first contrast reductionist and complexity thinking as a basis for people to become conscious of their own thinking patterns, and then propose an integrated framework for how learning can lead to transformation of a person's frame of reference in complex systems. Lastly, we explore a number of habits of mind which may be used as heuristic tools through which researchers and stakeholders can begin to "live" complexity.

Becoming conscious of reductionist and complexity frames of reference

The literature contains a number of discussions contrasting the reductive and complexity paradigms (Cilliers, 2008; Morin, 2008; Ison et al., 2011). Here we present a particular perspective that contrasts these different world views as context for bringing about change in peoples' consciousness, mind-sets and behaviour when engaging with complex social-ecological systems.

The reductive frame of reference

Reductive thinking has dominated Western thought patterns for at least 3 centuries and can be traced back to Aristotle's "logic" and then Descartes "Rules for the direction of the mind" (Montuori, 2008). Indeed, reductive thinking has become such a societal habit (Kopferer, 2004; Morin, 2008) that it is seldom questioned by the general populace and even many scientists.

The centrality of reductive thinking in Descartes' rules is illustrated by the following texts from rules 4, 5 and 6 (Descartes, 1954):

Rule 4: *reduce complicated ..... propositions step by step to simpler ones,*

Rule 5: Once you have applied *intuition to the simplest ones of all, try to ascend through the same steps to a knowledge of all the rest,*

and

Rule 6: *observe how all the rest are more, or less, or equally removed from the simplest*

In essence Descartes proposed that the only sound thinking practice was to isolate phenomena from each other and their environment and apply a process of reduction, simplification and clarification based on a disjunctive logic of "either/or" which he borrowed from Aristotle (Montuori, 2008). Descartes (1954) went further to insist in Rule 6 that we must use this process to *concentrate our mind's eye ..... long enough to acquire the habit of intuiting the truth distinctly and clearly*. Indeed society has done just that and the reductive thinking pattern, which rejects any form of integration, ambiguity or paradox, became cemented in the Weston way of life first by Newton and then by the industrial revolution.

Newton fathered the "scientific method" (also referred to as "reductionism") of using experiments to break systems down into their simplest components or building blocks in order to understand them. Newton also considered the world "reversible" which implies that the past and future have no real significance (Davies, 1989; Montuori, 2008) and errors can be precisely rectified. The technology developed to drive the industrial revolution was built with this thinking to ensure repeated production of identical units in identical ways. The coup de grâce of reductionism came from the growth of organisational bureaucracies (Montuori, 2008) which provided "managers" with the tools to isolate and categorise tasks and decisions before allocating them individually within a hierarchically structured workforce.

The reductionist mind-set seeks to understand the world as a collection of separable and thus independent units, and assumes linear cause and effect relations between these units and that these relations are reversible. A system and its parts are therefore assumed to have an ultimately knowable structure and behaviour. The belief that a system, and ultimately reality, is identifiable and knowable has very important implications for decision-making because it supports and legitimises the notions that we can both "get it right" and, if something goes wrong, "reverse it". This in turn leads to the assumption that we can directly or indirectly control the decision process. Even more important in action research and problem solving, is that if in theory it is possible to get it right and/or fix it, then stakeholders will rightfully expect that we (who they may see as experts) do so.

The use of the reductionist paradigm in western society is therefore founded on at least three centuries of socially constructed habit (Berger and Luckman, 1966; Kapferer, 2004) that our social-bio-physical reality is ultimately knowable, and that paths into the future are mapable (Cilliers, 1999; Mitchell, 2009). Under this perspective of reality science and society built a deeply held confidence that good science makes scientists into disciplinary experts who can, given the right conditions, objectively provide decision-makers with knowable, and by implication, certain, facts/answers.

A Complexity Frame of Reference

Under the complexity paradigm variability and uncertainty are valued givens, so complexity thinkers seek to understand systems in terms of the heterogeneity of their structure, relationships, and properties that emerge from interactions.

The many variable elements interact dynamically in a causal thicket (Wimsatt, 1994) and interactions are propagated throughout the system in non-linear ways. The behaviour of a system is determined by the nature of interactions, not the character of the components and so relationships are fundamental. Temporal (history) and spatial contexts co-determine interaction outcomes so two similar-looking systems with different histories, or in different places, are not the same. There are many direct and indirect feedback loops, so the scale of the effect is not related to the scale of the cause, and behaviour cannot be predicted from knowing the components. Complex systems are not ultimately knowable in space or time (Cilliers, 2000) and thus scientific objectivity becomes largely a myth and not necessarily desirable, let alone sacrosanct.

Under a complexity perspective of reality problems are wicked (Rittel and Webber, 1973) and there are multiple legitimate ways of framing each question. You cannot fully understand a problem until you have found a solution but each solution is a one shot operation (Conklin, 2006) because each one you try has unintended consequences that are likely to spawn new problems. In other words wicked problems have no stopping rules (Ludwig, 2001; Conklin, 2006) and there cannot be an a priori or ex situ test of effectiveness of solutions. Each wicked problem is essentially unique and novel and there can be no right or wrong framing of either the problem or solution.

Indeed even the use of the term “problem solving” is inappropriate to wicked problems and hence we use less prejudicial terms such as engaging with or addressing problems or challenges and we accept that wicked problems cannot actually be solved but rather the problem space can be loosened so that a wider range of options for action emerges.

The challenge of shifting to a complexity frame of reference

The most disquieting realisation that people take away from the above descriptions of reductionist and complexity paradigms is that, without doubt, they present two very different pictures of reality. Given that social ecological systems are complex, then a reductive/reductionist approach will indeed “disfigure” (Morin, 2008 p3) our perceptions of their reality. No one, not scientists, professionals or lay people, are immune to the consequences of this realisation. Nonetheless, a complexity view of the world is rare (Sterman, 1994; Morin, 2008) and the majority of professionals, disciplinary scientists and lay stakeholders/decision-makers one, and certainly the authors, engages when conducting action research has yet to encounter complexity thinking/science. They display all the distinctly reductionist habits of expecting to come to “know the” problem and objectively find “the right” solution by dividing the problem into discrete elements to be tackled by experts who “know” how to do it (Zellmer et al., 2006; Arthur et al., 2002). Any range of

solutions can be tried because if they go wrong they can be reversed with little consequence for the system. They will expect, consciously or unconsciously, that once the "real" solution is reached the problem will go away and they will now have an "evidence-based" decision that can be applied again should "the" problem emerge again.

Fostering a change in peoples' frame of reference is much more than just adding to their knowledge base, it implies changing their mind-set and behavior (Senge et al., 1999; Brock and Solerno, 1998) in a process of "transformative learning" (Mezirow, 2003). Much has been written about the process of learning and there are many models of how individuals, groups and institutions gain knowledge, learn and change behavior. It is beyond our scope to review this literature but we will briefly explore four common conceptualizations that are useful in building a framework of learning in a complex system. These are the (1) explicit/tacit knowledge framework (Polanyi, 1983), (2) unlearning selective exposure (Miller and Morris, 1999; Rogers, 1995), (3) conscious/competence learning matrix (Howell, 1982) and (4) model of learning loops (Argris and Schon, 1974).

Explicit/tacit knowledge framework

A person's knowledge is defined by a mix of their experiences, values, contextual information, and intuition (Roux et al., 2006; Davenport and Prusak (1997) which is used to evaluate new experiences and information and prepare for action (Dawson, 2000). Knowledge in this sense has two dimensions: explicit knowledge that comes in the form of written reports, publications or other media which we experience on a regular basis, and tacit knowledge (Polanyi, 1983) that is highly personal and deeply rooted in an individual's experience, ideals, values, and emotions. Tacit knowledge is very difficult to formalize and share with others but if only explicit knowledge is recognised we grossly underestimate the true effort required for knowledge transfer and thus learning. Exchanging context-laden tacit knowledge requires a shift from viewing knowledge as a thing to be transferred, to viewing its acquisition as a process of negotiating meaning among partners. Negotiating meaning is slow and requires lasting partnerships that provide the time and opportunity to build mutual trust (Roux et al., 2006).

Unlearning selective exposure

Surprisingly one of the biggest impediments to changing one's world view or paradigm is what you already know, because human learning patterns are strongly influenced by previously accumulated knowledge (Cohen and Levinthal, 1990). Indeed the more a person's worldview is shaped by learning within a defined field, the harder it becomes to associate with what emerges from other fields. Miller and Morris (1999) refer to this tendency as trained incapacity and emphasise the conundrum that the more we know about something, the harder it is to unlearn (Fig 2), before it can be replaced by something else. Rogers (1995) refers to the same phenomenon as the path of selective exposure whereby an individual protects existing knowledge by disregarding conflicting or unrelated information. Our challenge in action research is to enable people to become sufficiently competent in complexity thinking and conscious of the reality it projects, that they have the confidence to

unlearn their long imposed path of selective exposure to trained incapacity in the habit of reductionism.

Conscious/competence learning matrix

The 'conscious competence learning matrix' (Howell, 1982; Fig 1) has proved a durable model of the process and stages people go through in becoming aware of, and learning, new knowledge, skills or behaviour. The learner is considered to always begin at stage 1 – 'unconscious incompetence', and end at stage 4 – 'unconscious competence', having passed through stage 2 – 'conscious incompetence' and – 3 'conscious competence'.

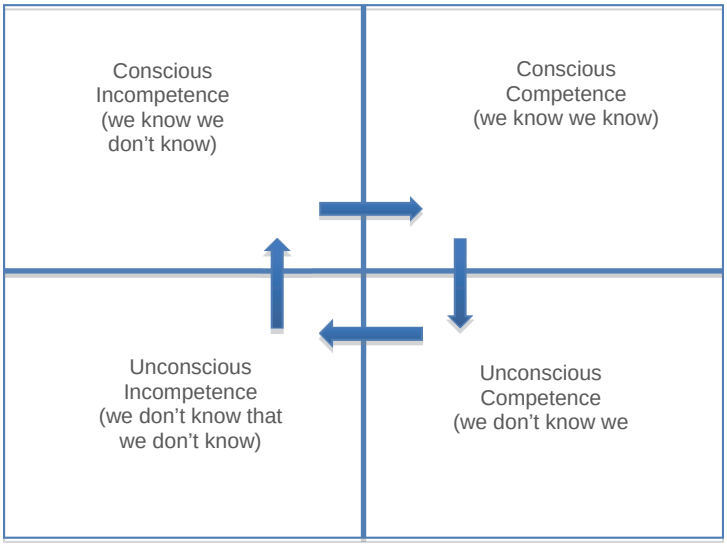

Figure 1. Howell's (1982) four stages of learning

- **Unconscious Incompetence** applies when people do not recognize or understand that there is a deficit. They either do not know that some knowledge exists, or they deny its usefulness. They don't know that they don't know!

- **Conscious Incompetence** is found in people who do recognize the deficit and the value of addressing it but do not understand or know how to do something about it. They know they don't know!

- In **Conscious Competence** the individual understands or knows how to do something and heavy conscious involvement is required to use the skill/knowledge or demonstrate to others. They know they know!

- When a skill or knowledge set becomes second nature individuals are said to exhibit **Unconscious Competence**. They don't know they know!

A number of authors have questioned the assumption that learning would end with unconscious competence, particularly in respect of how someone who is unconscious of their competence can pass their knowledge and skill on to others (Nonaka, 1994; Chapman, 2012). There have been many suggestions on how to deal with this. Taylor (2007, in Chapman, 2012) proposed a fifth stage, termed reflective competence, to illustrate that people would continually revisit and challenge their conscious incompetence to discover holes in their knowledge that they need to fill. Indeed a critical element in advancing through any learning process is that of reflection (Grimmet et al., 1990; Raelin, 2001; Mezirow, 2003).

Learning loops model

The last model we introduce describes three different levels of learning and knowing based on the depth of reflection needed to translate knowledge into action. The learning loops model was introduced by Argyris and Schon (1974) who proposed two loops, single and double. The model was later revised to include a third loop (Raelin, 2001).

- **Single loop learning,** also known as practical knowing, is mediated through deliberation among competing versions of effective practice leading to general rules of thumb that can be used repeatedly, without the need for recourse to the governing variables.
- **Double loop learning,** propositional knowing, occurs when we challenge our assumptions (practical knowing) enough to question the transfer of learning and doing from one context to another.
- **Triple-loop learning,** dialectical knowing, is when we go to higher order context to challenge our premises and entire frame of reference before taking action.

Together these four models provide a useful framework for describing learning processes in a complex system (Figure 2). In the context of the reductionism/complexity contrast single loop learning would equate to someone who habitually used reductionism even when dealing with dynamic systems. Since there is no useful halfway house between reductionist and complexity thinking, there should be no case for double loop learning in this context. Morin (2008) however, asserts that pseudo-complexity thinking abounds in approaches and people who define themselves in opposition to the tenets of reductionism but do not consistently live complexity. Such people would also be described as having a trained incapacity, as a result of selective exposure to reductionism, so deep that although they are conscious of their incompetence, they are incapable of unlearning the old invalid thinking processes. Both learning and unlearning are made more difficult by the fact that much knowledge about the use of complexity thinking is currently in tacit form because living complexity is still very much in its infancy and yet to be made explicit.

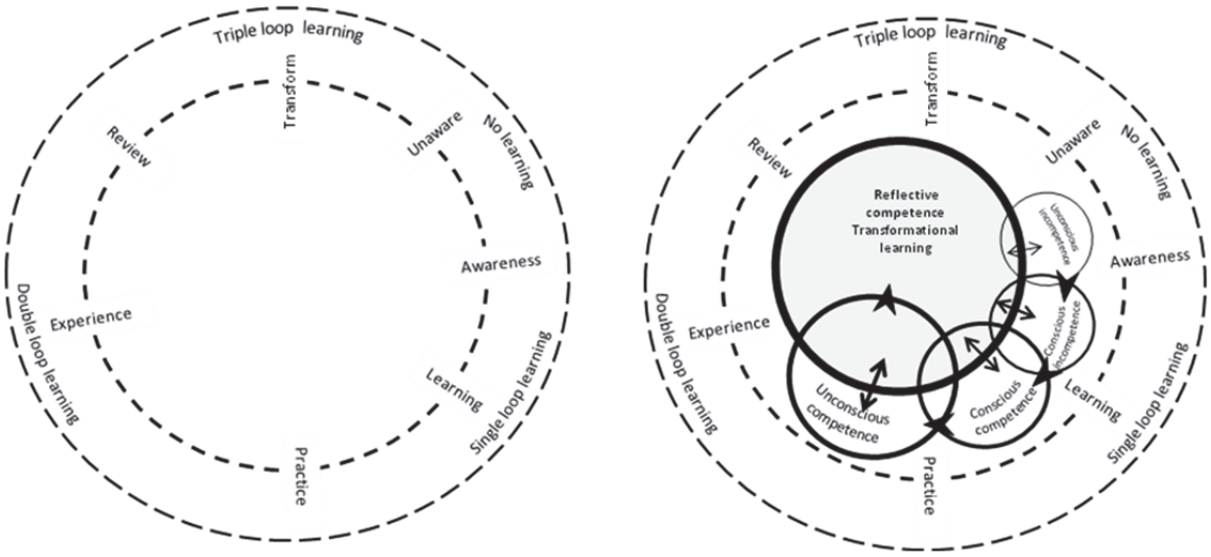

Figure 2. *An integrated framework for the complex stages and processes of learning and adopting new knowledge, skills or frame of reference. The first step for anyone is becoming aware of the need to learn. This learning must proceed through practice and review from single to double to triple loop learning (left hand diagram). Changing levels of consciousness and reflection then lead to deeper learning that can change ones frame of reference. The framework (right hand diagram) presents a number of stages along the path to a mature understanding and reflection that continually challenges one's path of selective exposure. Unlearning happens during, or as a consequence of, repeated incursions into reflective mode and back again.*

Engaging the framework (Fig. 2 right) begins with unawareness. Most of the stakeholders we encounter are in stage 1 (Unconscious incompetence). They are unaware of their trained incapacity in reductionism and that their path of selective exposure has left them ignorant of complexity thinking. Awareness can be stimulated (movement to stage 2, Conscious incompetence) by contrasting the perceptions of reality that can be experienced under the two different paradigms and by relating a range of examples from our experiences. As people reflect on these new world views they achieve awareness of the limitations of their current mind set and engage single loop learning by slowly accepting some different ways of thinking. Continued and stimulated (by, for example action researcher facilitators) reflection on their awareness brings to light examples from their own experiences, providing some comfort against the self-doubt they feel. Slowly, with repeated exposure and facilitation, their knowledge and confidence grows (hence the increasing size of the circles Fig. 2) and competence begins to emerge. Repeated practice of what they have learnt moves them into double loop learning. Once again reflection on things such as experiences of the differences in outcome that might arise from the use of the different paradigms dampens the doubt and raises the confidence that facilitates movement to the next stage.

In a real social-ecological system different parts of each individual's tacit knowledge and thus frame of reference, will be in different stages of this learning cycle. Something they grasp quickly will move through the cycles quicker than something they have difficulty

comprehending. Something they have just become aware of will be less conducive to reflection than something they have gained some competency in. Consequently different knowledge, attitudes and skills of individuals will be in different stages of the learning cycle and will move through at different rates. Similarly different individuals will be differentially ready to become conscious of and learn about a new frame of reference such as complexity.

At any one time a facilitator or leader of an action research program, is faced with participants who each have multiple frames of reference, each at a different stage of maturity, that they are differentially able to bring to the consciousness of the research team. Any assumption that stakeholders have similar frames of reference, or are similarly ready to learn and reflect on a wicked problem, is extremely dangerous. Especially when trying to foster a complexity frame of reference in the participants.

Consider how researchers begin interacting with participants when starting an action research program that entails embedding complexity thinking in an institution. One of the first actions might be to present participants with a handout that describes the need to change their frame of reference and explains how they should start thinking as the program gets underway. They may be tempted to consider including a list of hints for complexity thinking and their no-go reductionist contrasts. The handout might be a good idea but it would of course only represent explicit knowledge. Participants would need to gain firsthand experience of such thinking patterns if they were to effectively progress through the learning process. The facilitators can provide this by "walking-the-talk" and exposing their tacit knowledge of complexity thinking in the process. In the next section we present, for the first time in explicit form, the outcome of the authors' attempt at surfacing their tacit complexity thinking framework. This tacit knowledge comes from years of experience in facilitating action research programmes in social ecological systems in the fields of biodiversity conservation, water resources and catchment management, and helping businesses and government institutions rethink their planning and management approaches.

Frames and habits of mind for complexity thinkers

We find that the most important competencies which enable effective use of this integrative learning framework are psychological. They are ways of thinking that allow one to unlearn reductionist habits while adopting and embedding those more conducive to working in complex systems. We have adapted the educational learning concept of Habits of Mind developed by Arthur Costa and colleagues (Costa, 1991; Costa and Kallick, 2008) to foster intelligent thinking in school children.

A habit of mind is a pattern of intellectual behaviour that leads to productive actions. Habits of mind are seldom used in isolation but rather in clusters that collectively present a pattern of behaviours. When people are confused by dilemmas, or come face-to-face with uncertainties, their response is determined by the patterns of intellectual behaviour upon which they can draw. This implies that people should maintain an awareness of, and make conscious choices

about, which patterns of intellectual behaviour (habits of mind) are most appropriate to use under which circumstances. A certain level of competency is then required to use, carry out, and sustain the behaviours effectively, and also to reflect upon, evaluate and modify them for future use under different conditions.

Moving one's self, or a group of stakeholders, from one position of competency to another is unlikely to happen unless thinking and doing are bounded by particular intellectual patterns. We recognize three broad frames of mind which each encompass a set of habits of mind that are critical to leading participative planning and decision-making in complex social-ecological systems. These frames of mind are openness, situational awareness, and a healthy respect for, what we term, the restraint/action paradox.

Openness (see Text Box 1)

To embrace and effectively engage with complexity requires a certain psychological openness from individuals and institutions, especially when in transition from a predominantly reductionist paradigm. This openness can be described as a willingness to accept, engage with and internalize the different perspectives, even paradigms, to be encountered when dealing with diverse participants in an interdisciplinary situation. An open frame of mind requires conscious acceptance that notions such as ambiguity, unpredictability, serendipity and paradox will compete strongly, and legitimately, with knowledge, science and fact. In essence, it means that while navigating challenges of a complex social-ecological system one holds one's own strong opinions lightly (Pfeffer and Sutton, 2006) and engages as both facilitator and learner.

Box 1. Habits of mind that promote patterns of Openness in behaviour

- Hold your strong opinions lightly and encourage others to do the same.
- Be prepared to identify and accept the intervention of surprise, serendipity and epiphany.
- Encounter every person with equal respect, listen for their specific needs, knowledge and ways of knowing.
- Be open to both/and options.
- Do not reject ambiguity or paradox. They are to be expected and their acceptance as legitimate can often avoid dispute.
- Cultivate, honor and affirm the legitimacy of multiple perspectives and outcomes. Be ready to chart your way through them to learn about multiple legitimate outcomes: There are many ways of skinning the cat.
- Accept everyone as co-learners, not experts or competitors.
- Encourage cooperation and consensus: the best way to get what you need is to help others get what they need.

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Situational awareness (see Text Box 2)

One of the critical differences between complexity-based and reduction-based thinking is the importance of context and scale in complex systems. Each issue or system attribute can

appear quite different, and interactions have quite different outcomes, under different contexts and at different scales (Levin, 1998; Dollar et al., 2007). Spatial and historical context are very important but so too are the different participants' value systems and how they lead to different outcomes. We use the acronym V-STEEP (Values – Social, Technical, Economic, Environmental and Political) (Rogers and Luton, 2011) to guide us when scoping context. An awareness of the complex context in which an adaptive challenge exists, and of how it changes in time and space, is critical to effectively navigating through it. In essence, one must cultivate a state of anticipatory awareness and constant mindfulness of the V-STEEP environment when navigating complex systems.

Box 2. Habits of mind that promote patterns of situational awareness in behaviour

- Discern when a change is sufficient to require re-negotiation or review.
- Consider the importance of relationships and interactions between entities and not just the entities themselves.
- Become conscious of and accept change agents and processes.
- Be time and place specific: without it you cannot properly identify the appropriate context or define problems and solutions.
- Be aware of contingencies, scale and history: they all play a role in mapping the present and the future.
- Surface the collective principles and values that will bound decision situations and help keep decision-making consistent from one context to the next.
- Use these principles to guide decision-making, rather than relying on facts and numbers which will change with context.
- Reflect often: formally, informally, individually and collectively.

A healthy respect for the restraint/action paradox (see Text Box 3)

Leadership and decision-making in a complex system is a balance between the risks associated with practicing restraint and taking action. On the one hand, if the context requires it, one needs to consciously practice restraint and create space that allows the emergence of ideas, trust, opportunity and even epiphany to loosen the tangled problem knot. There is a strong need for a certain slowness (Cilliers, 2006) in taking time to allow emergence to unfold. On the other hand, one needs the courage to take action in a mist of uncertainty because, in a complex system, the consequences of our actions are never entirely predictable and no matter how good our knowledge, there is never an objective "right" decision. Being conscious of, and comfortable with, this paradox is critical to successfully fostering and practicing adaptive leadership in social ecological systems.

These three frames of mind are interdependent, with openness as the foundation or most critical one of the three as it can enable or constrain the other frames. To some extent, adequate situational awareness is not possible without openness to a diversity of perspectives.

In a complex system one simply cannot afford a one-sided perspective. Knowing when to act and when to practice restraint depends on one's awareness of changing dynamics in the system, but it also requires openness to the unexpected. The more specific habits of mind are more easily contextualized, remembered and taught when grouped under these frames but they are not confined to use under one frame. As one becomes more competent in their use they are easily moved or modified, from one context to the next. This list of habits is a living list that is continually honed as we learn more from explicitly applying complexity thinking to social-ecological problem situations.

Box 3. Habits of mind that promote patterns of a healthy respect for the restraint/action paradox

Decisiveness/willingness to act under tension

- Encourage courage. Do not be afraid of intelligent mistakes.
- Avoid paralysis from the paranoia of omission, and/or fear of simplicity.
- Have the courage to seize the just-do-it moment.
- Accept that there is no one right place to start or end. Do so when it is sensible and useful.
- Have courage to take action from which you can learn. Even mistakes lead to learning.
- Cultivate an awareness of the natural inclination to avoid discomfort and have the courage to push beyond it.

Restraint under tension

- Discern when to trust the facilitation process and stand back quietly, giving the group dynamic space, and allowing emergence.
- Avoid premature convergence – avoid being too quick to make judgments and choices. Keep options on the table long past their apparent usefulness. Many will find context later in the process.
- Avoid overconfidence about being ready to take action in a data-driven 'predict and act' mode.
- Know when to rest. Open and participatory engagement exposes vulnerabilities, requires humility and takes energy. Getting ahead of the game leaves participants unsettled and opens opportunities for dissent. Provide participants ample time for healing and replenishment.

Habits of mind as heuristics to guide action and learning?

The scientific literature on social-ecological systems strongly advocates adaptive approaches to decision-making which come under many guises. For illustrative purposes a typical adaptive decision process consists of 4 main steps, 1) Framing the issue and its context; 2) Deciding; 3) Doing; and 4) Reviewing. As can be expected each of these steps presents different contexts and opportunities for the use by complexity thinkers of different combinations of habits of mind. Although the following text is far from comprehensive it

does illustrate how individual habits of mind might be used in context specific ways while moving through these steps.

Framing the issue and its context

Framing can be understood as a form of scoping in which we are explicit about developing a complexity perspective of both the issue at hand and its particular context. It is not a step by step approach as reductive thinking would suggest. A more complexity friendly description might be that it is more akin to trying to unravel the knots in a hastily gathered bundle of string, or in fishing line that has stripped from a reel. One cannot understand the bundle (issue) without trying to unravel it (solve it) and vice versa. Tugging at one point can loosen some parts of the knot but tighten others so the process needs a holistic and empathetic approach.

A high degree of openness must be cultivated as stakeholders explore the thicket of social, technical, economic, environmental and political (STEEP) attributes of the issue (question, problem), its context and potential solutions in a scaled, spatially and temporally explicit, and participative way, acknowledging the importance of values (V-STEEP)(Rogers and Luton, 2011).

Critical habits of mind to encourage in this phase include holding one's strong opinions lightly and adopting a certain slowness which together open time for shared reflection and learning. These grounding habits are essential in prodding participants to become conscious of how contingencies and feedbacks generate many different legitimate perspectives. Soon they also realize the limitations of rules, fact and data in wicked problem decision-making.

Deciding

Adopting a complexity based frame of mind and practice opens a new world of decision possibilities usually unseen by the reductionist who strives to eliminate all but the right perspective, answer or solution. Participants can move quite suddenly from being in a position where there is one, or only a small number of logical choices and actions, to a new situation where multiple choices become legitimate and viable in their own right. At the heart of the deciding step is proactive choice. It is a choice to make a decision in the apparent absence of the usual indicators of success for a particular path of action, rather than for a carefully constructed end point. It is the awareness that a choice has to be made, that it is likely to be imperfect and that it will be provisional at best. Choosing a certain path of action is as much a psychological value based standpoint as it is an entry into more learning. Choosing a path will take the practitioner to a new set of learnings from which to make new and more relevant choices in an iterative way.

Doing

Implementing a chosen action in a complex context is ultimately about getting started where it is sensible and/or useful to do so. It is in this space that action becomes a form of diagnosing and learning of the dynamics and interactions within the complexity. Practitioners need to be aware of the pressures to be acting continuously. It is difficult to justify not acting

to decision and policy makers; however, there are times in complexity thinking when resting and taking no action is the best form of acting. This form of doing then acknowledges the inherent action within a complex system and becomes open to windows of opportunity that may arise. It contrasts with the reductionist tendency to undertake tasks in a predefined way and sequence which invariably falls foul in the face of unexpected hitches.

Reviewing

Reviewing should be, but unfortunately is not, a natural occurrence after action, even in tightly controlled bureaucracies where emphasis is on the efficacy of the action, in and of itself. It is the most critical step in an adaptive process, as it initiates a new cycle of framing, deciding, doing and reviewing. Without it we become stuck in doing – often in an unproductive manner or direction. We need review so that we can reflect on and challenge our in/competencies and make our tacit habits of mind explicit. In a complexity context formalizing the review process is difficult, given the number and variability of outcomes and the range of legitimate perspectives. It can be undertaken as a process of understanding and learning about the shifts in dynamics and direction within the complexity that arise as a result of choosing a certain path of action. Reflection in an open frame of mind is a critical aspect of reviewing in complexity.

Conclusion

In this paper we describe why, in social ecological systems dialogue, it is crucial to be conscious of the realities of complexity and to adapt thinking and decision-making styles accordingly. Simply put, the key to understanding complexity is that it is anti-reductionist (Wagenaar, 2007). It is also becoming abundantly clear that reductive thinking, which privileges systematic approaches over system complexity, provides a distortion of systems reality that can have, and indeed has had, considerable social cost (Morin, 2008; Montouri, 2008; Rogers, 2008; Ison, 2010). Lastly, it is widely held that systems and complexity thinking is a skill that far too few people have and even fewer can practice (live) (Nowotny et al., 2001; Funtowitz and Ravetz, 1992; Wagenaar, 2007; Morin, 2008; Ison, 2010). In Ison's (2010) words most people rarely make it to complexity's first base because they are trapped in a dominant linear, causal mode of thinking typical of reductive mind-set.

This presents serious problems and even ethical dilemmas (Celliers, 2000) for action research projects where the stakeholders (citizens, professionals and researchers of all persuasions and origins), and researchers plan and implement interventions (new policy; management actions; resource redistribution, etc.) with the aim of generating transformation in social-ecological systems. Many intellectual and case study publications which espouse this view exhort readers to adopt a complexity frame of reference but few explain what complexity thinking is and how can be harnessed in practice.

In the introduction we identified three main challenges for action research in this context.
Firstly, researchers and their stakeholder partners must become conscious of their current frames of reference, and how they are located within reductionist or complexity paradigms. We have explained that they must guard against "pseudo complexity" thinking

(Morin, 2008), in which complexity principles are espoused but communication and action practices are still influenced by a reductionist legacy that remains to be unlearned from their knowledge base.

Secondly, the process of assimilating and internalising new knowledge, to the extent that it transforms world views, is itself complex. We have developed an integrated framework for how learning in complex systems can lead to transformation of a person's frame of reference. This framework is less linear than its predecessors and illustrates the multiple paths, processes and rates of how learning takes place in and about complex systems. Any assumption that stakeholders have similar frames of reference, or are similarly ready to learn and reflect on a wicked problem, is highly flawed but often made, even if unconsciously. At any one time the action researcher/facilitator is faced with stakeholder partners is faced with participants who each have multiple frames of reference, each of which is at a different stage of maturity, that they are differentially able to bring to the consciousness of the research team. Attempts to foster a new frame of reference must acknowledge this diversity and avoid in appropriate step by step guidelines of learning processes.

Thirdly intellectual acceptance of the characteristics of complex systems is only the foundation on which to start building a new set of thinking patterns and behaviours. The challenge was to be explicit about the types of habits of mind that could be used as heuristic tools through which researchers and stakeholders can begin to better "live" complexity.

The concept of action researchers and their partners "living" complexity is an important one because the learning and understanding processes that lead to transformation are not complete without experience of, and feedback from, application. Future use of our frame and habits of mind in activities such as policy implementation, governance and other participative decision processes will deepen understanding of both intellectual and lived complexity, which in turn should lead to improved models to better enhance the communicative space in complex systems.

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APPENDIX 2: ADAPTIVE PLANNING FOR STRATEGIC ADAPTIVE MANAGEMENT: TRANSLATING VISION INTO ACHIEVABLE OBJECTIVES.

This protocol provides a step-by-step process for decomposing the vision into a series of "objectives" of increasing focus, rigour and achievability. The finest level of the hierarchy is defined by achievable targets.

Procedural tips are given in text boxes for each protocol step. This protocol should ideally be implemented in a workshop environment with the assistance of a facilitator who is familiar with both the protocol and consensus facilitation.

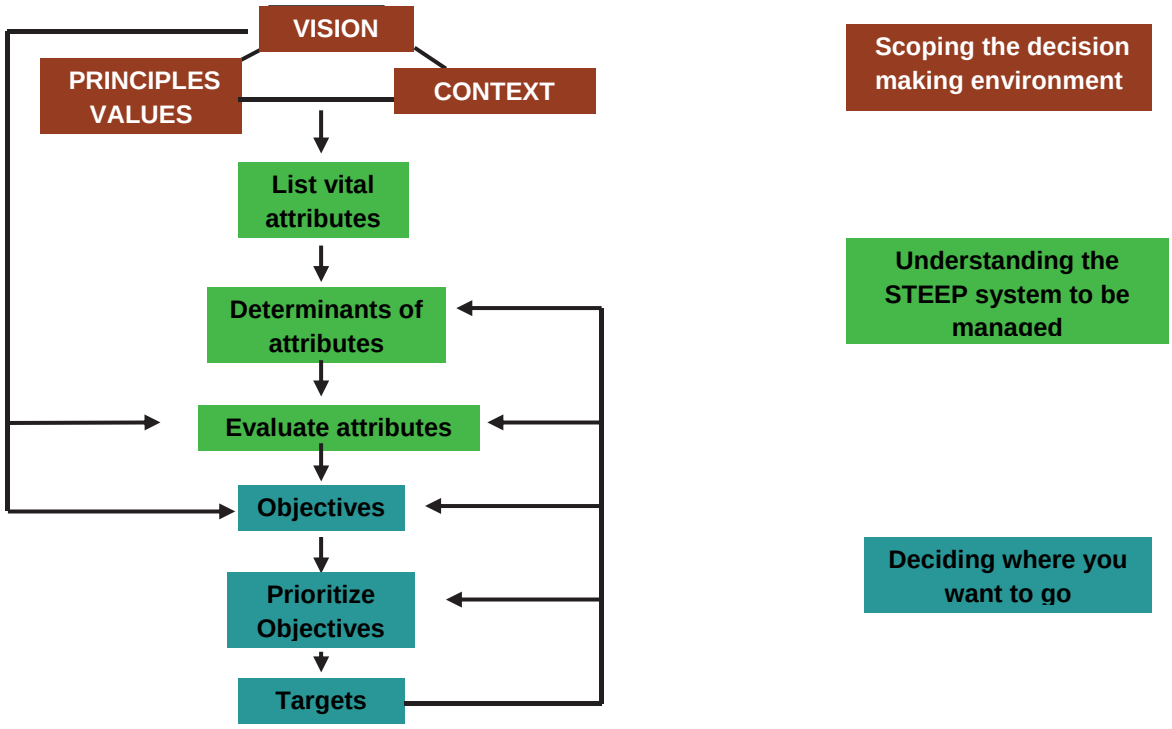

Fig 1. A strategic planning framework for translating vision into achievable objectives

Step 1. Reach consensus on the vision, values, and operating principles

A vision is a concise statement describing an institutions' core business and philosophy of management, whereas a statement of the operating principles describes the core values of the organisation in terms of managing the resource. Before any other management

This is one step at which value and needs-based negotiation (See Guide to building cooperation) is essential. Identify the key elements of the vision and develop operating principles for each.

Since the operating principles describe core institutional values they should be used as checks and balances at each step of the protocol.

action can be taken the vision and operating principles need to be fully accepted to prevent subsequent procedural breakdown. Development of a sound information base to provide the full context (Step 2) for management will greatly assist this process.

Step 2. Provide the context for setting the objectives

Describe the context of/for the system to be managed, at local, regional, national and international scales and in ecological, socio-economic, political and legal terms. Often socio-economic, legal and ecological factors are included in international, regional, national and local context.

This step requires considerable brainstorming, knowledge of the literature, local conditions and policies, governmental policies and international agreements. It is important to involve all stakeholders in building this context to ensure common understanding as a base for future negotiations.

Step 3. Document the vital attributes of the system to be managed

List **all** the known and perceived, current and future vital attributes of the system.

Current attributes may be determined from inventory type lists of V-STEEP characteristics of the system. In protected areas these may be species diversity and landscape types, social and cultural attributes, the role in the local economy, etc.). Scenario modelling may be useful for identifying future attributes.

This is an important step in the objective setting process as it identifies the fundamental purpose(s) of management for a particular resource.

It is essential that everyone's perceptions of the strengths/vital attributes are aired. This is a step that brings participants mental models of the system to the surface. Sometimes it exposes hidden agendas. Careful facilitation and much tact are needed in this phase. Encourage participants to put their "cards on the table" to produce a provisional list of their perceptions of the vital attributes, without debating their merits. Then reduce the list by eliminating those incompatible with each other, or the vision.

The next step is to discuss and evaluate these lists to reduce them to the essential elements compatible with the vision.

Step 4. Evaluate and consolidate the attributes

Matrices are a useful tool in exploring which attributes appear to be complementary and those that are conflicting. Attributes can be sifted, grouped together and condensed. Thus the end product would be a concise list of vital attributes for which the catchment would be managed.

Personal values play an important role in this step as long held assumptions about what is "vital" in a catchment need to be discussed and supporting evidence found. Look for common ground to rationalise the list of attributes to ensure compatibility with the vision and operating principles, including institutional values).

This can be a complex task. Techniques such as ordination, overlapping, congruency, optimization, linkage and interaction may be used to investigate compatibility and trade-offs between strengths if round table discussion does not resolve the issues.

Table 1. An example of a matrix used in the initial evaluation of the strengths of Nylsvley Nature Reserve (O – complimentary, X – conflicting, ? – unknown).

Strength	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	-	O	O	O	O	O	O
2		-	?	O	X	?	O
3			-	O	O	O	O
4				-	O	O	O
5					-	O	X
6						-	?
7							-

Step 5. Record all the determinants of, and constraints and threats to, the vital attributes

A major purpose of management is to ensure the maintenance of the determinants of the vital attributes. List all the determinants of, and the constraints and threats to, the condensed list of vital attributes. Knowledge of the environmental and cultural "goods and services" the system has the potential to deliver is essential to this step. A matrix can be set up to facilitate the process of assigning determinants, threats and constraints to the particular strengths.

Expert opinion is needed for this important step but do not let it be constrained by the lack of site specific knowledge. Use experts across the V-STEEP spectrum where you can.
Develop hypotheses of determinants if they are not known. This is invoking an adaptive approach to management which will test their importance over time.

Step 6. Formulate the high level objectives

Objectives are set to:
1) ensure the maintenance of the identified vital attributes of the system being managed; and
2) overcome the constraints and threats to meeting the vision.

A hierarchical approach should be adopted to formulate a set of nested objectives of increasing rigour and achievability. Note that this is an iterative process of identifying, structuring and analysing objectives, and understanding how they relate to each other.

Repeatedly cross reference the vision, principles, context and vital attributes with constraints and threats to set up statements of intent to ensure vital attributes are maintained by overcoming threats and constraints.

Several devices can help stimulate formulation of objectives:
1. Drawing up a wish list.
2. Use of alternatives.
3. Identifying problems and shortcomings – articulate reasons for concern.
4. Identify consequences of existing objectives and management actions.
5. Use of different perspectives.

It is important to recognise that objectives at different levels in the objectives hierarchy would probably be used to direct operations at different levels in the institutional hierarchy.

Table 2. An example of a section of the matrix used in assigning determinants, threats and constraints to the particular vital attributes of Nylsvley Nature Reserve.

Vital Attribute	Determinant	Threat	Constraint
1. A good information base.	History of involvement: academic, research, management.	Lack of support from funding agencies.	Reserve is a very small part of floodplain and catchment; lack of understanding of the system as a whole. Information is not in a user friendly format. Management does not have clear objectives, and therefore does not demonstrate their information requirements.
2. It is an excellent breeding and staging site for nomadic aquatic birds.	Hydrological regime drives wetland processes, water quantity and quality. Grazing and fire regime on reserve influences breeding and other life history strategies.	Water resources development in catchment is a threat to the hydrological regime (water is scarce) – extraction is a high risk. Exotic plants in the catchment – alter water quantity (reduce runoff) and quality.	Management does not know how to, and have not, explicitly managed for birds.
3. The NNR has a large number of red data listed species (especially fauna).	Habitat availability due to grazing and fire regime on reserve, and the hydrological regime.	Droughts. Over utilisation of the catchment area, egg: overgrazing.	High human impact. Management practices for other species – veld and fire.

Step 7. Prioritize the high level objectives

Prioritising objectives is both difficult and subtle. Use the vision, strengths, principles and context as a basis to prioritize the objectives. They provide the checks and balances. It is important to note that the priority may change according to the level of management personnel involved so try to involve a wide range.

Negotiation is an important tool. Not all the objectives will stand up to this process and there will be many perceptions of what is most important.

The preceding steps of the protocol have set a good foundation though. Use this information to give the checks and balances needed to rationally prioritize the objectives. Do not do it by vote as this often reduces decisions to gut feel or personal agendas.

One of the most useful devices for prioritising is simply to ask WHY? Why is A preferred to B? and to relate the answer to the vision, principles and vital attributes.

Step 8. Set lower level objectives

Construct an objectives hierarchy by decomposing the higher level objectives set into component objectives ("sub-objectives") of increasing focus, rigour and achievability. The final level represents acceptable, achievable and measurable objectives.

Use the same procedure as for formulating objectives (Step 6) to sub-divide objectives into smaller and smaller, more circumscribed units until the statement ceases to describe an intent and becomes one of "what must be done". You have set the final objectives when clear statements of the temporal, spatial and resource limits have been identified and they are unequivocally achievable.

The most difficult task is to ensure that the smallest number of objectives is set to achieve a particular high level objective. Again, ask WHY? Why is this needed, why is it the best option? Remember, the purpose is to maintain vital attributes by overcoming constraints and threats. Also remember that one reason why you are conducting this exercise is to focus management on priority, achievable and measurable objectives. Therefore repeatedly check that the resources needed are available or potentially available.

There is also a need to **prioritise these lower level objectives**. Different degrees of rigour can be given to the time frame of different priorities. An objective may have a low priority because other objectives have to be achieved first, not because it is less important. Future objectives may have low priority now, but will be given a time frame for revisiting them. One of the reasons for prioritising is to check for redundancy between objectives. Quite often one lower objective serves two higher level objectives, or needs minor modification to do so. The more these can be identified the more duplication, or waste of effort, can be eliminated.

APPENDIX 3: THE ART OF STAKEHOLDER FACILITATION

KH ROGERS

As has been said and implied many times above, it is not what you do but HOW you do it, that is critical to successful. There is no more important component of IWRM that must be done "right" than public participation in decision-making. Especially in South Africa where we have such a diverse array of stakeholders at any meeting.

This document describes the approach that the IUCMA and project team takes to stakeholder centred planning and decision-making, whether it be in big public events such as developing a Catchment Management Strategy, or smaller specific purpose workshops.

Facilitating a workshop, especially one in which there are participants with a diversity of backgrounds and views, is an art and VERY different from chairing a meeting. It is also much more than controlling the participants to ensure they behave and don't just argue with each other. Unfortunately, too few people realise these differences and most public participation exercises in this country are very badly run. The biggest reason for this is that the facilitator often allows the organisers to do a DAD (Decide Announce Defend) on the participants!

A DAD happens when people or institutions, usually with the best intentions, develop a plan that they believe will be in the stakeholders' best interests. When they "announce" the plan to stakeholders it appears that they have already "decided" what is best. The stakeholders' reaction is always to attack the plan which the planners then try to "defend" in a cycle of discontent, or even serious conflict. No matter how well you think you understand an issue you cannot experience it in the many legitimate ways that stakeholders do, so never assume you KNOW what either the problem or solution is under these conditions.

A far more appropriate process is to do an ALIDA (Ask, Listen, Integrate, Decide, Act) in which facilitator and participants are equal partners. When doing an ALIDA one first "asks" the stakeholders how they experience/understand the issues, and what they need of you. Be sure to listen carefully and empathetically to their views. Acknowledge the legitimacy of their perspective and do not try to convince the stakeholders differently. Once all the views are on the table (not debated) the facilitator must "integrate" them into a systems perspective and integrate them with any policy or management mandate. This process will include participative feedback with stakeholders to reach a shared understanding.

Everyone's understanding will be much richer for having worked this ALIDA way. You will also achieve the buy-in and trust needed to build a long term relationship with your stakeholders. Refer back to the Adaptive Planning Process which described a practical example of an ALIDA.

Negotiating for consensus

Negotiations for change in patterns of water resource use, the basic task of CMAs, need to be aimed at achieving consensus on a shared, albeit uncertain (Rogers and Breen, 2003) future. Consensus in this respect does not imply the lay interpretation of complete agreement after exhaustive discussions till the small hours. If done properly achieving consensus may sometimes be a bit slow but it will always be rewarding and save much time later on. We used a process that is based on that (Figure 1a and b) used in the successful negotiations for a transition from apartheid to democracy in South Africa (Rogers and Bestbier, 1997). Our reasoning is that if it can work for a nation with our diversity of cultures, then surely it must have the potential to work for catchment management (Rogers et al., 2000).

Figure 1a The process of consulting stakeholders with the aim of achieving compromise is not appropriate in democratic South Africa although it is currently the dominant form of stakeholder engagement.

Our consensus seeking approach to negotiation can be better understood if contrasted with a compromise seeking approach that mimics that used in many political and labour negotiations around the world (Figure 1a). In the compromise seeking approach, parties generally come to the table with the problem already defined in their terms and a list of the solutions/demands they want. They then trade solutions and outcomes off against each other. Unfortunately the problem is never defined in terms that are mutually acceptable to the various parties and they tend, instead, to see each other as the problem. Compromise negotiations are not durable and are of little value in focusing the long term co-operative decision-making needed in resource management.

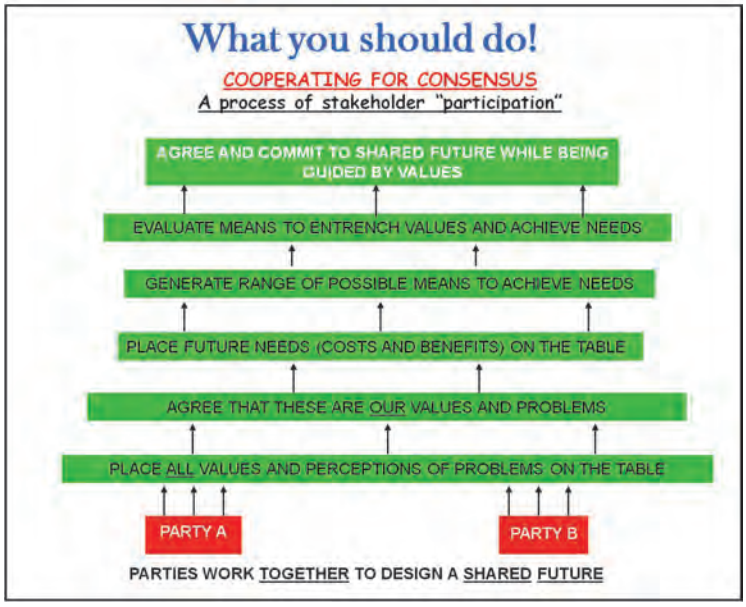

Figure 1b. The practice of seeking consensus is simple and appropriate in South Africa

The purpose of consensus negotiation in SAM is to design a shared future. As such, it is heavily dependent on moving beyond current problems and on developing a shared understanding for future decision-making (Figure 1b).

The first step is to have all participants place all perceptions of the problem on the table along with the values they believe should guide decision-making. There is no need to debate who is right or wrong, only a need to understand that everyone's perspective must be seen as legitimate. This ensures that the full nature of the problem is fully and there will be much less likelihood of marginalising some sectors of the stakeholder base, especially those who are already disadvantaged. Emphasis should, however, be rapidly shifted away from the current problem, to envisaging a future where the costs and benefits of redistributing a resource meet the collective values of the users. A focus on values and the future has the remarkable ability to dissipate the conflict (Keeney, 1992; Rogers and Bestbier, 1997) that often arises from defence of current territory, personal desires or present ownership.

The ability to metaphorically look back from the future to the present is very powerful in deciding what needs to be done to get there so there. Furthermore, you will find there is much less chance in getting bogged down in peoples day-to-day problems and more potential to be strategic.

The above characteristics of consensus facilitation and negotiation are strongly built into the process we advocate for facilitating any workshop or meeting appropriate to IWRM. It works as well with 3 people as it does with 100.

Pre-workshop preparation

- For any participatory stakeholder meeting, the facilitator must carefully plan the *process* of the meeting but must **not** plan the *outcome* in detail. You only need to know what your general purpose is. Co-operation with your participants will get you the best outcome.

- The facilitator must research and build a good basic knowledge of the STEEPP system to be discussed. Don't go in completely cold! Do some homework.

- Make sure that the meeting will be set-up in a horse-shoe format, instead of rows facing the front. Ideally, no stakeholder should have their back to any other stakeholder, and the facilitator should be able to easily walk up to every stakeholder wherever they are positioned in the room.

- Ensure that every participant is provided with a piece of paper on which to write their name. Have them fold it and position it on the desk in front of them. This allows both the facilitator and other participants to see who they are.

- If possible keep the door to the workshop room closed until just before the meeting, (give the participants tea outside) then let everyone in together. If you can do this you will find that there is a good mix of who sits where, and next to whom. If people dribble in slowly they look for familiar faces and you end up with cliques clustered around the room. Sometimes this can lead to problem groups arising, whereas what you want is people meeting each other and interacting closely, often for the first time.

Starting the meeting

- The first job of the facilitator is to **build trust** – both in the facilitator and in the process. Stakeholders often arrive suspicious of the facilitator and "agenda".
- *The facilitator must introduce themselves*. Tell them who you are in a way that allows them to understand your background, affiliations and experience. Do not make the introduction too long, especially if stakeholder suspicions are high. Actions speak louder than words, so start actively listening to stakeholder voices as soon as possible.
- *Build clarity about the very broad purpose of the meeting*. Don't be tempted to be too specific as can invite premature argument. "We're all here for the same reason: we all want a better future for this catchment. Does anyone disagree?" No-one will disagree! This is another example of how powerful the future focus is. (Note: you will ask them what they think the meeting is about in a minute)
- Introduce the rules of engagement, e.g. "As facilitator, I would like to suggest to you a few ground rules that will help our conversation along". Her are 5 simple rules. You probably only need 3 at any one time.
    1. Emphasise that there will always be multiple perspectives and this should not be viewed as a problem, and that all participants' perspectives are valid and equally valued.
    2. Everyone will be able to and needs to, give their own perspective on any issues. We will all accept it as the way they see the issue.

3. We can ask questions of each other to seek clarification at any time.
4. You will find that the best way to get what you need is to help others get what they need.
5. Seek first to understand THEN to be understood. Listen first and speak later.

★ Note: Someone's perspective might be ill-informed but it is still what they know at the time. It is often advisable to resist the temptation to persuade them otherwise. They are going to learn and adjust their thinking as the workshop progresses.

<u>During the Workshop</u>

- As facilitator, never directly challenge a participant's point, but probe and try to understand where it is coming from. Preferably avoid opening it up to the floor for other participants to comment – this creates space for conflict. Ask the stakeholder for clarification so that you keep control of the discussion:
  - "Why do you think that?" / "What makes you think that?"
  - "Can you give us an example?"
  - Guide stakeholders to qualify 'sweeping statements' and work towards them providing evidence or solid argument for what they say but do it by asking questions of them not telling.
  - Conversely, guide stakeholders to generalise overly-detailed points, so that they are described at a 'useful' level. The aim is not to get stuck in the nitty-gritty detail of today, but to paint a broad contextual picture of how we can move towards tomorrow.
- When writing a participant's point on the flip chart or computer screen, remove any explicitly negative connotations/accusations/blame, e.g. if a participant says they are concerned about "how those damn coal mines mess up our water quality", simply note that "coal mining and water quality" are an issue. If they provide specific detail you can write that up.
- You must stay subtly in control. Just keep thinking, "I won't let them/that person rush/push me. I know where I want this to go (even if it is "wherever it takes us").
- Keeping the meeting happy is more important than keeping that moaner happy, or trying to out- smart him. Don't get caught up in that, just sidestep it by saying "OK Jack we note your point. Let's see what Jane has to say before we go on to Joe and ....". Then it is not you against Jack but Jack in amongst the other participants.
- Remember the 80/20 principle. You will get 80% of what you need from 20% of the time. As soon as the rate of ideas/input starts to slow (and you think you have enough) you can say: "Well I think we have a good idea of the general feeling of the meeting, don't you? Can we move on to the next point then?". Look around at people and give them a little time to react. Never make them feel rushed but don't linger too long that they start getting restless.

If things get tricky

- Don't forget to embrace diversity and heterogeneity! There will always be multiple perspectives: this is inevitable and valuable. If there appears to be a 'deadlock', as facilitator you must step back from the issues and find a way to move forward that incorporates all sides.

    - Remember that everyone agreed to the rules of engagement at the outset of the meeting – reminding people of this can be a useful tool to give you space to move forward.
    - If there are four different perspectives in the room, and an apparent impasse, break it simply: "Ok, so we have four different views here – do we have consensus on that? Great, let's note them and move on". If there are significantly opposing views, or conflict/mistrust between particular stakeholder groups, do not shy away from it. Acknowledge and record it explicitly as a part of the Context in which you/they will need to work.

How to make sure you are doing an ALIDA

- Begin a workshop or session by asking everyone to say what are their expectations and/or concerns of the exercise. Write them all down as a cross reference. Mostly this allows you the opportunity to confirm the original purpose and embed a common view in the participants' minds. This can bring up anomalies, problems, expectations you had not foreseen early in the process and give you an opportunity to deal with them up front before they become a problem.
- Ask people to write down 2-3 key words, issues which they will give you. This helps avoid long rambling, self-serving and opinionated responses from stakeholders.
- Go round the room and ask *every single stakeholder for the top one on their list*. If people give you their whole list there will soon be nothing novel left for the other participants to say and this will irritate them. Write their concerns up on a flip-chart or computer/projector screen at the front of the room where everyone can see. After you have gone around the room ask everyone if there is anything else on their lists that hasn't been covered.
- Once you judge that the inputs have become sufficiently slow/repetitive, stop and ask two questions:
    - Is there anything important missing from this list?
    - Is there anything up here that anyone strongly feels is inappropriate?
- Explain to stakeholders that we now have a long list of problems and if we tried to address them one by one we would never get through them. Then you can ask them if you can use your process, e.g. the Adaptive Planning Process which will help integrate the issues.
- Sum up from time to time in a humble way. "Let me try to summarise what I think I have heard". Then ask the meeting or person "is that the way you see it?", or "does that represent a fair reflection?". "Anyone want to offer other views?".

The last word!

If you begin with these guidelines you will develop your own art of facilitating and be amazed at how stakeholders/participants respond.

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APPENDIX 4: TIMELINE OF CHANGE IN THE INKOMATI (USUTHU) CATCHMENT MANAGEMENT AGENCY, 2009-2015

Time	National interventions/activities	Institutional interventions/activities
Beginning 2005	DWA (Department of Water Affairs) establishes ICMA by appointment of Governing Board (GB). No water management staff appointed.	Governing Board becomes de facto "staff" and writes first business plan.
End 2006		Begin appointing operational staff (full complement of I&P (Institutions & Participation), one water quantity and one water quality).
2008	Institutional Realignment project at DWA.	Leads to uncertainty about the future of institution and jobs.
	DWA forgets to budget for CMAs in 2009/2010 financial year.	Extension of Governing Board term.
2009		January. We introduce Strategic Adaptive Management (SAM) as a useful decision-making system.
		February. Run Adaptive Planning Process (APP) of SAM.
		Term and concept of "grannies" emerges and leads to need and process of unlearning.
		APP outcome becomes basis of new business plan.
		Governing Board rejects new business plan.
		Staff morale at very low ebb. There is no operating budget, salary payments uncertain after two DWAF-ups. CEO AWOL.
	When DWA see new business plan they accuse ICMA of duplicating DWA functions.	May. The farmhouse meeting. ICMA staff show ownership of APP outcomes and the consequent business plan and strategically use it to counter DWA accusations. This clearly gives staff a new sense of self confidence.
		September. "Adaptive Planning for the Inkomati catchment" document (with three cross cutting IWRM projects) produced.

		October. ICMA meet Minister and present to her their first decent strategic plan.
		ICMA meet with government Portfolio Committee.
		November. Blue file reflection meeting.
	December. Minister announces that the ICMA must produce a CMS on limited budget by the end of the financial year.	
2010		Jan to March: ICMA staff pull together and produce an integrated, stakeholder-centred CMS.
		Brian Jackson and Kevin Rogers present to CEO search committee including members of Portfolio Committee.
	Resignation of Chief of Institutional Realignment and new appointment.	
	Timeous transparent budget from DWA for the first time.	
	December. Powers and functions delegated to ICMA by Minister.	
2011		Governing Board indicates no confidence in MANCO. Reporting to Governing Board still old bureaucratic process which was not compatible with new APP based business plan.
		Two meetings to resolve this. APP key to this resolution and forms basis of new reporting style linking activities to objectives.
		I&P is given more money for public engagement, and feels more purpose has been given to the forums by the CMS. The levels of stakeholder fatigue and community officer fatigue start to decrease and the forums start taking shape as IWRM spaces.
		February. Equity Working Group (EWG) formed.

		CMS and SAM presented to Portfolio Committee and very well received. In retrospect, this is seen to have ensured the survival of the ICMA (by ICMA staff, and backed up by DWA officials). The ICMA were able to prove their worth and, critically, that they were doing things that DWA had never done (and arguably could not do) themselves.
		Five year strategic plan developed for implementation of CMS.
	No cooperation from regional DWA on transfer of staff to CMA.	
	DWA process for setting tariffs for water excludes ICMA.	
		August. Narrative Lab runs ICMA learning/unlearning workshop using the Future Backwards technique.
		October. Facilitation training workshop with the EWG.
		November. Lower Komati and Sabie forums re-launched with good stakeholder focus.
		November. Team from the University of Limpopo runs Archetypes workshop with the EWG.
2012	January. The GB is directed by the Portfolio Committee to start a process of developing a new remuneration strategy for ICMA staff. This restructuring/remuneration process continues until October 2012. During this time, the staff are preoccupied with their jobs and salaries being reassessed, and operational focus takes a back seat. Mass staff disillusionment with the process, and a feeling that the Acting CEOs did not have the power to stand up to the GB. Staff generally feeling very disempowered.	January. Acid Mine Drainage (AMD) crisis in Carolina begins. From this point, I&P and Water Use start working more closely with each other and with stakeholders. Trusting, non-prosecutorial relationships start being built between the ICMA and the mines and municipalities.

		Throughout the year, the I&P division (through guidance in the form of the EWG) re-energise the sub-catchment forums, using SAM principles of engagement and agenda-setting. Gradually, more stakeholders/sectors begin participating regularly, action starts happening on issues that stakeholders have identified as important, and accountability grows. These spaces stop being talk shops.
		Jan/Feb. Water Use/River Operations divisions start trying to install water meters in the Komati. They are met with resistance from stakeholders and they ask I&P for help. The working relationship between the I&P and Water Use division has improved since this point, with regular communication and joint work between the two relating to both the water meters and the Upper Komati water quality issues.
	DWA finally agree, after about a year, to the ICMA procuring a new lab contract. Staff perceive that this came as a result of the Carolina AMD crisis.	
	February. DWA hires consultant to develop business plans for Water User Associations (WUAs), including those in Inkomati, without consulting ICMA.	February. Kevin Rogers, Brian Jackson and Johan Boshoff meet to decide that the WRC project would now focus on Water User Association establishment process.
	March. DWA do a DAD by presenting a draft business plan for the Usuthu without consulting either party.	
		April. Limpopo teams runs follow-up archetype reflection workshop with EWG.
		Mpumalanga Parks and Tourism Agency, Kruger National Park, and ICMA begin cooperating better with respect to bio-monitoring data. Now it all comes to the ICMA and the ICMA use it as part of CROCOC

		decision-making.
		June. EWG, on its own initiative, hold a reflection meeting to review and revise their action plan.
		July. EWG, Kevin Rogers and Rebecca Luton meet to decide how to approach the development of WUA business plans.
		7 August. First stakeholder meeting for Upper Komati WUA. Stakeholders asked to tell us what their problems are. D. Nxumalo and S. Machimana of the ICMA facilitate.
		22 August. Consultant does a DAD on Upper Komati WUA! (DAD = Decide, Announce, Defend). Presents draft business plan by projecting page by page on screen. Stakeholders very annoyed.
	September. I&P convene a meeting with DWA RO and the consultants to discuss funding of WUAs. This was the last time anyone at the ICMA heard back from DWA RO or the Consultant about the WUAs.	September. EWG fill in Rebecca's questionnaire about EWG processes, outcomes and experiences.
		The Upper Komati forum elects a stakeholder executive. The ICMA remains responsible for the secretariat, but the executive now runs the meetings and follows up with stakeholders about activities they have agreed to do.
		November 4-5. ICMA request and run an "Inkomati special session" at the International Freshwater Governance Conference. DWA staff, and others at the conference, are surprised and impressed with the ICMA's involvement in research and the use of new research in their practice.
		November. Learning/unlearning workshop with ICMA (operational and support staff)
2013		January. Kingfisher project begins.
	March. Knowledge sharing workshop with DWA	February. SAM refresher course with ICMA (operational and support

	Institutional Realignment staff, mostly from regional offices around the country, and ICMA and Breede-Overberg CMA.	staff). Staff recognise that the ICMA is a learning organisation working under a bureaucracy.
	March. On day two of this workshop, KR runs an APP to assist in planning for the establishment of a further seven CMAs.	March 7th. D. Nxumalo, a key leader in the I&P department and the EWG, dies.
		April. ICMA begins issuing legal notices and directives to municipalities for water quality transgressions. I&P ensures face to face follow up with municipalities to ensure that they do not feel "attacked" and understand that the ICMA is keen to assist them to work on their problems in an amicable and cooperative way.
		ICMA work with the already existing water management forum in the Usuthu and begin building working relationships with stakeholders and officials there.
		June(ish). New ICMA CEO appointed.
		September. ICMA and KR go to Holland for Kingfisher project. Johan extols the virtues of SAM during KR's presentation!
		November. RL leaves the country. The EWG stops meeting and being active (having lost two of its champions: RL and D. Nxumalo). Some of the key EWG objectives continue to be worked towards, but the EWG as an entity stops coming together.
2014	July. New ICMA GB appointed.	KR is banished by the (old) GB! The ICMA are forbidden to do any work with him until there has been a financial audit to check that the ICMA have not been paying him as a consultant.

	ICMA becomes the IUCMA.	The “Inkomati Flows” newsletter, produced by the ICMA, now reports on IWRM activities. It shows the clear direction and activities of the IUCMA.
		I&P continue to work with resource-poor Farmers Associations in all sub-catchments to make sure that representatives from these associations are empowered to take their issues to the broader IWRM sub-catchment forums.
		March. KR engages Water Quality division with APP (under the auspices of the THRIP project). Over the next 12 months, he runs three workshops and finalises an APP outcomes document in May 2015.
	Staff from the relatively new public participation division in DWA come to the Upper Komati forum to present on how to do public participation. By the time they get to their presentation, the DWA official starts by saying “I can see that the IUCMA already knows how to engage stakeholders!” This starts a new relationship between DWA and the IUCMA, where DWA asks the IUCMA for help, actively acknowledges the value of the knowledge, experience and skills that the IUCMA has, and engages the IUCMA with the view to learning from them.	The I&P division are increasingly asked to engage with new CMAs and proto-CMAs to share their knowledge and experience in stakeholder engagement and, particularly, the stakeholder-centred development of the Inkomati CMS.
		September. IUCMA partners with other organisations to host the 3rd REMCO International Transboundary Water Management Conference. The IUCMA did not have budget for this, but due to partnerships, the conference was able to go ahead and is heralded as a success.

		IUCMA presents on operational adaptive management, based primarily on the experience of the CROCOC, at the VNG Conference in the Netherlands. Wins second prize.
2015		February 11. Learning/unlearning workshop with MANCO (half day)
		February 11. Learning/unlearning workshop with non-MANCO staff (half day). Operational staff in both workshops indicate that the bureaucratic constraints they face to implementing IWRM and SAM are now primarily internal (as the number of support staff in the organisation has dramatically increased) rather than external, from DWA and the GB.
		In the Usuthu forum, one of the stakeholders thanks the IUCMA, saying: ever since the IUCMA have come here, we have seen a high level of professionalism; we can see where we are going, and it is clear that the IUCMA really knows what it is doing.
		June. RL does final interviews with IUCMA staff.
		Dutch partners VGN International are to work with Inkomati municipalities on WWTW operations.
		I&P is ready to launch an Inkomati catchment-wide forum. Leaders from sub-catchment forums are eager to come together at the catchment level to identify common issues and start implementing programmes to address these issues.

APPENDIX 5: OUTCOMES OF INKOMATI CATCHMENT MANAGEMENT AGENCY ADAPTIVE PLANNING FOR MANAGEMENT OF THE INKOMATI CATCHMENT, 2009

Vision

A vision is a concise statement describing an institution's core business and philosophy of management

Our vision is of a pioneering catchment management system that empowers stakeholders to engage in consensual and adaptive decision-making, to achieve reform, and to promote persistent social, economic and environmental justice across the Inkomati catchment.

Values/ Principles to guide operations and decision-making

Our values are the principles we use to evaluate the consequences of actions (or inaction), to propose and choose between alternative options and decisions. Values may be held by individuals, communities, organisations or even society at large. A group's values must reflect the values of the individuals in that group.

1. Our understanding and management of the Inkomati catchment reflect the social imperatives (e.g. transformation, equity, efficiency, empowerment, development) of an emerging African democracy.

2. We practice problem solving leadership that embraces:
   - ethics of Ubuntu (my humanity is defined by how others experience my behaviour), Simunye (we are one) and Batho Pele (people first)
   - consensus driven stakeholder participation

3. Decisions within our mandate are made and are justified on the basis of the best available social, technical, economic, environmental and governance knowledge.

4. We objectively balance, within our mandate, the redistribution of the costs and benefits of water resource use to ensure sustainable quality of human life, and social, environmental and economic justice.

Context for the management of the Inkomati Catchment

The range of legal, ecological, social and economic facts, conditions, causes and surroundings, that define the circumstances relevant to a problem provide the "context" for all decisions and are therefore important elements of any decision-making environment.

1. **The Inkomati economy is highly dependent on water, with forestry, irrigation-based agriculture and eco-tourism as the main economic drivers.**
   - Irrigation-based agriculture and forestry provide most (60% check) of jobs in the catchment.
   - Rainfall in the catchment is spatially and temporally variable, and does not always correlate with the water use requirements.
   - Eco-tourism is based on the catchment's high biodiversity, relatively free-flowing river systems, and generally high water quality.
   - Poor municipal waste (dumps, sewerage, storms water, etc.) management results in decreased water quality and fitness for use.
   - Uncoordinated, poorly resourced land use planning and management have potentially negative impacts on terrestrial and aquatic systems.
   - Geographically, the catchment is the artery linking South Africa's industrial and administrative centre (Gauteng) with our important SADC neighbours Swaziland and Mozambique.

2. **The National Water Act is a highly enabling piece of legislation, which provides potential to pro-actively address current WRM challenges in the catchment.**
   - Catchment water use is currently characterised by: inequitable distribution; water stress (quantity and quality over allocation before the reserve is implemented); inefficient use in many, but not all, areas; strategic water export, in the form of interbasin transfers for Eskom and international obligations; and virtual water export, in the form of exported products.
   - There is very poor enforcement and variable monitoring of water quality, quantity, and legal and illegal use.
   - Legislative implementation is lacking, particularly in terms of: the Reserve; the transformation of irrigation boards to WUAs; and co-operative governance. There is also a lack of strategic direction from DWAF.

3. **There is a wide diversity of water users, cultures, skills, knowledge and attitudes in the catchment.**
   - Gross disparities in technological and traditional knowledge and their transfer between age, gender and cultural groups exacerbates the variability in spatial distribution of water and land use efficiency and development.
   - There are vast disparities between social groups in terms of: employment opportunities and income; education levels and access to knowledge (particularly technological knowledge, for women and youth); understanding of water resources and IWRM; access to water and sanitation; access to productive land, and support and infrastructure that promote effective farming practices.
   - Despite many challenges and a degree of resistance to water reform, there are many localised examples of voluntary resource-sharing, relationship building and skills development in the catchment on which we can draw.
   - There is a perception that despite a general acceptance of the need for change amongst stakeholders, some of them exploit limitations in the law and its lack of implementation to frustrating the water reform process.

Vital Attributes

The few most important characteristics/properties within the catchment that relate to water management are its "vital attributes". They may be technical, ecological, legal, historic, social, political or economic.

1. The Kruger National Park and Cape Town, are *THE* mainstays of South African tourism. The KNP/Lowveld, and Trout/Panorama tourism draw-cards are *VITAL* to both the catchment and national economies.
2. The state of development in the catchment is still largely compatible with both tourism and agriculture.
3. The rivers are international rivers.
4. The Inkomati WMA is pioneering the field of participative IWRM and is thus an international point of interest and scientific attention.
5. There are currently governance structures, and a large, diverse and appropriate knowledge base, on which innovative and enthusiastic stakeholders can, and do, draw.
6. Despite the overall state of water stress, there is still potential for increased water yield and economic development in some areas of the catchment.
7. The catchment geology (especially that of the escarpment) acts as an important hydrological and water quality regulator, and primary driver of aquatic biodiversity (including a Ramsar wetland).

Determinants of vital attributes

A determinant is a factor or process that ensures the persistence of a vital attribute.
See Table below.

Threats to vital attributes and determinants

Threats are factors within, or outside, a partnership that undermine its values and inhibit the pursuit of the vision. Threats are also factors or processes that inhibit ecosystem determinants or vital attributes. See Table below.

Vital Attribute	***Determinants***	***Threats and Constraints***
#1 KNP/ Lowveld, and Trout/Panorama tourist draw-cards are vital to both the catchment and national economies.	They are highly dependent on water of an appropriate quality and flow regime.	i) KNP/Lowveld – excessive storage, over allocation and pollution occurs upstream ii) Panorama – over/poorly planned development (including of the tourism industry) and land-use leads to degradation/loss of wetlands/riparian fringe, to erosion and sedimentation. iii) Mining licences are granted and mining commences under current or other poor *land*/pollution management. iv) Forestry expansion is allowed to go ahead

Vital Attribute	***Determinants***	***Threats and Constraints***
		v) Climate change [current prediction = more rain but over a shorter period therefore more intense and longer dry period]
#2 The international character of major rivers.	Geographic location of the international boundaries and the nature of the agreements. Quantity and quality of water that must cross a boundary.	i) Continued over-allocation of water in the Inkomati, leading to potential legal challenges from Mozambique. ii) Continued over-use (legal and illegal) in Inkomati iii) Continued poor performance/administration of DWAF foreign office prevents timeous and appropriate negotiations with neighbours
#3 The Inkomati WMA is pioneering in the field of IWRM. It is an international point of interest.	ICMA is the "first born"! It has committed and enthusiastic staff.	i) The ICMA's "upbringing" continues to be held back by DWAF's top-down control, uncertainty in decision-making, lack of direction and inertia in delegating functions & responsibility to the ICMA. ii) Can't get the right staff, of the right quality at the right time because of the above, salaries and other admin obstacles in DWAF and ICMA. iii) Too many "grannies" continue trying to "help" *but instead* "smother" the ICMA (often via DWAF) diverting its focus and slowing down progress. iv) Continued pressure for the limited ICMA staff to "showcase" on many "stages" will prevent delivery. v) Continued lack of staff discipline, especially in respect of meetings, deadlines, etc. does and will erode professional image ***vi) Staff have poor STEEP knowledge of the catchment***
#4 There are currently governance structures, and a large, diverse and appropriate	i) Many important governance structures have maintained cohesion and a	i) Continued lack of, and poor co-ordination of transformation of institutions from the past regime. ii) Delay of transfers to ICMA is leading to serious loss of institutional memory and a huge

Vital Attribute	***Determinants***	***Threats and Constraints***
knowledge base, on which our innovative and enthusiastic stakeholders can and do draw.	level of functionality despite the transformation vacuum (limbo period). Transition period in NWA was six months! ii) <u>Knowledge base:</u> Strategic response by DWAF to the1st born. The ICMA acting as a draw card for researchers from all over the world.	rise in opportunity costs for skills retention. iii) The knowledge base (data and metadata) remains uncoordinated, meta data are becoming outdated, and knowledge transfer between stakeholders is insufficient. This is exacerbating stakeholder fatigue and compounding skills and knowledge disparities between cultural, gender and age groups.
#5 Despite the overall state of water stress, there is still potential for increased yield and economic development in some areas of the catchment.	Both dam sites and water available in these areas.	i) Resource development in the Inkomati is constrained by poor groundwater bearing capacity and *is thus* very surface water dependent. ii) The current poor knowledge of, and confused/naïve mind-set about, the purpose and delivery of the Ecological Reserve, and its effects on development. iii) Continued lack of innovation on how to operationalise ER in face of development needs. iv) Outdated economic and resource operating rules/planning/surveys remain and there is no innovation towards resource economics. v) Opposition by lobby groups (e.g. environmentalists) vi) Inefficient current resource use approaches, including operating rules, continue.
#6 The upper catchment, especially escarpment, geology is an important flow (dolomite cavities store water and	Geology, geomorphology (wetlands) & good natural ground cover, deep soils, in high fall rain areas.	i) Poor cooperative governance and enforcement leading to over-, and inappropriate development and land-use. Especially activities that change the persistence of ground cover and runoff patterns, both of which affect delivery, fitness for use and cost/benefits for downstream users. ii) Poor quality effluent discharged by users,

Vital Attribute	*Determinants*	*Threats and Constraints*
extend winter flows) and water quality regulator, thus also a driver of biodiversity.		particularly municipalities. iii) Limited understanding of groundwater linkages.

Management Objectives

Objectives are aimed at achieving the Vision within the current catchment "Context" and are aimed at overcoming threats, or constraints, to ensure the persistence of vital attributes and/or their determinants.

Recall that the Vision that stands ahead of the Objectives is:

A pioneering catchment management system that empowers stakeholders to engage in consensual and adaptive decision-making, to achieve reform, and to promote persistent social, economic and environmental justice across the Inkomati catchment.

Primary Objectives

1. Adaptively develop/implement participative systems for authorisation, compliance, monitoring and enforcement that aim to balance resource use and protection in ways that ensure reform and promote socio-economic development.

   a) Develop/implement empowerment programmes that promote strategic, adaptive and consensual decision-making across the stakeholder base.
   b) Develop/implement systems and strategies (e.g. the CMS and river operating systems) that facilitate improved and equitable access to the resource.
   c) Develop/implement cost effective monitoring programmes that serve strategic, adaptive and consensual decision-making.

2. Adaptively stimulate/develop/implement co-operative governance that promotes co-ordination of river operating systems, spatial planning and development to protect the resource and catchment.

   a) Grow multi-level, multi-sectoral (Private, NGO and Gov.) governance networks and engagement processes that keep ICMA agendas at the forefront, taking advantage of existing structures wherever they can achieve this purpose.
   b) Structure the ICMA's advisory function, within resource constraints, to ensure ICMA needs are served alongside those who are requesting advice.

c) Support the development, and where appropriate transformation, of other WRM institutions (WUA, CMC, etc.).
d) Develop and implement rules and procedures for operational river management.

3. Set and pursue the agenda for international negotiations that reflect local conditions/needs.

a) Improve cross-boundary stakeholder relationships and understanding of current agreements.
b) Strategically improve understanding of local catchment conditions and IWRM needs to inform decision-making about international obligations under changing circumstances. (i.e. do not wait for a crisis or demand from a neighbour).

4. Become an internationally recognised hub for participative IWRM by adaptively coordinating, generating and distributing data, knowledge, skills and management systems.

a) Design and implement a system of data and meta-data management, pertinent to participative IWRM in the Inkomati, that is accessible to all stakeholders.
b) Identify, collect and collate data/information for the system in 4a) and map the stakeholder network, including the distribution of STEEP competencies, activities, needs, decision-making mandates, etc.
c) Using outputs from a) and b), develop a strategic plan for knowledge acquisition that will guide future partnerships with stakeholders, and with other knowledge/skills providers.
d) Develop/implement strategic empowerment programmes that are explicit about the transfer and diffusion of knowledge/skills across the stakeholder network.

5. Adaptively develop/implement institutional structures and services **within the ICMA** to create an enabling environment that supports achievement of the above objectives as they evolve to meet changing circumstances.

a) Explore and internalise the characteristics and processes of an enabling environment for pioneering IWRM in an emerging African democracy.
b) Ensure appropriate capacity is built within the ICMA for participative IWRM.
c) Co-ordinate and align the adaptive systems that serve objectives 1-4.
d) Improve internal networking.
e) Improve internal service infrastructure, e.g. the computer network.

NEXT STEP IN ADAPTIVE PLANNING: Dissect these Objectives into subsets of achievable projects/tasks/targets, or integrate them into a selection of team projects with integrated outcomes.

APPENDIX 6: TERMS OF REFERENCE FOR THE EQUITY WORKING GROUP OF THE INKOMATI CATCHMENT MANAGEMENT AGENCY, 2011

Name

The Inkomati Equity Working Group

Preamble

The ICMA has come a long way since 2006, when it only had initial functions. It has now developed its first generation Catchment Management Strategy (CMS) which is yet to be approved by the Minister, and a key challenge will be the implementation of the strategy. The delegation of functions by the Minister has removed one of the major obstacles towards the full implementation of the CMS.

It is important for the ICMA to ensure that all stakeholders are fully empowered and capacitated to take part in water resource management and to derive maximum benefits from water resource use. This is more so for historically disadvantaged individuals and resource poor farmers.

Unless people's lives are changed and the status quo is changed there will be very little incentive for people/stakeholders to participate in ICMA projects and programmes.

The Inkomati Equity Working Group seeks adaptive participatory ways to address stakeholder needs in the Inkomati Water Management Area (IWMA), by implementing the strategic actions programmes of the CMS.

Without effective stakeholder participation and empowerment the goals of equity, efficiency and sustainability will not be achieved.

Objectives

The broad aim is to ensure that there is maximum stakeholder understanding of the CMS and effective participation in its implementation and review processes.

- Develop and implement project based empowerment programmes
- Promote transformation of IWRM decision-making processes and structures to redress current imbalances in empowerment, access and resource use.
- Claim our political and governance space as mandated leaders of catchment wide cooperative governance.

Guiding Principles

- Use current and future ICMA/DWA projects and programmes as vehicles for empowering the previously disadvantaged to achieve equity goals.
- Do not "parachute" in to stakeholders. Begin by understanding their obstacles, needs, aspirations, etc. and work from there.
- Co-learning.
- Empowerment principles.
- Consensus.

Group structure and membership

The Equity Working Group is a committee comprised of ICMA staff members (Van Rooi Khoza: CEO's office; Dumisani Nxumalo: Institutions & Participation; and Sylvia Machimana: Communication and Marketing) and WRC project team/Wits (Prof Kevin Rogers; and Rebecca Luton).

Meetings

The Equity Working Group will meet at least on a monthly basis.

Initial Deliverables

1. Assess the effectiveness of current platforms of participation. Transform structures, processes, and outcomes for improved performance.
2. Establish a resource-poor farmer (historically disadvantaged individuals) forum at a catchment level to promote informed and empowered participation. Use this forum as a template for developing forums to empower other sectors where needed.
3. Explore and implement external mechanisms (e.g. funding, mentoring) that allow resource-poor farmers to step beyond current bureaucratic constraints to beneficial water resource use.
4. Develop and distribute simplified communication tools and marketing materials (e.g. brochures, posters, media releases) that explain the mandate and functions of the ICMA, and CMS processes and expected/desirable outcomes.
5. Identify individuals and institutions to participate in cooperative governance ventures. Understand their needs, and the ICMA role in achieving cooperative outcomes.
6. Empower ICMA staff members in facilitation strategies and techniques that can be used to ensure that CMS projects/programmes are stakeholder centred.
7. Develop a manual of EWG processes, outcomes, and experiences, that may be used as an empowerment tool for ICMA staff members and stakeholders.

APPENDIX 7: UPPER KOMATI CATCHMENT FORUM CHARTER, 2013

Our Purpose

- To implement a protocol for action that balances water use by the range of water-use sectors with long term socio-economic sustainability, through stakeholder participation.
- To effect reciprocal empowerment amongst stakeholders through opportunities to share ideas, experiences and practices in Integrated Water Resources Management.
- Act as a platform of open discussion that serves to develop, improve, enforce legislation, policies, guidelines, plans, standards, norms, by-laws and regulations of relevance to IWRM.

Our Future

- A water resource that is managed to meet economic, social and environmental needs in the present and future.
- The ICMA is successful in facilitating dialogue between stakeholders that leads to effective action by both agencies and stakeholders in a spirit of mutual empowerment.

Principles to guide our decision-making in the Forum

- Openness, transparency and honesty from all stakeholders that avoids unfair treatment (persecution) of individuals and institutions. Consequently conversation in our forum is open and may not be used/held against each other in other the
- Cooperation from, and with, all stakeholders provides the co-ordination essential for achieving the desired future.
- The ICMA, as the legislated authority, plays multiple roles of facilitation, advising, empowerment and enforcement.
- Our task is complex with many uncertainties. Achieving our purpose is therefore an ongoing process of adaptive decision-making and action, supported by reciprocated empowerment.

Our Commitment

- Committed to attend all forum meetings. If one cannot attend send an apology and explanation as to why not to ICMA
- Openness and transparency are achieved when each stakeholder freely presents, in open forum, their vision, strategy, plans and progress for meeting the charter purpose.
- Commitment to open sharing of information verbally and in written form. We do not hide behind unjustified claims of confidentiality and always explain the process and time frame by which such information will be made available to the forum and public.