The Forum for Young Scholars (YSF) in Transboundary Water Governance in SADC

In association with the Southern African Young Water Professionals (SA YWP), WISA and IWA

Exploring Transdisciplinarity to address Change in the SADC Water Sector: Establishing the Role of Social Scientists in this Vision

SYMPOSIUM PROCEEDINGS

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29-30 November 2010

Council for Scientific and Industrial Research (CSIR), Pretoria

Water Institute of SA WISA | IWA International Water Association | YWP Young Water Professionals | Water Research Commission | CSIR our future through science

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WRC Research Consultancy K8/937/1

The Building of a Forum for Young Scholars in Transboundary Water Governance

KSA 1: Water Resource Management

Thrust 4: Water Resource Institutional Arrangements
Programme 4:Transboundary Water resources

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Date:

December 2010

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1. INTRODUCTION

The Southern African Development Community (SADC), as a region, faces a wide variety of water-related challenges and problems. Some of these problems have been around for decades and others are new or emerging issues. In order to address these 'old and new' challenges and complexities it is essential to achieve more integrated levels of ingenuity and expertise from a diverse set of disciplines and actors.

Historically, the SADC water sector has been dominated by skilled natural scientists and engineers. This has led to a high degree of technical and scientific innovation and expertise in the sector. However, this innovation has had less impact than it could have because the social-political, socio-cultural, socio-economic relevance and utility of these technical solutions have not always been adequately considered. In order to create meaningful, relevant and lasting solutions to the perennial and changing challenges that the water sector faces; it is critical to achieve a balance between technical, natural and social science inputs, and also to include a wide spectrum of actors in dealing with the problems (e.g. scientists, government actors, civil society and so on).

Presently, however, there are limited numbers of social scientists working on water issues, there are few transdisciplinary research initiatives being pursued and the challenge of creating the space for scientists, government officials and other stakeholders to work together around common areas of concern, remains a difficulty.

Given the described situation, it is evident that there is a need to draw more social scientists to the water sector, develop interest and expertise in transdisciplinary research, and create space for different types of actors with a stake and interest in water issues to learn to understand each other and work together on common areas of concern.

In response to this need the Young Scholars Forum (YSF) for Transboundary Water Governance in SADC has been formed. It is this forum that has hosted the symposium documented in these proceedings.

1.1 Introducing the Young Scholars Forum (YSF) for Transboundary Water Governance in SADC

YSF is a WRC-funded initiative that strives to raise awareness about, and build capacity in, transdisciplinarity in the SADC water sector. This forum is an issue-driven, collaborative exchange for young water professionals and students, and one which encourages the recognition and mutual respect of multiple perspectives. YSF hosts a variety of workshops and events which aim to facilitate transdisciplinary, collaborative work for students and young water professionals to grow their competence in dealing with complex water-related problems. This forum also specifically commits to incentivising the Social Sciences in the water sector both by creating awareness of the need for social science skills in the sector; and to make social scientists aware that there are fruitful career opportunities in the water sector.

YSF aims:

- To build a community and network of young water professionals interested in water governance in SADC;
- To create opportunities for younger and more experienced water professionals to interact and share knowledge;

- To increase the social science literature output relating to water issues by young water professionals, and to provide opportunities for individuals to collaboratively publish and grow professionally;
- To increase the awareness of the need for transdisciplinarity in the water sector; and
- To incentivise social science perspectives in the water sector.

This forum is unique in a number of ways. Firstly, it is focus-driven in that it looks, specifically, at the transboundary governance dimensions of water in SADC. Secondly, YSF encourages a proactive, theme-based agenda which allows young professionals to identify challenges in the SADC water sector in a focussed and directed manner. Thirdly, the forum encourages members to holistically engage with water issues in SADC through the integration of a variety of perspectives and actors. Fourthly, YSF has a series of linkages to the wider national and global water community and networks. For example, it has become a sub-division of the Young Water Professionals initiative in South Africa, and is affiliated with WISA, the WRC, and the International Water Association (IWA). This links YSF members to a wide, network of water professionals that can support them as they grow in their careers.

1.2 Symposium Theme

As previously mentioned, YSF has run a series of events around the country during the course of this year. The culminating event of the "2010 YSF Road Show" has been to host the first YSF annual symposium. The decision to host this symposium grew from a desire to explore the benefits of transdisciplinary collaborative exchanges in addressing change in the SADC Water Sector. This workshop offered a number of exciting opportunities to interested young professionals.

- It brought together a broad spectrum of young scientists, from different backgrounds, to workshop the theme of the event.
- It offered a theme-specific presentation opportunity to young professionals.
- It offered an opportunity for inter-generational learning as a 'community of elders' or more experienced professionals was present to engage young professionals on the topics at hand.
- Publishing opportunities for selected papers are being explored.

Inspired by the core aims of YSF and the issues described in the opening paragraphs, the symposium theme was ***"Exploring transdisciplinarity to address change in the SADC Water Sector: Establishing the role of social scientists in this vision".***

Abstracts were accepted that looked innovatively at transdisciplinarity as a means to addressing the region's emerging change and challenges, specifically targeting the following sub-themes: ***Climate Change; Acid Mine Drainage; Water and Health; and Water Governance****.*

Photograph 1: Symposium participants and guest speakers participate in the Guest Speaker Debate

1.3 Transdisciplinarity

As a way of trying to create conceptual clarity, and common ground to move forward with in the symposium; a broad explanation and definition of transdisciplinarity was offered to debate around, dispute, and guide conversation.

It was suggested that transdisciplinarity is more than a new discipline or supra-discipline, but is a different manner of seeing the world, which is in many ways more systemic and more holistic than before. Transdisciplinarity extends enquiry through different levels of reality and organisations. By working through the lens of multiple perceptions to understand different facets of reality; transdisciplinarity facilitates deeper understanding of complexity and complex problems. This understanding is only possible through the collaboration of multiple actors. Transdisciplinarity therefore transcends the notion of a new and innovative research methodology in the sense that it is more than a way of conducting research, but rather the 'position' or 'approach' a scientist takes in his or her strategic thinking regarding problem solving.

Max-Neef (2005) suggests that there are two ways of understanding transdisciplinarity. There is the so called 'weak' and 'strong' version of the concept.

Weak transdisciplinarity works as described in the diagram below. An action can be considered transdisciplinary when there is evidence of more than one block, on each of the levels, being present. Thus, 'weak' transdisciplinarity is a type of method for doing transdisciplinary work which calls on multiple different actors to answer various types of questions when grappling with a complex problem.

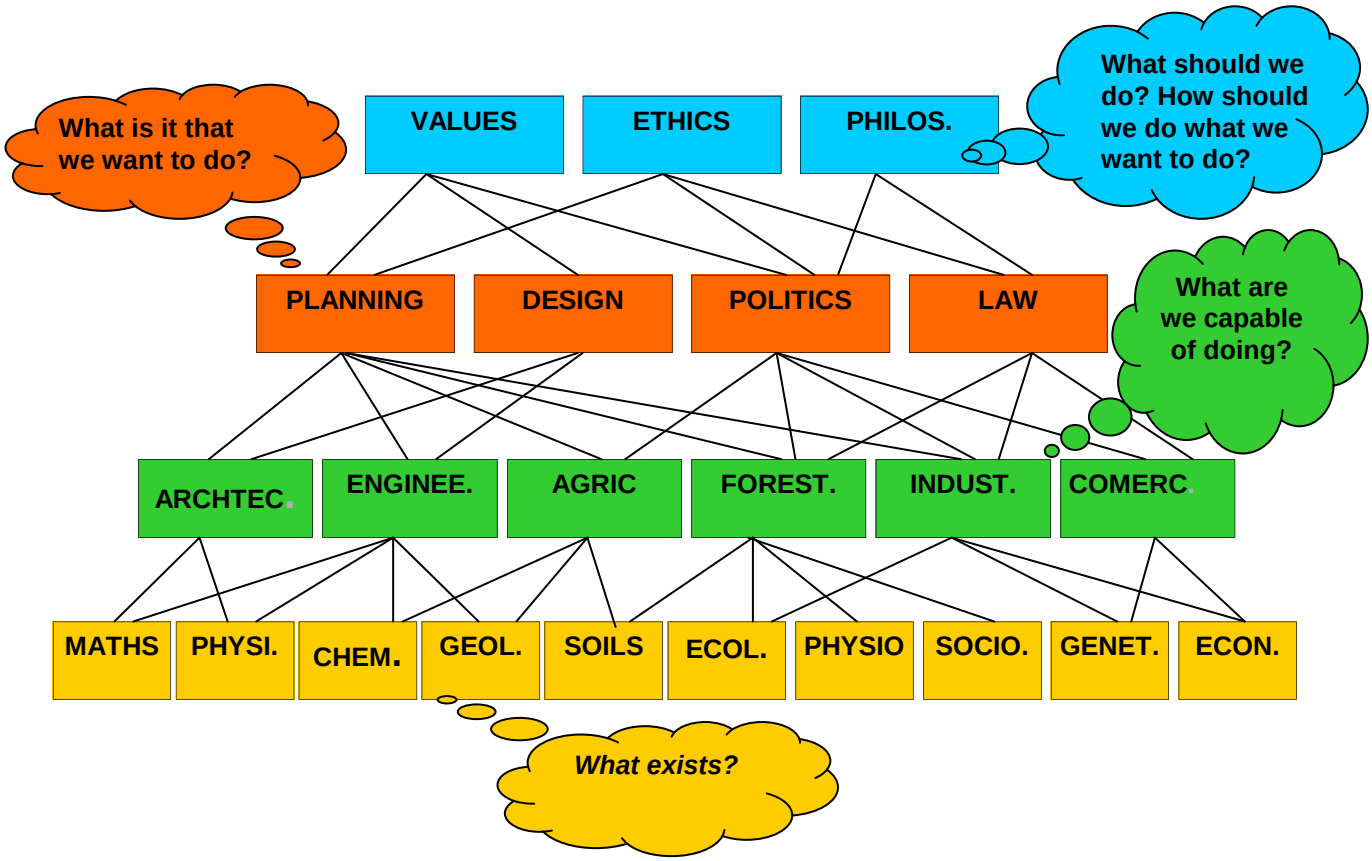


Figure 1: Max Neef Conceptualisation of Transdisciplinarity (Source: Max-Neef, 2005)

Strong transdisciplinarity, on the other hand, is more than just a method to more systematically solving complex and changing problems. It is a unique positionality and approach to science and dealing with problems. Transdisciplinarity, in this sense of the word calls on actors to grapple with the short-comings of binary, linear and rationalist logic that dominates the scientific field. It calls us to grapple with reality in such a way that we acknowledge that reality is "that which resists our experiences, representations, descriptions, images or mathematical formalisations" thus different levels of reality are accessible through different levels of perception. There is permeability between different levels of reality which allows for links to be formed between these different levels. The 'project' of transdisciplinarity, in this sense, is then about developing a thinking capable of establishing feedback loops in terms of concepts such as whole/part, order/disorder, observer/observed, system/ecosystem, in such a way that they remain simultaneously complementary and antagonistic.[1]

[1] Max-Neef, M.A. 2005. "Foundations of transdisciplinarity" *Ecological Economics* Vol. 53 (2005): 5-16.

2. SYMPOSIUM OBJECTIVES

Given that the focus of the forum this year was to attract interest in the forum, gain members and encourage young social scientists currently not in the water sector to consider this as an option, the theme was tailored to address these needs.

The objectives of the symposium were:

- To promote the value of pursuing transdisciplinary work and thinking in relation to water issues;
- To define each of the sub-theme problem areas from the perspective of the transdisciplinary lens;
- To consider the most pressing challenges and changes occurring in the water sector in relation to the outlined issue areas;
- To explore ways in which transdisciplinary thinking can facilitate the research being conducted and problems being solved;
- To discuss the challenges that arise when conducting transdisciplinary research in the water sector;
- To interrogate the value that social science theories, methodologies and perspectives can bring to the water sector;
- To highlight the issue of barriers to communication between technical, natural and social scientists in the water sector, and discuss ways to overcome this;

Benefits of the theme choice:

- The theme was broad enough to attract the interest and imagination of a broad spectrum of social scientists coming from very different backgrounds; from Water and Human Health, to Political Science, to Ecosystems Health, to Bioresources Engineering and Environmental Hydrology
- It had the research scope for both distinguished and young water professionals to grapple with the issues facing the water sector;
- It clearly established and affirmed the need for transdisciplinary work and social science input into the SADC water sector.

Given the theme and sub-themes, presentations and discussions also addressed topics such as transboundary water governance, sustainable knowledge transfer, dealing with emerging change, complexity and uncertainty in the SADC water sector; and identifying how we can facilitate adaptive management and increase absorptive capacity.

3. EXPECTATIONS OF SYMPOSIUM

The outcomes of the symposium were twofold: Firstly, it served as a forum where papers pertaining to the theme could be presented and constructively discussed and criticised between the young scholars themselves and also experienced professionals. Secondly, the results of the symposium would be made available as conference/workshop proceedings with a view to publish.

The listed objectives gave rise to a number of expectations for the symposium, namely:

- To develop a definition and understanding of transdisciplinarity relevant to the water sector and young professionals in this field;
- To situate the transdisciplinary debate within the transboundary water governance and regional integration debate.
- To grapple with the reality of change and increasing complexity in relation to the sub-theme issue areas; and in so doing, acknowledge the need for new and innovative perspectives on how to respond to these problems
- To establish the roles of young water professionals in contributing to the transdisciplinary project.

Photograph 2: Professor Willie Grabow sheds light on the need for social scientists in helping to address water and human health challenges in the water sector today.

4. ADDRESSING CHANGE THROUGH COMPLEXITY - AND COMPLEXITY WITH CHANGE

Global environmental change, such as rising demand and pollution, and the impacts of climate change, fuels uncertainty about the future of water resources and poses many challenges for effective water management. Water quantity is called to question due to increasing temperatures and diminishing precipitation. Water quality is declining largely because of mass pollution. Competition over water is increasing as demand rises for growing domestic, industrial and agricultural needs. And where governance structures are unable to manage increasing competition, divergent interests may trigger localised disputes with the potential for conflict.

Because of the complexity and inter-relatedness of these challenges, water professionals have to grapple with a multiplicity of causal factors, actors, levels of scale and issue areas to deal with any one challenge. As a way of helping the audience to conceptualise the complexity of the landscape in which water finds itself, a guest speaker debate was coordinated, where distinguished water professionals with extensive experience in their fields of expertise, were invited to participate.[2]

Four speakers participated in the debate, each representing one of the four symposium sessions: Governance, AMD, Water and Health and Climate Change. Speakers were asked to reflect on the following questions:

1. How do you define your topic (Governance, AMD, Health, Climate Change) from a transdisciplinary lens?
2. From this topic's perspective, what are the most pressing challenges and changes occurring in the water sector?
3. How does your research fit into a broader transdisciplinary framework for research?
4. How can transdisciplinary thinking facilitate the work you do, or have conducted?
5. What are the challenges to conducting transdisciplinary research in the water sector?
6. What is the specific role of social scientists in addressing these changes?

[2] Refer to Appendix A for speaker profiles.

Photograph 3: Guest Speaker Panel discuss opportunities and challenges of transdisciplinarity in the water sector

4.1 Presentation Summaries

Presenters and Themes:

1. Dr. Anthony Turton (TouchStone Resources): Governance
2. Mr. Phil Hobbs (NRE, CSIR): Acid Mine Drainage
3. Prof. Willie Grabow: Water and Health
4. Dr. Marius Claassen (Natural Resources and the Environment, CSIR): Climate Change

1. Water and Governance by Dr. Anthony Turton

Summary
"Transdisciplinarity is not an easy challenge. The nature of a transdisciplinary world is such that it is characterised by paradoxes within society…"

Cooperative water resource management is contingent upon adaptive capacity – from technical and financial capacities to legitimate water governance structures and efficient structures for conflict resolution. This presentation questioned how far we have come to achieving this. The presenter illustrated governance on a curve showing fragmented efforts in dealing with resource issues. South Africa's water governance model was characterised by different stages with no continuation: starting at the golden era of civil engineering (dam building era), the emphasis was on supply-driven infrastructure and economic growth. However, as more resources are exploited, absorptive capacity decreases and probability of catastrophic failure increases. This spurred on a new era that focused on improved water quality and the development of sound water policy. However, **the post-dam building world has moved into complex territory where outcomes are no longer predictable**, and where the paradigm of extraction and externalisation of costs are no longer useful.

The South African economy, like any other economy, is based on the notion of constant growth, and aquatic ecosystems are critical in this regard, for these supply some of the ecosystem services to realise and sustain such growth. South Africa is fast reaching a situation where such growth will no longer be possible – referred to as a state of 'peak water', which is similar to the notion of peak oil. This rests on the notion that the more

water we use the lower the resilience to adapt to increasing water scarcity, resulting in a diminished absorptive capacity. This ignites conflict and can be considered a further transition within the evolution of the hydrosocial contract in society.

Linkages to Transdisciplinary Theme

- **Transdisciplinarity is not an easy challenge**. The nature of a transdisciplinary world is such that it is characterised by paradoxes within society (e.g. AMD is a local phenomenon with national ramifications; climate change is global in nature but local in uncertainty).
- The **interface between the natural and social sciences are bi-directional and even multi-directional** when the different fields of study within each discipline are taken into consideration.

We need a cautious approach to new thinking as current science is influenced by what has been done before. However, there is also a need to think about ways in which we can capitalise on uncertainty. Social scientists are critically important in this regard.

2. Water and Acid Mine Drainage by Mr. Phil Hobbs[3]

Summary

"There is a big 'hoo-ha' around AMD, which must be tempered with scientific rationality?"

This presentation provided a scientific overview of acid mine drainage in South Africa by presenting the scientific formula for AMD and identifying the location of our mines in South Africa on a map.

South Africa is making progress in minimising the threat and the risk of poor quality water going into the caste aquifer, in terms of where AMD comes out, and when it comes out. However, while there is a good "scientific" understanding of the AMD challenge in South Africa, and this has been the case for a long time, effective tools are needed to deal with the issue.

Linkages to Transdisciplinary Theme

- The social sciences have a role to play in the frontier where the natural sciences cross over into addressing social issues or where natural phenomena have societal ramifications and consequences. This point was questioned by audience members who questioned scientific rationality, arguing that the benefit of social science is not merely to act as "**service providers" to natural sciences**, but rather **to question rational empiricism** and in this regard, find new ways of conceptualising projects. Indeed, rationality is embedded within only one view of the world.

[3] Refer to Appendix B for Hobbs PowerPoint presentation.

3. Water and Human Health by Prof. Willie Grabow[4]

Summary

"How do you change the thinking of people, how do you change their minds?"

A number of water-related human health challenges were highlighted, brought about by the changing world in which we live. These include changes in thinking, perceptions and beliefs related to education, training, culture, tradition and assumptions of different disciplines. In order to survive these water-related human health challenges in a rapidly changing world, there needs to be a concerted and cooperative effort by all disciplines. There is therefore an opportunity for integrated effort in dealing with these issues.

Linkages to Transdisciplinary Theme

- **Social science inputs are needed to change the minds of people** (e.g. how do we convince people that they should drink purified sewerage?) – however there was **debate around this point as to whether this is/should be the responsibility of the social science project i.e. changing mindsets.**
- Social science inputs are also needed to interrogate acceptable health risk definitions and standards. Currently, the acceptable risk of infection (US EPA, 1988) includes the following:
  - One infection per 10 000 consumers pa
  - 1000 infections per 10 000 000 consumers
  - Viruses to comply: < 1 / 1000 000 litres
  - SABS Specification: < 1 / 100 litres
- The tolerable disease burden according to the World Health Organisation (WHO, 2004) is 10^{-6} DALYs pa.
- Inputs from social science could include analyses of how we get to these figures and whether they are acceptable or not. It was however pointed out that while there is a need to develop new approaches to analyse water quality, new ontologies and epistemologies are needed to provide alternatives to rationalist science-based approaches.
- Social scientists are needed in informal water quality education and training. The cholera outbreak was used as an example to illustrate the need to change perceptions. When government officials promoted the idea of using Jik (i.e. chlorine) to kill pathogens, rumours began to spread that this would lead to infertility. The issue of the role and responsibility of social scientists was again debated as many **social scientists believed that it is not within their disciplinary jurisdiction to "fix" peoples' perceptions.** This assumes a normative bias towards a scientific project that undermines the reality of multiple perceptions. What was suggested was rather to focus attention on how perceptions are formed, developed, conveyed and shared, and most importantly,

[4] Refer to Appendix B for Grabow PowerPoint presentation.

how they affect behaviour.

4. Water and Climate Change by Dr. Marius Claassen

Summary

"Climate change mitigation requires global scale responses, which oftentimes results in a tension between national sovereignty and the need for collective action at the global level."

An overview of global warming and how climate change occurs was provided. Additionally, two aspects of climate change were highlighted, as was the relationship between them: the biophysical basis and the political context. There is evidence that the climate is changing globally, however there is some uncertainty about the degree of change at local levels, as well as variation between different parts of the world. However, climate change forecasting is particularly important for South and Southern Africa due to its geographical location (on or close to 30°S latitude). This is the divide between atmospheric circulatory cells. Despite the variability in models and forecasting, climate change is undisputable. The variability of climate is not new, but uncertainty surrounding it, is. The **challenge in dealing with climate change issues is largely as a result of the mismatch between political timelines (that are defined by electoral cycles) and biophysical prediction time lines**. Furthermore, the spatial scale is also an important factor to consider. Climate change mitigation requires global scale responses, which oftentimes results in a tension between national sovereignty and the need for collective action at the global level. There is therefore a great need to learn how to be more adaptive to change and uncertainty.

Linkages to Transdisciplinary Theme

- There is a need for adaptive management. According to the David Snowden framework, any particular context can be simple, complicated, complex or chaotic. We are used to living in a world that is either simple or complicated. However, in the future, the world and the environment in which we live, is more likely to be complex or chaotic. Adopting an adaptive management cycle allows us to recognise and acknowledge complexity and adapt accordingly and cope with spaces of flux and unpredictability. This requires in large part, a flexible, emergent approach to research.
- We **need a new kind of thinking that will enable us to address the 'wicked' environmental and water problems we are currently facing**.

4.2 Discussion

Transdisciplinarity: a clash of paradigms?

- While the natural science project is focused on changing behaviour and understanding, the social science project is more focused on taking people's points of view into account.
- Some natural scientists believe that they are not trained to deal with people. Interfacing is challenging and friction may arise.
- The foundation of natural science is based on reductionism, which is oftentimes a flawed logic. We need to grapple with the shortcomings of rationalism and a reality that is not quantifiable. There is a need to move towards integration rather than reductionism.
- In order to address both old and new challenges and complexities in the water sector, there is a great need for more integration and innovation. This entails

acknowledging different ways of seeing the world, different perceptions of reality, and different scientific epistemologies.
- There is a need for dialogue because there are many understandings around any one issue.
- Transdisciplinarity is about acknowledging positionality, and constantly being reflexive about ones position (e.g. as a political scientist, as a student, as a politician, as a Christian etc.).

Transdisciplinarity: comprising depth for breath in our science?

Another key discussion point was whether transdisciplinarity implied a comprise of depth for breadth in our science. When adopting a transdisciplinary approach, do you become a jack of all trades, and a master of none?

- Participants were concerned that their credibility within a particular discipline would be at stake if they engaged in too much "diluted" research.
- Distinguished professionals emphasised the importance of achieving depth in one's discipline before looking at breadth. At the individual level, individuals need to develop depth before they develop breadth. At the team level, there is a need for both specialists and generalists.
- We need to reconcile the imbalance between the social and natural sciences. This is coupled with the realisation that working together as natural and social scientists is a two-way effort. Social scientists can do more than play a supporting role to natural sciences. Similarly, social scientists need to overcome their 'inferiority complex' and create opportunities to apply their science. This will help to alleviate the normative bias that natural science is superior to social science in the water sector, and that social science is "soft and fluffy" science.

The Challenges of Conducting Transdisciplinary Work

- The financial struggle of doing transdisciplinary work presents a major challenge for academics. Confusion may arise as to who becomes lead author on publications, and which government department could provide funding for a transdisciplinary team. Moreover, the silo university management style makes transdisciplinary work very difficult.

Factors and Actors who activate change and can raise awareness around environmental issues

- The government is no longer the only actor that should be held accountable. Other actors also need to get involved.
- Collaborative learning was emphasised as a means to bridge the gap between science and the public.
- There is a need to acknowledge the multiple-actor landscape, the multiplicity of voices and that those who shout the loudest at the negotiation table do not necessarily have the best advice, even though they might be taken the most serious.
- The role of the media in communicating our science or reporting back to the public on our science was also discussed.

The role of social science and social scientists

- There is a need to incentivise social science i.e. to make social scientists aware of possible career opportunities in the water sector and make the water sector aware of the role that social scientists can play.
- Participants called for social scientists to get out of their ivory towers and start collaborating in multidisciplinary teams.

- The question was raised whether social scientists can/should change people's perceptions. For example, if there is scientific evidence that lives could be saved with a particular intervention (e.g. purifying water), is it the "moral obligation" of social scientists to make people aware of this and try to influence their behaviour? Do social scientists only study behaviour and distance themselves from influencing it completely? Should social scientists maybe give different options to people (in terms of water purification for example) and then let them decide for themselves?

The role and responsibilities of young water professionals in addressing change and complexity in the water sector

- There are more females and black people working within the water sector and within science than in the past. This is an encouraging trend, but more can be done to encourage people to take up careers in science and technology.
- The Young Water Professionals (YWP) network was lauded as a very fruitful endeavour because of its achievements to date: building a network of young professionals who want to learn and grow their own capacity in the water sector, providing career building opportunities and exposure, fostering friendships within the sector, maintaining a standard of rigour and credibility. As such, the Southern African YWP has become an example to other regions in the world.
- Young water professionals are strategically placed within the sector to take up the challenge of transdisciplinarity because they are less constrained by the norms of behaviour dictated by their disciplines and fields that steer thinking and research design.

5. WATER GOVERNANCE AND ITS CHALLENGES

This session focused on defining water governance and identifying its myriad challenges. While the first presentation explored new frontiers in transboundary water governance, the second presentation examined governance challenges at the national level. Both presentations highlighted the need to recognise multiplicity as well as the complexity of the water governance landscape. Additionally, a key synergy between presentations was the implications of multiple understandings of integration, and the multiple perspectives on the role and responsibility of social scientists. The need for dialogue was expressed as a way of reconciling the diversity of understandings on any given issue as well as the wide range of assumptions that researchers hold. Moreover, the commitment to achieving true integration/transdisciplinarity lies with individuals, and in part, requires us to overcome multiple fears that keep us in our disciplinary silos. The need to acknowledge the multiplicity of scale – spatial, temporal, sectoral, discipline, operational/management scales was also emphasised, as well as how they interact with one another.

Photograph 4: Dr Inga Jacobs (CSIR) and Mr. Albert Jeleni (Muondli Consulting and Projects CC) facilitate a group discussion on water governance challenges.

5.1 Presentation Summaries

Presentation title: *Exploring New Frontiers in Transboundary Water Governance in Africa: Recognising Multiplicity*[5]	**Presenter:** Dr. Inga Jacobs (Natural Resources and the Environment, CSIR)

Summary

This presentation argued for the need for transboundary water governance and the role of transdisciplinarity in exploring new research frontiers in the field. Firstly, the nature of the Southern African context necessitates regional cooperation and effective governance strategies.

- The Southern African Development Community (SADC) contains 21 international river basins to which one or more SADC member states are riparian, which results in hydrologic linkages across all of SADC's national borders on the mainland.
- Secondly, the most economically developed southern African states; South Africa and Botswana, are water scarce and are fast approaching the limits of their readily available water resources. Future economic development is therefore potentially constrained if current water use patterns remain unchanged.
- Thirdly, a spatial development pattern exists where several key cities or centres of economic development (such as Johannesburg, Pretoria, Harare, Bulawayo, Francistown, Gaborone and Windhoek) are not located on rivers, lakes or seafronts but instead, have been built on watershed divides. This results in the dependency of these cities on water that has to be pumped uphill, and subsequently, results in sewage return flows as these rivers are additionally burdened with transporting waste material, most of which enters downstream water storage reservoirs.
- Fourthly, there are pronounced developmental differences in SADC. Thus some countries are more able to mobilise the necessary human, financial and technological resources to address water scarcity and related human welfare needs than others.
- Fifthly, social challenges such as population growth, urbanisation, climate change, refugee movements, and diseases such as cholera, malaria, tuberculoses and Aids riddle the region.

All these issues will affect and be affected by the way in which water is managed. Moreover, all of these collective issues call for regional cooperation and effective transboundary water governance strategies. Governance issues form the central obstruction to sound and equitable water sharing and management. In the context of this presentation, governance includes the relationships between actors in society and the norms that guide their interaction. Governance occurs at different scales-

[5] Refer to Appendix B for Jacobs PowerPoint presentation.

household, communal, national and global levels, and is both formal (governmental) and informal (non-governmental). Defined along these lines, governance then is removed from the perception that the state and state organs are the most important actors in society in that governance occurs at different levels within society and among multiple actors (interaction). Norms and actors' reaction to them is a central facet of any governance system. Norms are contained not only in 'hard' law but also the 'softer' customary aspects of society like gentleman's agreements and unwritten codes of conduct.

Because of SADC's specific context and the variety of factors affecting our levels of vulnerability and adaptive capacity here in South Africa and Southern Africa, we are constantly exploring new approaches to transboundary water governance. New approaches in transboundary water governance must take into account: trans-disciplinary capacity, the multiplicity of actors, perceptions, interests and power disparities in the governance landscape, as well as the multiplicity of scale.

Additionally, international river basins are part of an increasingly complex landscape of policies, trading relations and sectoral demands. This institutional complexity presents challenges but also opportunities for the water sector to increasingly integrate with other sectors in terms of decision-making in agriculture, energy, industry and urban development in particular. In fact, water can aid regional integration efforts because of the need to address important resource questions in an integrated manner. The challenge, however, is to move from policy to action. Similarly, we need to develop analyses that can enable national decision-makers to allocate more funding to water resources and water supply development – and to see these as investments in growth and development. This also needs to be combined with wider decision-making within regional economic communities, particularly as these communities become part of bilateral or multilateral trade agreements with other trading blocs and given their inherent links to river basin organisations.

Linkages to Transdisciplinary Theme
This presentation argued that because governance is not the only the purview of the state, social scientists need to shift their focus of attention to large corporations and other such actors. Indeed, emerging challenges and complexities are demanding more integrated levels of ingenuity and expertise from a diverse set of backgrounds.

External actors within transboundary river basins are becoming more visible and influential. In order to understand their impact on other actors within the basin, transdisciplinarity is necessary. Not one researcher has the skill set to conduct research within the domain and therefore transdisciplinary research is required. Network building therefore may become a challenge in this regard.

The role of social scientists
Social scientists offer an alternative and unique perspective towards understanding units of analyses e.g. international river basins, which are traditionally at the core of the natural sciences. The natural science-dominated tendency has been to prioritise the hydrological basin as the primary unit of analysis but this notion is broadening in scope to include the unique socio-political and socio-economic communities they have formed: from the watershed-to the problemshed-to the virtual basin-to the social basin. The definition of international river basins is now changing to encompass "lived in" social spaces i.e. the sum of social practices and discourses that exist within the biophysical space.

The social scientist can also assist in transmitting research findings into the policy domain, mainly due to the implicit knowledge of the social scientist of the domain. A challenge here would be to add a level of sobriety in tempering high expectations from natural scientists that research is easily translated into policy.

Presentation title: *Towards Integrating Water resources and Water Services Management Tools: a Conceptual Framework*[6]	**Presenter:** Mr. Albert Jeleni (Muondli Consulting and Projects CC)

Summary

This presentation provided an overview of a WRC-funded project entitled, "*Integrating Water Services and Water Resources Management Tools*." The need for integrating water resources and water services management tools was expressed because water resources is predominantly concerned with the engineering of infrastructure such as dams to make sure water is available, whereas, water services is about meeting the needs of the people. The problem is that the management tools used in both these contexts are different and fragmented. Water resources management tools are engineering driven and water services management tools are socially driven. The main challenge is bringing the two together for better implementation of policies, law and strategies. The project aims to address this problem by developing a generic integrated conceptual framework which can incorporate water management tools that are required for use in water resources and water services management.

Linkages to Transdisciplinary Theme

- The challenges to integration were highlighted, which presents obstacles to effectively doing transdisciplinary research as well. Good integration methods, policies and strategies exist but we cannot implement them due to the lack of appropriate tools from both social and natural science points of view. We have specialists in different fields, but we lack mechanisms to bring that knowledge together. This fosters silo approaches to water management.
- Silo approaches in turn create the "battle of the best science" i.e. who is right between technocrats, sociocrats and politicians, as all these specialists have their own tools which they believe in.
- Integration entails bringing stakeholders together- across sectors and disciplines and across institutional roles.

[6] Refer to Appendix B for Jeleni paper abstract and PowerPoint presentation.

5.2 Discussion

Nature of Transdisciplinarity

- A key discussion point revolved around the need to clarify whether transdisciplinarity was a methodology, an approach, a positioning, or an epistemology.

Multiple understandings of integration

- Integration means so many different things to so many different people. The first challenge is coming up with a collective understanding. The second challenge is deciding when to integrate. Most participants agreed that integration needs to occur from the project design phase. Additionally, integration does not mean that social science becomes a service provider to natural science.

The role of social scientists

- The social scientist as "benevolent researcher" – this stems from the misperception that all social scientists conduct research to benefit people, and that they know what is best for those they research. This positionality of researchers, both social and natural scientists alike, plays a significant role in determining what is researched, what findings receive priority, and what conclusions and recommendations are made.
- In this regard, it is important to remain humble about our scientific method, to acknowledge the inter-subjectivity of our science and the existence of many "rights," and that our knowledge may be fallible. Acknowledging multiple disciplines also necessitates the recognition of multiple epistemologies, and multiple realities.
- This is linked to notions of impact and communicating our science. Different perspectives exist on the role of social scientists: to address the (social-related) gaps that natural science cannot address alone; social science as service provider; doing science for science sake; achieving impact and making our science real and relevant for communities.
- The inferiority complex of social scientists was reiterated, which affects the type and quality of science produced and how this science is communicated.
- The drive to achieve impact in the South African research community was contrasted with the role of social scientists elsewhere in the world i.e. France where social scientists possess neither the tools nor desire to change peoples' mindsets.

6. ACID MINE DRAINAGE

The session on AMD aimed to clarify a number of issues. Firstly, it aimed to clarify the nature of the AMD problem, and identify the most pressing challenges and changes in relation to this issue. Secondly, this session aimed to position AMD in relation to transdisciplinarity.

Critical issues that emerged in this session were considerations about how transdisciplinarity is a way of systematically grappling with the complexity surrounding the AMD issue. There was also clear acknowledgement of the importance of different disciplines and types of actors working together to solve this problem. It was suggested that it is only through diverse action from a broad actor spectrum that the 'red tape' which hampers progress on this issue can be challenged. Particular emphasis was placed on the importance of the media and NGO's in catalysing change and action around this issue, despite the fact that these actors are not necessarily 'accurate' experts when it comes to the technical complexity related to the AMD issue.

6.1 Presentation Summaries

Presentation title: *Environmental Activism in South Africa: The case of acid mine drainage on the West Rand in Johannesburg*[7]	**Presenter:** Ms. Shanna Nienaber and Ms. Nikki Funke (Natural Resources and the Environment, CSIR)

Summary
The overall objectives of this presentation were two-fold. Firstly, it tried to identify and describe the type of civil society action, and in particular non-governmental organisation (NGO) response, to the Acid Mine Drainage (AMD) problem on the West Rand of Johannesburg. Secondly, this presentation analysed the various strengths and weaknesses of NGO action, particularly behaviour on the work of the Federation for Sustainable Environment which is the leading NGO active in the issue-area of AMD.

These aims were explored in a few steps. Firstly the phenomenon of AMD, its related challenges, as well as the legislative context which guides the management of this problem was described. Secondly, the state of environmental activism in general, and AMD activism particularly, was described. Thirdly, the strengths and weaknesses of AMD activism, as led by the federation for Sustainable Environments, was considered. The presentation concluded with some recommendations about how to improve the quality of AMD activism in South Africa.

Linkages to Transdisciplinary Theme

[7] Refer to Appendix B for Nienaber-Funke paper abstract and PowerPoint presentation.

This presentation had explicit links to the three major focuses of the symposium namely, transdisciplinarity, change in the water sector and establishing the role of social scientists.

Firstly, the presenters indicated that AMD is a profoundly transdisciplinary issue given the need for many different disciplinary inputs to understand and deal with the problem, given the need for there to be many different types of actors involved in addressing this issue (e.g. social and natural scientists, NGO's, government, industry, political parties, the media), and given the fact that this problem requires us to grapple, simultaneously with both technical and ethical issues in order to meaningfully deal with the problem.

Secondly, the presenters indicated that AMD is a problem that is intrinsically tied to the phenomenon of change. The biophysical problem is getting worse with each passing day, the gold mining sector is changing as it nears its final productive years, the government officials called on to respond to this issue change with elections and party politics, and, more positively, there is an evolving civil society response and awareness about this issue.

Thirdly, the presenters indicated that there is a clear need for more social science work on this issue. Whilst the technical and biophysical dimensions of the problem are increasingly well understood there has been little attention paid to issues such as how to improve the quality of governance in relation to this issue, little research done in terms of understanding the complex relationships that play out between actors within this problem, what the effect of the institutionalised relationship between gold mines and the government has on this problem, and so on.

Presentation title: *Challenges of implementing mine water projects*[8]	**Presenter:** Dr. Jo Burgess (Water Research Commission)

Summary

This presentation explained the nature of the AMD phenomenon and why it is so difficult to respond to the problems that AMD causes. The presenter firstly explained that the AMD phenomenon is referred to in a variety of ways: acid rock drainage, acid mine drainage, metalliferous drainage, mining influenced water, saline drainage, neutral mine drainage. She then went on to describe what AMD is, how it forms and what technologies are available to deal with or treat this water.

Secondly, the complex and intricate nature of responding to the AMD problem was considered. For example, it was suggested that no generalisations can be made when it comes to AMD. In order to adequately predict whether AMD is likely to occur requires a

[8] Refer to Appendix B for Burgess PowerPoint presentation.

case by case analysis. Some mines will produce AMD, whilst others will not. This analysis can allow for one to predict whether AMD is likely to occur and in which case decisions need to be made about how to prevent and mitigate this problem. Treatment options that can facilitate prevention and mitigation require an ongoing process of monitoring. Given the number of mines in the country it is a huge and complex task to adequately analyse and monitor the AMD issue.

Thirdly, the presenter considered why, despite the predication capability we have to discern when and where this problem will arise, despite technology being available to treat this water and there being large-scale desire to deal with this problem, AMD continues to be a threat and worry. It was suggested that this issue is wrapped up in huge amounts of 'red tape' which limits capacity to proactively act on and deal with this problem. It is only through a long-term, proactive management plan that we can hope to deal with this problem. To do so the bureaucratic and political red tape around this issue will need to be addressed.

Linkages to Transdisciplinary Theme

This presentation linked to the theme of the symposium in many ways. In terms of transdisciplinarity, Dr Burgess pointed out that the AMD issue highlights how difficult it can be to work in a transdisciplinary manner. She suggested that it not only difficult for the different disciplinary experts who work on this issue to understand and communicate with each other; it is even more difficult for these various scientists to communicate with the other actors who have influential roles to play in addressing this problem (e.g. government decision makers, civil society, the media and so on).

It was also pointed out that for scientists and engineers the "soft issues are hard". To these actors the public is perceived as a 'many faced monster' that they do not know how to communicate with and talk to. Similarly they are able to grapple with the 'here and now'; quantifiable issues relating to the issue but do not necessarily adequately grapple with how to continue to deal with this problem in future. Herein lies a critical gap and need for social scientists to step in and offer their support and skills in addressing this challenge.

The major concluding recommendation of the presentation was to emphasise how critically important it is to talk to each other, work together and strive towards common goals when it comes to the AMD challenge.

Photograph 5: Miss Shanna Nienaber (CSIR) presents on environmental activism and acid mine drainage in South Africa

6.2 Discussion

A number of arguments were explored during the discussion session following on from these presentations.

Firstly, the issue of the complex spectrum of actors involved in this issue, and the variety of angles these actors take on responding to the problem, was discussed. It was pointed out that there are natural scientists and engineers involved in this issue who are trying to understand the biophysical problem and how to treat it. Gradually social scientists are starting to consider this issue and the various legislative, historical, power and governance issues that are related to this problem. There are also NGO's, journalists, political parties who try to highlight the social atrocities that this problem causes. All of these actors are involved with the issue but have very different aims and reasons for being involved.

The second issue that was discussed was the idea of credibility of knowledge and information in relation to AMD. It was acknowledged that it is important for a wide variety of actors to share information and spread awareness about the issue. Scientists need to address parliament, write project summaries and briefs and answer questions about the problem. The media needs to report about the issue to create awareness. Activists such as Mariette Liefferink need to explain the problem and generate awareness about AMD. However, given the highly complex nature of the science and issue in general, very few actors are accurately able to report the nature of the problem and the level of threat that it poses. Arguably, activists and the media have sensationalised this issue and caused concern around the problem to be blown out of proportion. Scientists, on the other hand, are not always as proactive about communicating their findings to the public.

Ultimately what we are left with is the reality that the AMD issue is shrouded with multiple, and at times mixed messages. Thus one must be aware that not all information around this issue is fully credible.

The third issue discussed was the idea that uncertainty around the exact nature of this problem and how to deal with it could be part of the reason for the red tape and lack of action on this issue. It was pointed out that scientists believe they are good scientists if they acknowledge uncertainty, and limitations of their research, whereas politicians do not operate like this. Politicians want certainties and want to be able to ensure the outcomes of their decisions. Uncertainty, thus, can become an excuse not to act on the part of politicians.

The fourth issue considered was the importance of balancing positive and negative reinforcement in relation to this issue. The media, opposition parties, activists and so on, are quick to sensationalise 'horror' stories about this issue and the behaviour of mines. However, in order to create a more balanced public understanding of the issues, it is necessary to 'market' success and failure stories in relation to AMD.

7. EMERGING CHALLENGES TO WATER AND HEALTH

The session on water and health aimed to synthesise both human health and ecosystems health challenges, and the necessity of, not only the benefit, of addressing these issues through a transdisciplinary conceptual lens. Specifically, this session explored the question: What are we doing to our environment and how is this impacting on drinking water? The multiplicity of perceptions and attitudes on water quality was emphasised in both presentations. Addressing water quality problems requires a nuanced approach because of the uncertainty factor i.e. there could be many causal factors contributing to deteriorating water quality, and quantifying how much of the problem is as a result of one particular factor, is a complex process. Transdisciplinarity was suggested as a useful methodology because of its ability to better grapple with complex problems, as compared to the rationalist scientific agenda.

Photograph 6: Dr. TG Barnard (University of Johannesburg) facilitates the water and health discussion, as presenters, Jackie Brown (University of Pretoria/CSIR) and Cherie Ann Robertson (University of Johannesburg) discuss the multiple impacts of reduced water quality in Loskop Dam and water quality concerns in water filtration devices.

7.1 Presentation Summaries

Presentation title: *The effects of reduced water quality in Loskop Dam on the health of Mozambique Tilapia*[9]	**Presenter:** Ms**.** Jackie Brown (University of Pretoria/CSIR)

Summary

The paper presented focused on the deterioration of water quality in Loskop Dam as evidenced by an increase in the frequency and abundance of fish mortalities, as well as the range of anthropogenic activities in the upper catchment contributing to this. These activities create complex impacts that range both temporally and spatially. These include acid mine drainage from coal mines in the Witbank and Middelberg area, agriculture, urbanisation and atmospheric deposition. The presenter investigated fish health in the Loskop Dam using Mozambique Tilapia (Oreochromis mossambicus) as a model species, and specifically, those affected by pansteatitis. While eutrophication proved to have the biggest impact to fish health, conditions in transitional zones were very variable, and evidence of mining and industry's impact as well as sewerage were also contributing factors.

Linkages to Transdisciplinary Theme

Despite the desperate need for transdisciplinary approaches to address complex problems such as ecosystems health, this presentation also alluded to the challenges of transdisciplinarity, that include: misunderstandings as a result of working in large multidisciplinary teams (i.e. too many cooks spoil the broth), compromising depth for breadth of research (i.e. jack of all trades, master of none), having to deal with large scientific egos and the clash thereof if multidisciplinary teams involve several high-profile researchers, doing successful transdisciplinary work depends to a large extent on the ability to network and communicate across disciplines (i.e. all about who you know) and finding the right people. Based on these challenges, the presenter suggested several ways to address them. Firstly, researchers need to align their goals with workable people, who understand and believe in the transdisciplinary project. Secondly, researchers need to carefully select which disciplines are needed and which will help them best address the research problem. Experts can be sought from elsewhere (other institutions, countries etc). Thirdly, the key to successful transdisciplinary work is to collaborate, negotiate and remain humble about your research and experience. Finally, this entails a concerted effort to patiently and persistently make contacts with potential collaborators.

[9] Refer to Appendix B for Brown paper abstract and PowerPoint presentation.

Presentation title: *Water Quality Concerns in Water Filtration Devices*[10]	**Presenter:** Ms. Cherie Ann Robertson (University of Johannesburg)

Summary

Presenting her PhD research to date, Cherie Robertson provided an overview of water quality concerns pertaining to water filtration devices in South Africa. Recent outbreaks of cholera and other waterborne diseases in SA have resulted in a public perception that tap water is not safe for drinking purposes. In this regard, the major challenge is the control of microbial contamination risks from water treatment plants to the consumer's taps. The required intervention for this would be to control and maintain the microbial quality of water at point of use (POU) household level. Therefore, POU water purifying filtration systems are popular with consumers as a countermeasure to remove waterborne pathogens and undesirable chemicals from water. The problem however, is that consumers buy devices in good faith on the basis of claims of efficiency made during marketing campaigns, "the unit will remove 90-100% of all harmful microorganisms". But claims often made by manufactures are not substantiated by independent research (products are usually tested in-house and mostly only for their capacity to remove traditional indicator bacteria). In South Africa, it seems there are limited policies in place when endorsing these devices for public sale approval, which could have a huge impact on water health. Therefore, a need exists for a transdisciplinary study to evaluate POU devices currently manufactured and sold in SA, in concern with regulation and commercialisation of these devices against the claims that are made by these manufacturers.

The approach advocated in this presentation rests on three methodological pillars. The first pillar, transdisciplinarity, implies an inclusive vision of ecosystem-water related health and certification problems associated with POU devices (this requires the full participation of each of the four groups mentioned previously). The second pillar, participation, aims to achieve consensus and cooperation, not only within the community using POU devices, but also among the manufactures making these devices, scientists investigating these devices and decision-making groups which certify and regulate these devices. And the third pillar, equity, will involve analysing the respective roles of these various social groups. Through the use of POU devices, water and human health cannot be considered in isolation. It depends on the quality of the water environment in which people live. In order for people and water to be healthy, they need healthy environments. However, the ecosystem also affects human health, and the Ecohealth approach recognises that there are links between humans and their biophysical, social, and economic environments that are reflected in an individual's health. In this context, it is impossible to improve the human use of POU devices within their ecosystems without including the human population, with its inherent social, cultural, and political concerns, in the management of resources. Thus, a sectoral approach is no longer adequate. Rather, co-management of human activity and the environment is essential. This

[10] Refer to Appendix B for Robertson PowerPoint presentation.

challenge requires that disciplines draw together to study the human–environment relationship, so health can be improved upon, through the correct use, certification and regulation of POU devices.

Linkages to Transdisciplinary Theme
In linking her presentation with the transdisciplinary theme, the presenter identified the need for participation from scientists and communities in addressing water filtration device challenges. The transdisciplinary framework advocated in this presentation will allow for various aspects of POU device problems to be assessed by closely involving the local population as well as decision-makers. When these POU device problems are articulated in questions that can be addressed in a scientific process, communities are able to express what they expect from scientists and decision-makers. This, in turn, leads to "socially robust" solutions. This study therefore requires the participation not only of scientists but also of community representatives and other actors who, in addition to possessing particular knowledge of the problem at hand, have a role and a stake in its solution. This transdisciplinary approach gives them the right to be heard by decision makers and thereby share their experiences, knowledge, and expectations. This also enables researchers from different disciplines and key actors to develop a common vision when considering POU devices, while preserving the richness and strength of their respective areas of knowledge. By adopting this approach the research team will avoid carrying out parallel studies whose results are pooled only at the end. The integration of knowledge and the adoption of a common language will take place while the problem of POU water filtration devices is being defined. This is the core of a transdisciplinary approach.

The presenter, does however, also point out the challenges to conducting transdisciplinary research. Even though, in theory, transdisciplinarity enjoys a high standing in the scientific community, it still remains a challenge for this Ecohealth study. Going beyond one's own discipline requires a great capability for synthesis as well as sensitivity to the strengths and limitations of others. Succeeding in a transdisciplinary initiative requires defining a research protocol, finding ways of integrating the community in problem definition, and ascribing appropriate importance to the various ecosystem components. Equally challenging is assembling a team and organising the work of members from extremely different disciplines. Moreover, supervising a transdisciplinary project is all the more difficult when the original concept stems from a particular discipline and the researchers are not aware of the transdisciplinary nature of the problem. It is therefore only to be expected that the development of a transdisciplinary project is time-consuming.

7.2 Discussion

Education between science and community as a two-way process

- The issue of education was raised in relation to the role of social scientists as “benevolent” researchers, as objective/subjective scientists, vs. learning from communities. It was decided that any research project seeking to improve public awareness on environmental issues needs to take into consideration local knowledge that affects public perceptions. Science needs to learn from communities just as communities can learn from science. In order to achieve this, researchers need to understand the norms, values and standards of appropriate behaviour in any given area and/or community. Policy interventions will therefore be very different if embedded within local contexts than if they are produced in vacuums.

- Another key discussion point was whether education aimed to influence people's minds or influence behaviour. Thousands of studies show that education does not necessarily change behaviour.
- The importance of public participation was reiterated. Also emphasised in this discussion was the fact that government can no longer be solely responsible for facilitating public participation. The onus is now up to individuals (researchers, scientific community etc.) to incorporate this into their research designs. Additionally, the discussion on public participation also raised a caveat that participation does not/and should not mean that people become the object of the study. This discussion centred around finding new and alternative ways to get people involved in research processes, once again, emphasising the importance of interaction between communities and science.

How do we foster adaptive management to deal with complexity?

- One suggestion for an effective adaptive management approach described the "hour-glass approach" i.e. when you have a multitude of problems, go for the "quick wins." In other words, in dealing with complex problems with multiple causes and impacts, a prioritisation process of elimination can help reduce complexity by firstly, identifying and eliminating the least likely factors, or those with minimal impact.
- Another view highlighted the benefits of a transdisciplinary project in dealing with complex problems. Transdisciplinarity was suggested as a useful methodology, for its ability to better grapple with complex problems, as compared to the rationalist scientific agenda.

8. CLIMATE CHANGE

The session on climate change aimed to clarify a number of issues. Firstly, it aimed to clarify the nature of the climate change problem, and identify the most pressing challenges and changes in relation to this issue. Secondly, this session aimed to position climate change in relation to transdisciplinarity.

A critical issue that emerged in this session was the recognition that the climate change issue is highly complex and multifaceted. This breeds uncertainty about how we deal with this problem. A transdisciplinary approach can help us to meaningfully deal with this uncertainty by positioning researchers in a mindset that encourages the questioning of facts, events, and debates; and encourages scientists to become proactive agents of change who own and drive the results of their research to ensure positive outcomes in society.

8.1 Presentation Summaries

Presentation title: *On Climate Change, El Niño and La Niña, a Looming Water Crisis and Baloney*[11]	**Presenter:** Dr Richard Meissner, CSIR

Summary
In broad terms, this presentation grappled with two issues. Firstly, it explored notions of climate change, el Niño and la Niña. In this regard, the presentation offered a brief overview of the current state of knowledge and science in relation to these issues. Critical to this description was the observation that whilst there is a large amount of knowledge and data available to help us to better understand these phenomena, there is also a huge amount of uncertainty in relation to these issues. The presenter also pointed out the importance of analysing unlikely concepts in the same picture, a method he referred to as 'mash-up'. He argued that by looking at unlikely concepts in relation to each other (e.g. climate change, el Niño and a water crisis) new creativity can be generated and inspired to support innovative scientific findings.

Linkages to Transdisciplinary Theme
The presentation explored the utility of a complexity and transdisciplinary approach for facilitating meaningful understanding of the issue areas. It was suggested that the inherent uncertainty tied to climate change and other potentially related environmental phenomenon, makes these issues inherently complex. Thus it is only a complex type of thinking that can respond to the challenges these issues pose. It was also suggested that by adopting a complex and transdisciplinary approach to understanding complex problems, it is possible to devise more relevant solutions, and more appropriate policy options to respond to these issues which are profoundly multi-varied and multi-layered. Also, the transdisciplinary positionality reminds researchers of their role as agents of change and the importance of asking critical questions of all knowledge and assumptions.

[11] Refer to Appendix B for Meissner PowerPoint presentation.

Presentation title: *An integrated scenario based approach in dealing with climate change uncertainties in Wami/Ruvu catchment, Tanzania*[12]	**Presenter:** Mercy Mwanikah (University of KwaZulu Natal, Dept of Bioresources Engineering & Environmental Hydrology) G. Jewitt and H. Mahoo

Summary

This presentation was an example of multidisciplinary work in relation to climate change issues that form part of the presenter's PhD research. This research has grown out of the recognition of two major points. Firstly, climate change, and related problems are having major impacts on water, land and natural resources; which ultimately affects livelihoods of people. Secondly, there is a gap in knowledge on how to bridge sectoral gaps between local knowledge and experience of climate changes and current technology and science.

In order to try to address this concern the presenter used a scenario-based design to determine appropriate use and management of water and land resources while enhancing agricultural productivity in the Wami Ruvu catchment within the context of climate change. The specific objectives of the study were:

- To identify changing trends in the water, land and agriculture sectors and their link to climate change;
- To assess major driving forces/ factors in relation to these trends;
- To encourage participatory planning in use and management of resources through integrated scenario processes.

The major findings of the research up until this point indicate that:

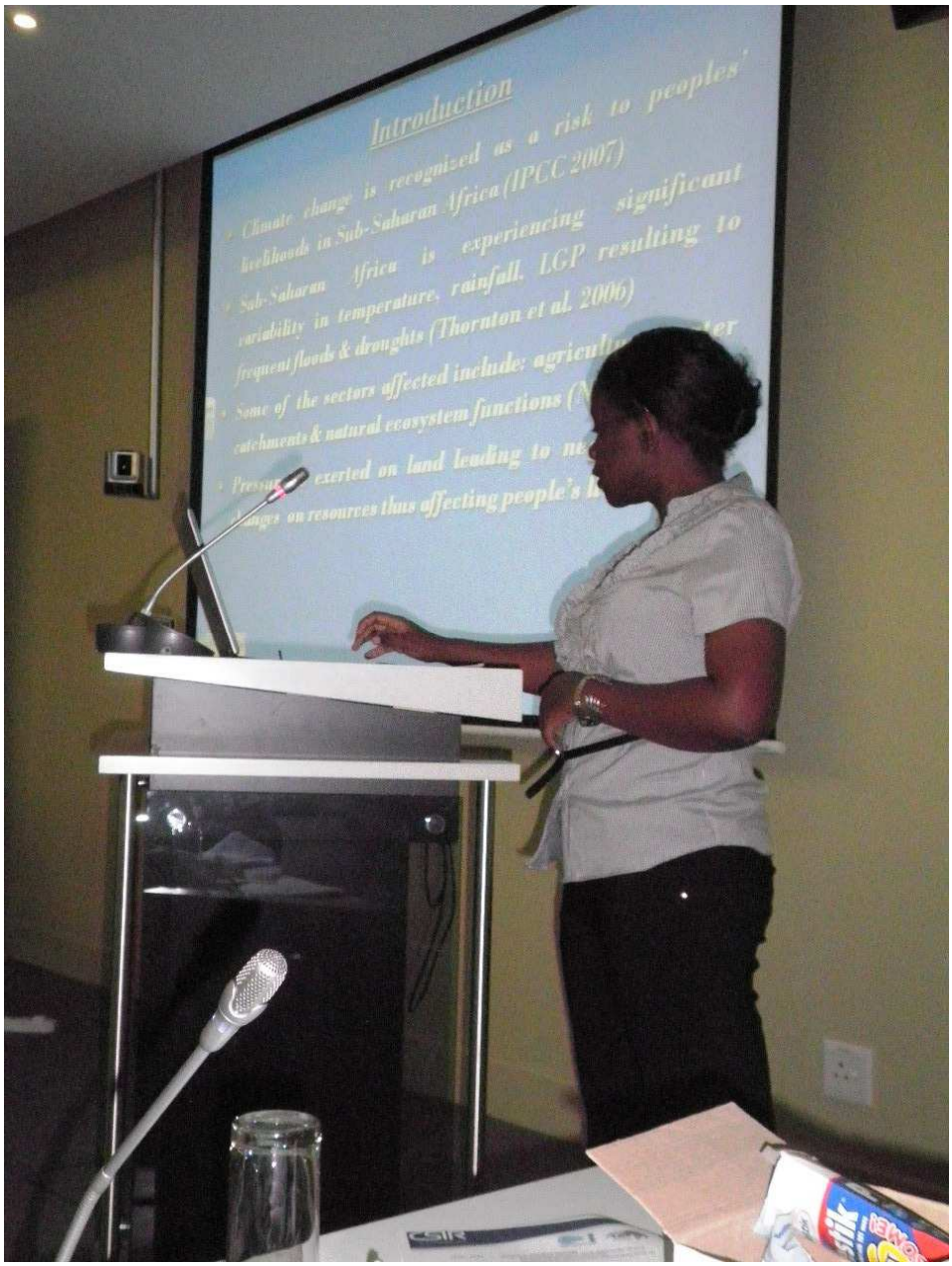
- There are major relationships between changing land uses, water resources, climate change and agricultural productivity;
- Scenarios, as a tool, are practical in the identification of major factors influencing changes in the agro-landscape;
- The scenarios approach used was helpful in the integration of stakeholder ideas at all stages of the scenario development process;
- The results of the scenario process provided useful windows for positive change in the catchment.

Linkages to Transdisciplinary Theme

This presentation offered an interesting perspective on how, 'in real terms', to include multiple stakeholders in the process of research around complex problems. One of the challenges related to the project of transdisciplinarity is that it advocates 'vast ambitions' like the inclusion of multiple stakeholders and actors in research, but provides very little insight into how to practically go about achieving this. This research, with its detailed explanation of how to go about running an inclusive scenario building process, provides a creative example of how stakeholder interaction can meaningfully happen when

[12] Refer to Appendix B for Mwanikah paper abstract and PowerPoint presentation.

studying complex problems. It is these practical success stories that need to be distilled in order for us to practically interpret how to go about the project of transdisciplinarity.



Photograph 7: Mercy Mwanikah (University of KwaZulu Natal) presents on the advantages of integrated and participatory scenario processes in dealing with climate change uncertainties.

9. DOING TRANSDISCIPLINARY WORK IN MULTIDISCIPLINARY TEAMS

Working in multidisciplinary teams, and conducting transdisciplinary research is a challenging task. An interactive group session was coordinated to identify these challenges and explore solutions.

Presentation title: *Interactive Session: How do we do multidisciplinary work?*	**Presenter:** Ms. Karen Nortje (CSIR)

Summary

The facilitator provided an overview of hoe to conduct transdisciplinary work in multidisciplinary teams. Multidisciplinarity occurs between people, whereas transdisciplinary research is an individual commitment or approach. Ones world view was identified as a key factor in shaping the way researchers conduct research. Worldviews have an impact on how we perceive ourselves, others and how we interact with one another. Learning was also identified as an essential component of successful multidisciplinary and transdisciplinary work. The antithesis of transdisciplinarity, i.e. exclusion and silos, are counter-productive to the research mission. These counterproductive approaches lead to the establishment of disciplinary tribes. The egos of scientists as well as the comfort zones in which they operate from are factors that inhibit productivity. This leads to 'labelling' and can be attributed to fear to transgress comfort zones. The facilitator emphasised that multidisciplinary research is not easy, but adds to the greater success of research projects.

A group activity ensued that prioritised four challenges:

1. Creating a group dynamic
2. Crossing disciplinary divides
3. Intrusion of the worldview
4. Learning - how can we better facilitate learning in these groups?

Creating a group dynamic

- Creating a strong group dynamic requires a strong leader to coordinate this.
- This person should ideally be a neutral person who is not directly involved in the project themselves.
- Objectives should also be made clear to group members at the outset.
- All group members need to be committed to the transdisciplinary process.
- Group members' strengths should be identified so as to maximise this within the group.
- The group leader needs to acknowledge that some people may "steal the limelight," and mechanisms should be put in place to curb this and facilitate equal involvement.

Crossing disciplinary divides

- The ability of individuals to cross disciplinary divides necessitates a positive attitude towards change as well as the courage to understand others.
- Once again, the importance of a skilled facilitator was identified, to give direction to discussions.
- Space needs to be created for people to be safe in their insecurity. Working outside of one's discipline, in unfamiliar territory may be frightening for some. Groups also need to ensure that many levels of expertise are represented to

dilute power plays.

Intrusion of the worldview

- The intrusion of multiple worldviews or ontologies may impede successful multidisciplinary work as team members may see this as an attempt by some team members to steer the research in a particular direction.
- Group members need to be explicit about their world view, if they are able to articulate this. If not, effort should be made to identify this indirectly. This can be identified by exploring what the goals are of a particular discipline.
- An individual's world view is linked to their integrity as a researcher, and this will have a significant impact on the way they conduct research.
- An individual's world view is partly dependent on the problem they are trying to solve.
- In order to avoid the intrusion of one particular world view, groups need to include many people from the start in the development of the project design.

Learning - how can we better facilitate learning in these groups?

- Before starting, a team building (and trust-building) exercise is necessary where people get to know each other on a non-project level.
- Rules need to be established and agreed upon at the outset.
- A useful tool to facilitate learning could be to encourage team members to try and imagine how another team member will approach a particular problem. This could help to facilitate new and different thinking beyond ones discipline.
- Get a collective understanding of the problem from different points of view.
- Encourage participation.
- Capacity building – train people to do better team work, level the playing field.
- Within multidisciplinary teams, learning comes after barriers have been diluted.
- Learning happens through translation and interpretation of others' thoughts.
- Change is the mainstay of multidisciplinarity/transdisciplinarity. The dynamism of change is informative - some will embrace and accept it while others will perpetually resist it.

Photograph 8: Karen Nortje (CSIR) explains the practical challenges of working in multidisciplinary teams

10. ESTABLISHING THE ROLE OF SOCIAL SCIENTISTS

The symposium concluded with a facilitated, group-work exercise which assisted the participants in pulling together ideas related to the overall theme of the symposium which was*" Exploring transdisciplinarity to address change in the SADC Water Sector: Establishing the role of social scientists in this vision".*

This reflection session was conducted by dividing the participants into three groups, each with their own cluster of questions to reflect on. The questions and their findings are summarised.

Group 1

Advancing our thinking on the changing the landscape

Biophysical environmental issues are intersecting with social changes to create complex problems in the water sector.

What are the factors, and who are the actors (within government and non-government circles) who activate change and can raise awareness around environmental issues?

There were a number of key points that emerged from this group's reflections. Firstly, it was made clear that establishing how factors and actors catalyse change is a highly

complex task. It is, however, this complexity of factors and actors that is the necessary ingredient for success. This complexity thus needs to be worked with rather than over-simplified.

Secondly, it was pointed out that given the multiplicity of actors that play a role in water issues, these voices, to varying degrees, are competing to be heard. It is important to be aware that the voice that 'shouts the loudest' is not necessarily the best informed voice. Power, interests and agendas play a big role in who is heard and who is not. This means that all actors need to be aware of the risk of being misguided in terms of the information they receive and decisions that are made.

Thirdly, the point was made that one of the major factors catalysing change in relation to water issues is the extent to which an issue can be personalised to different actors at different levels of scale. Generally speaking, various individuals, groups and actors need to 'feel' how they are individually affected by an issue before they will mobilise effectively.

Fourthly, the reality of changing consumer behaviour was noted. Social marketing and social networking are important. Scientists need to partner up with a variety of actors 'beyond their own kind'.

Photograph 8: Participants discuss how to solve multidisciplinary challenges in groups

Group 2

Advancing our thinking on transdisciplinarity

Given the discussions over the past two days, how have we advanced thinking about the issues of transdisciplinarity in relation to the South African Water sector?

Definition? Implications? Method? Challenges? Opportunities?

Firstly and in terms of a 'definition' of transdisciplinarity, it was re-affirmed that transdisciplinarity demands that a range of actors (civil society, academics from a range of disciplines, implementers, everyday citizens, etc.) are included in dealing with complex problems. Also transdisciplinarity is about embracing the complexity of problems rather than trying to over-simplify and obsessively 'bind and compartmentalise' issues.

Secondly, it was suggested that transdisciplinarity has a number of implications. It potentially leads to better policy choices, recommendations and implementation because it is an inclusive, communicative way of operating within complex problem areas. Also, it forces one to acknowledge a range of actors and their power relationships. Government, for example, is not necessarily the most important actor in society to interact with.

Thirdly, it was suggested that good leadership is a critical ingredient in instilling a transdisciplinary approach in different disciplines. Leaders can either effectively facilitate or profoundly undermine the transdisciplinarity project.

Fourthly, it was suggested that a certain element of pragmatism is necessary when approaching transdisciplinarity. Because the transdisciplinarity model calls for the inclusion of multiple stakeholders, this could result in a struggle to gain consensus. Thus, it is necessary to realise that not every stakeholder needs to be involved every single time or all the time. Whilst it is important to co-develop solutions, it is necessary to constructively include actors at appropriate points in a process.

Group 3

Establishing our role and how we communicate our role

What roles and responsibilities do I have, as a Young Water Professional, in taking up the transdisciplinary challenge?

Part of the challenge of achieving transdisciplinary science, projects and activity is that communication is very difficult. How can this barrier to communicating our role be overcome?

A number of YWP roles and responsibilities were discerned. Firstly, it was suggested that transdisciplinarity is not a 'mainstream' way of doing, operating and thinking; thus YWPs have a role in terms of informing themselves and others about this issue.

Secondly, it was suggested that YWPs need to commit to facilitating and engaging in dialogue between different groups. This is done by involving oneself with other disciplines and actors, making and maintaining new contacts, asking many questions to facilitate understanding, and consciously including multiple disciplines in your networks, databases and communications.

Thirdly, it was pointed out that it is necessary to have a humble approach to the

transdisciplinarity project and the complex problems it confronts. We need to immerse ourselves in the literature of this topic, and not assume that everyone is on the same page about transdisciplinarity. Conversation and debate is essential to create common ground to move forward from.

11. CONCLUDING REMARKS

During a two-day period the various symposium presenters and participants grappled with three broad themes or questions, through the specific issue areas of water and health, water governance, AMD and climate change. The three over-riding questions considered were:

1. How does transdisciplinarity relate to and support response to complex water related challenges in SADC?
2. How do we respond to water related challenges in times of change (both in a biophysical and a societal sense) and increased complexity?
3. What are the roles of young water professionals, and particularly of social scientists, in the SADC water sector?

Whilst the ideas and conclusions in relation to these questions have been multiple and vast, the main conclusion is distilled as follows.

1. Transdisciplinarity is a critical positionality and approach to systematically solving complex problems and thus needs to be engaged with and worked at if we hope to achieve meaningful and impactful ways of dealing with the problems facing the water sector. However, it needs to be noted that the transdisciplinary project is not an easy one to pursue. It requires time, patience, willingness to step out of one's comfort zone, the will to resist over-simplifying issues and much more.
2. We need to acknowledge that we live in dynamic times where change is an inherent part of our context. This demands that we are flexible, innovative and 'out of the box' in our response to problems. It also demands that we resist the urge to oversimplify issues. We must pursue complex thinking in relation to complex problems.
3. Each and every young water professional can and should play a role in contributing to responding to the problems of the SADC water sector. There is a lack of social scientists in the sector presently and thus social science careers in the water sector need to be incentivised. All scientific disciplines need to make a concerted effort to learn to communicate with and build networks within and beyond the scientific community.

Appendix A	**Symposium Programme and Speaker Biographies**
Appendix B	**Abstracts and PowerPoint Presentations**
Appendix C	**Participant List**

APPENDIX A:
Symposium Programme and Speaker Biographies

The Forum for Young Scholars (YSF) in Transboundary Water Governance in SADC
In association with the Southern African Young Water Professionals (SA YWP), WISA and IWA

Exploring transdisciplinarity to address change in the SADC Water Sector: Establishing the role of social scientists in this vision

29-30 November 2010
Council for Scientific and Industrial Research (CSIR), Pretoria
CSIR Pretoria Campus, Knowledge Commons, Ulwazi Room

DAY 1

08:30 – 09:00 **Registration and tea**

09:00 – 09:30 **Welcome and Introductions**
The Importance of emerging researchers in Science and Technology by Dr. Mamoeletsi Mosia (CSIR)
Introduction to the Young Water Professionals by Dr. TG Barnard (SA YWP Chair)
Grappling with Transdisciplinarity and Change by Ms. Shanna Nienaber (CSIR and YSF)

09:30 – 11:00 **Guest Speaker Debate: "Addressing change through complexity - and complexity with change"**
Speakers:
Governance by **Dr. Anthony Turton** (Touchstone Resources)
Acid Mine Drainage by **Mr. Phil Hobbs** (CSIR)
Water and Human Health by **Prof. Willie Grabow**
Climate Change by **Dr. Marius Claassen** (CSIR)
Facilitator: Dr. Inga Jacobs (CSIR)

11:00 – 11:30 **Tea break**

11:30 – 13:30 **Session 1: Water Governance and its Challenges**
- *Towards Integrating Water resources and Water Services Management Tools: a Conceptual Framework* by Mr. Albert Jeleni (Muondli Consulting and Projects CC)
- *Exploring New Frontiers in Transboundary Water Governance in Africa: Recognising Multiplicity* by Dr. Inga Jacobs (CSIR)

Chair: Dr. Inga Jacobs (CSIR)

13:30 – 14:30 **LUNCH**

14:30 – 16:00	**Session 2: Acid Mine Drainage** • *Environmental Activism in South Africa* by Ms. Shanna Nienaber and Ms. Nikki Funke (CSIR) • *Challenges of implementing mine water projects* by Dr. Jo Burgess (WRC) Chair: Ms. Shanna Nienaber (CSIR)
16:00 – 16:30	**Reflections and Session Summaries by Chairs**
16:30 – 18:00	**Cocktail Dinner sponsored by the Netherlands Embassy** *(in collaboration with the Dutch-SA Water Partnership)*

DAY 2

08:30 – 09:00	**Morning tea**
9:00 – 10:30	**Session 3: Emerging Challenges to Water Health** • *The effects of water quality in Loskop Dam on the health of Mozambique Tilapia* by Ms. Jackie Brown (CSIR) • *Water Quality Concerns in Water Filtration Devices* by Ms. Cherie Ann Robertson (UJ) Chair: Dr. TG Barnard (UJ)
10:30 – 11:30	**Interactive Session: How do we do multidisciplinary work?** By Ms. Karen Nortje
11:30 – 12:00	**Tea break**
12:00 – 13:30	**Session 4: Climate Change** • *El Nino, Water and Baloney* by Dr. Richard Meissner (CSIR) • *An integrated scenario based approach in dealing with climate change uncertainties in Wami/Ruvu catchment, Tanzania* by Mercy Mwanikah (University of KwaZulu Natal, Dept of Bioresources Engineering & Environmental Hydrology) G. Jewitt and H. Mahoo Chair: Dr. Richard Meissner (CSIR)
13:30 – 14:30	**LUNCH**
14:30 – 15:00	**Reflections and Session Summaries by Chairs**
15:00 – 16:00	**Group activity**
16:00	**Closure**

GUEST SPEAKER PROFILE

Dr. Anthony Turton (TouchStone Resources) **Author - Strategist – Speaker**

Anthony Turton is a political scientist by formal training, with a professional background in the field of national security. He thus came to the water sector from a specific perspective - national security strategic risk assessment - and so his work reflects this angle. He is a B-rated researcher in terms of the NRF, and he is a recognized author in the field of transboundary waters. His current focus is on mining in a water constrained economy where he is doing a number of strategic risk assessments for the financial services sector and the mining sector as they both respond to the AMD threat. He is a founding partner of the South African Water and Energy Forum (SAWEF) that will be launched in February 2011 and he holds a professorship in the Centre for Environmental Management at the University of Free State.

Mr. Phil Hobbs (CSIR) **Senior Researcher: Groundwater Sciences**

Phil is registered as an Earth Scientist with the South African Council for Natural Scientific Professions (SACNASP). He is currently employed as a Senior Research Hydrogeologist by the CSIR in the Water Resources Competence Area of the Natural Resources and Environment (NRE) Operational Unit. Experience in this discipline covers a wide range of groundwater studies across a broad spectrum of geological and hydrogeological environments in a career that spans 30 years across the public and private sectors. The studies include the exploration and development of groundwater resources for water supply purposes at local (domestic) and municipal (bulk) scale, the evaluation and assessment of land use activities such as waste disposal, industrial, mining and residential development on the groundwater environment, and the mapping of groundwater resources at regional scale. More recent experience is associated with resource directed measures (RDM), and pertains to determinations of the groundwater Reserve at rapid and intermediate level, and the associated classification of groundwater resources and setting of resource quality objectives (RQOs). Experience relating specifically to the mining industry derives from groundwater investigations conducted at various mining operations, currently in the West Rand Basin and the Cradle of Humankind World heritage Site with its associated acid mine drainage and karst groundwater issues. His knowledge of dolomitic groundwater resources makes him one of only a few experienced karst hydrogeologists in the country.

Prof. Willie Grabow

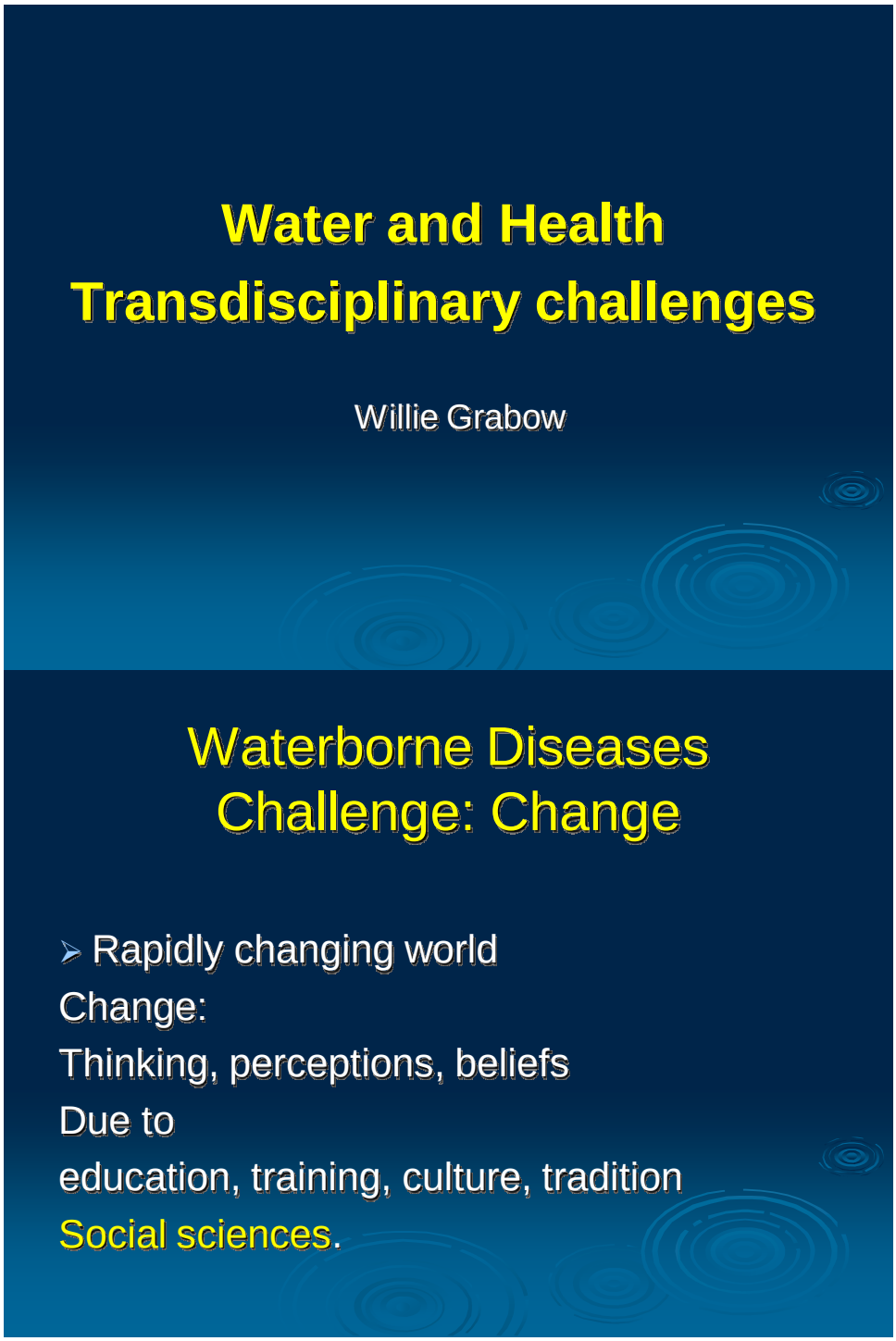
Professor Willie Grabow is the retired head of the Department of Medical Virology at the University of Pretoria. He has devoted a life-time career to health-related water microbiology. Professor Grabow is also an honorary member of the International Water Association (IWA), and the honorary president of the IWA Specialist Group on Health-Related Water Microbiology.

Dr. Marius Claassen (CSIR) **Research Group Leader**

Marius Claassen is Research Group Leader of the Water Resources Governance Systems. He completed his Masters degree on Biological Monitoring and his PhD in Risk Assessment. Marius has more than 18 years experience in Water Resources Management at the CSIR. His research interests range from aquatic ecosystems to decision support systems and transboundary issues. His track record includes national and international research initiatives and leadership positions in the CSIR.

APPENDIX B:
Abstracts and PowerPoint Presentations

12.1 Guest Speaker Debate PowerPoint Presentations



Drinking Water Quality

Raw water: surface, ground

Treatment and Disinfection

Final water

Quality monitoring: End point analysis

SABS Specifications:

E coli: < 1 / 100 ml

Aluminium: < 300 ug/litre

Shortcomings.

New Strategy

- Water Safety Plans:

HACCP

Hazard Assessment and Critical Control Points

- Quantify Health Risk

Risk of infection

Burden of disease.

Acceptable Health Risk

- Acceptable risk of infection (US EPA, 1988):

One infection per 10 000 consumers pa

1000 infections per 10 000 000 consumers

Viruses to comply: < 1 / 1000 000 litres

SABS Specification: < 1 / 100 litres

- Tolerable Disease Burden (WHO, 2004):

10^{-6} DALYs pa

Social Sciences: Definitions.

Risk of Infection

Statistical models

Data include: Exposure analysis

N = C x 1/R x I x V

- N = Daily exposure
- C = Number of viruses detected
- R = Efficiency of detection
- I = Fraction infectious
- V = Daily consumption.

Burden of Disease

DALY = Disability Adjusted Life Year

Scale: 0 = perfect health / 1 = dead

Life expectancy = 80 years

Seven Disability Classes with weights.

Global Burden of Disease

Risk factor	Deaths (1000s)	% of total deaths	DALYs (millions)	% of total DALYs
Underweight	3,748	6.6	138	9.5
Unsafe sex	2,886	5.1	92	6.3
Blood pressure	7,141	12.6	64	4.4
Tobacco	4,907	8.6	59	4.1
Alcohol	1,804	3.2	58	4.0
Unsafe water	1,730	3.1	54	3.7
Cholesterol	4,415	7.8	40	2.8
Indoor smoke: solid fuels	1,619	2.9	39	2.6
Iron deficiency	841	1.5	35	2.4
Overweight	2,591	4.6	33	2.3

Define Quality Goals

Optimal utilization of available resources
Priorities
Proposed goals
WHO advice: Each country itself
Social sciences.

Informal Drinking Water

Only raw water
Point of use treatment options
Social Sciences challenges:
Informal education and training
Moringa oleifera: coagulation, disinfection.

Survival in Rapidly Changing World

- Concerted effort of all disciplines

Many examples

SA far behind

Challenge for Young Scientists.

Disability Classes and Weights

Class	Weight	Examples
1	0.00 - 0.02	Vitiligo on face, low weight
2	0.02 - 0.12	Watery diarrhoea, sore throat
3	0.12 - 0.24	Infertility, arthritis, angina
4	0.24 - 0.36	Amputation, deafness
5	0.36 - 0.50	Down's syndrome
6	0.50 - 0.70	Depression, blindness
7	0.70 - 1.00	Psychosis, dementia, quadriplegia

20th Century Golden Rule

No faecal pollution – no disease

No *E coli* – no waterborne pathogens

Major impact on management

Practical tool

Replace detection of pathogens

Valid yesterday, today and tomorrow.

Changes: Waterborne Diseases

New, emerging, re-emerging diseases

Cryptosporidium parvum

1976 : Human infection

1985 : Waterborne transmission

1993 : Milwaukee outbreak

US data on waterborne diseases:

Before 1970s: *Salmonella*

After 1970s: More resistant pathogens.

Drinking water supplies
Risk of infection

Exponential risk assessment model

- Hazard identification
- Dose-response assessment
- Exposure analysis
- Risk characterisation.

Risk Characterisation

$P = 1 - \exp(-rN)$

- P = Probability of becoming infected pd
- r = Dose response parameter
- N = Number of viruses ingested.

Results

Comply with specifications for:

- Raw water quality
- Treatment
- Disinfection
- Indicators (end-point)

Fail specifications for:

- Presence of viruses
- 4-log reduction
- Acceptable risk.

YOUNG SCHOLARS FORUM

TRANSBOUNDARY WATER GOVERNANCE

ANNUAL SYMPOSIUM

29 NOVEMBER 2010

pHil hobbs

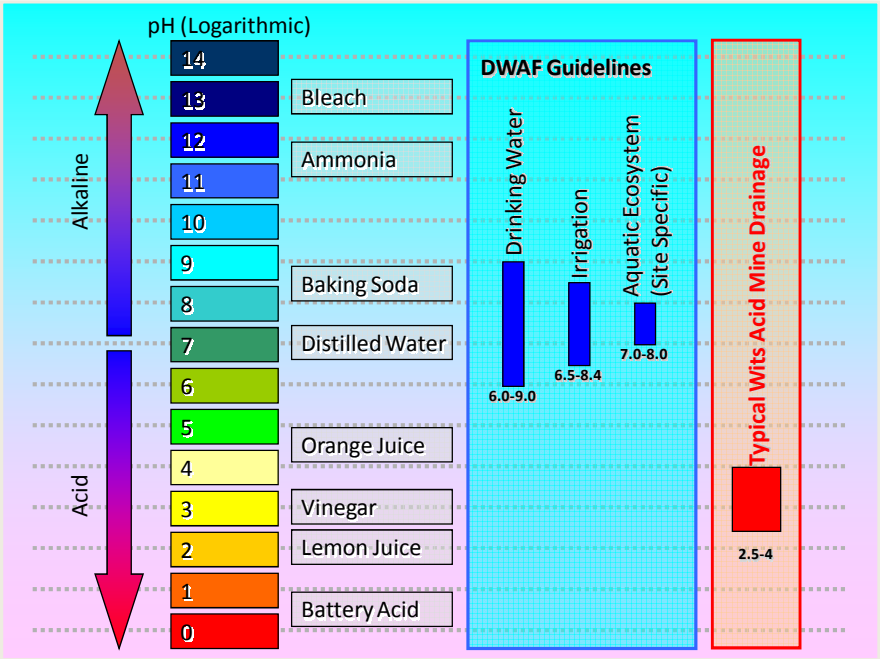
ACID MINE DRAINAGE

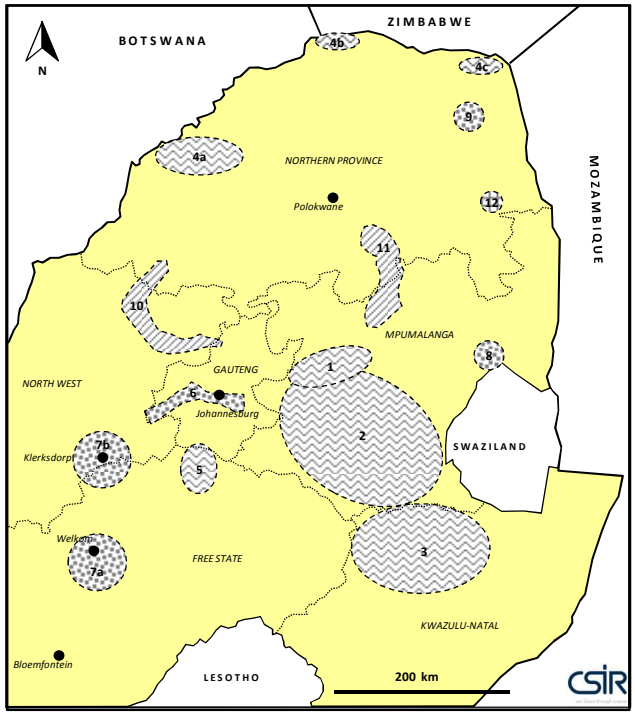
$$2FeS_2 + H_2O + 7O_2 = 2FeSO_4 + 2H_2SO_4$$

Pyrite + Water + Oxygen = Iron-sulphate + Sulphuric acid

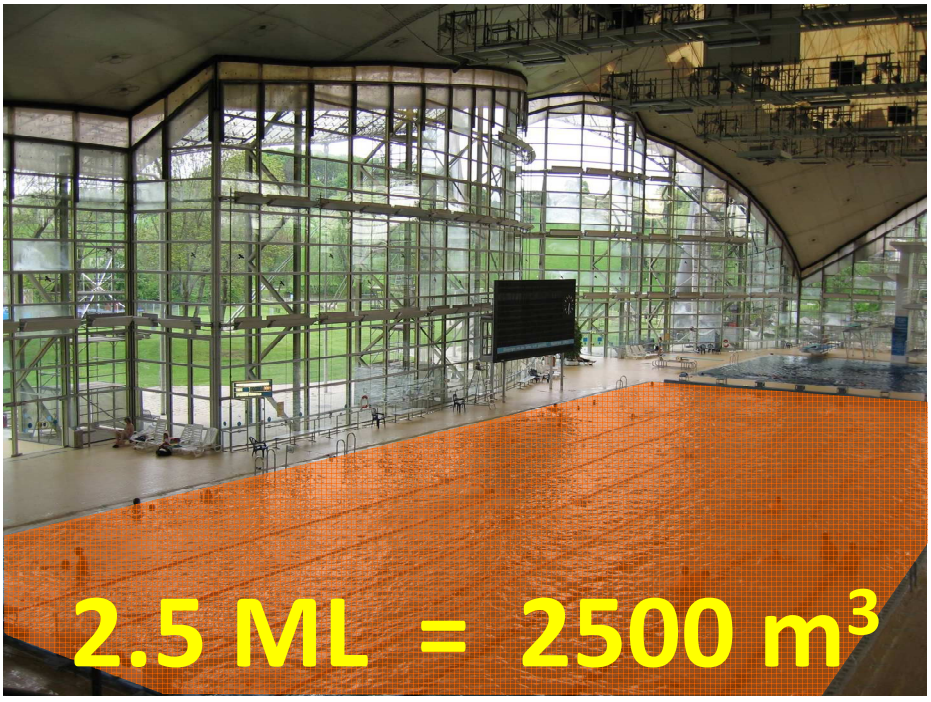
$$Fe^{3+} + 3H_2O = Fe(OH)_{3(s)} + 3H^+$$

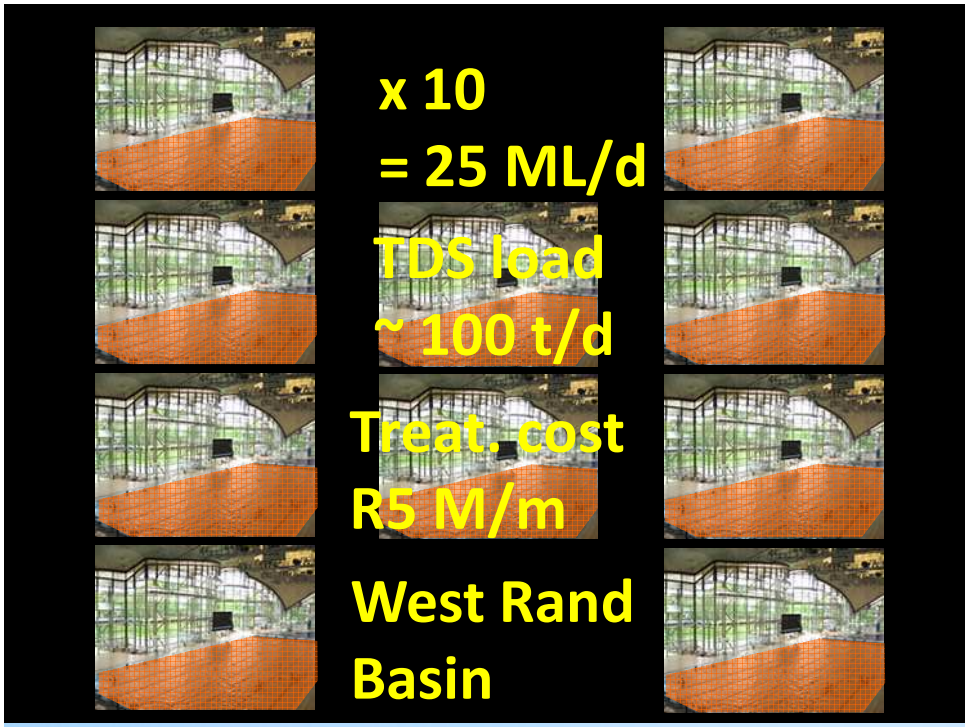
pH


pH (Logarithmic)
Alkaline
Acid
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Bleach
Ammonia
Baking Soda
Distilled Water
Orange Juice
Vinegar
Lemon Juice
Battery Acid
DWAF Guidelines
Drinking Water
6.0-9.0
Irrigation
6.5-8.4
Aquatic Ecosystem (Site Specific)
7.0-8.0
Typical Wits Acid Mine Drainage
2.5-4

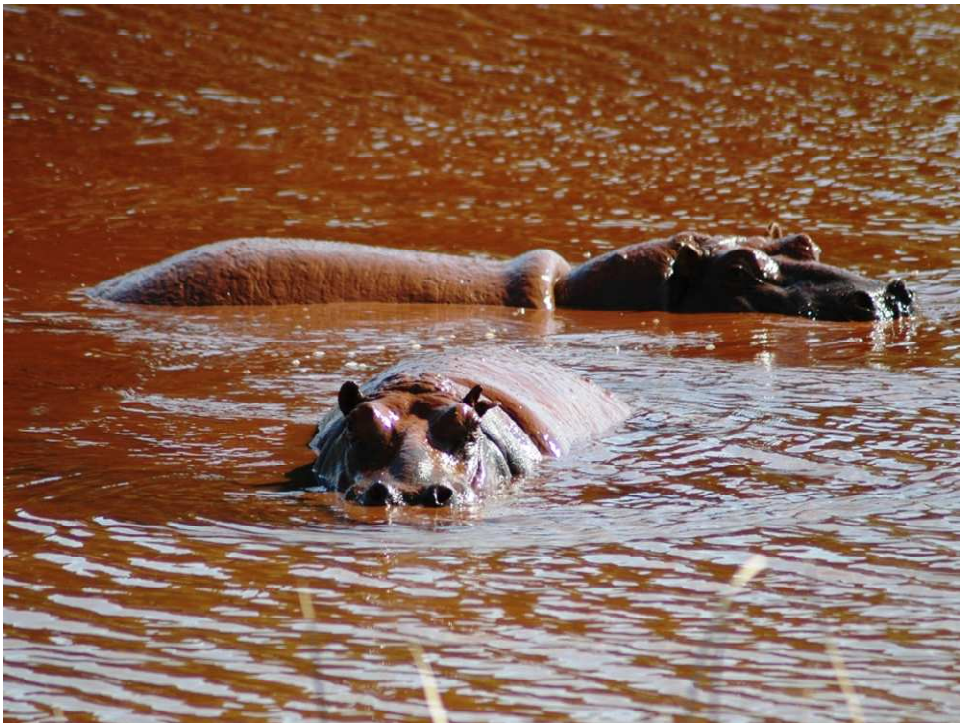

N
BOTSWANA
ZIMBABWE
MOZAMBIQUE
SWAZILAND
LESOTHO
NORTHERN PROVINCE
Polokwane
MPUMALANGA
GAUTENG
Johannesburg
NORTH WEST
Klerksdorp
FREE STATE
Welkom
Bloemfontein
KWAZULU-NATAL
4a
4b
4c
5
6
7a
7b
8
9
10
11
12
1
2
3
200 km
CSIR


• Polluted water discharged into receiving environment
– Volume ~25 ML/d
– Salt content ~4 g/L
– Salt load ~100 t/d
©PJ Hobbs


2.5 ML = 2500 m³

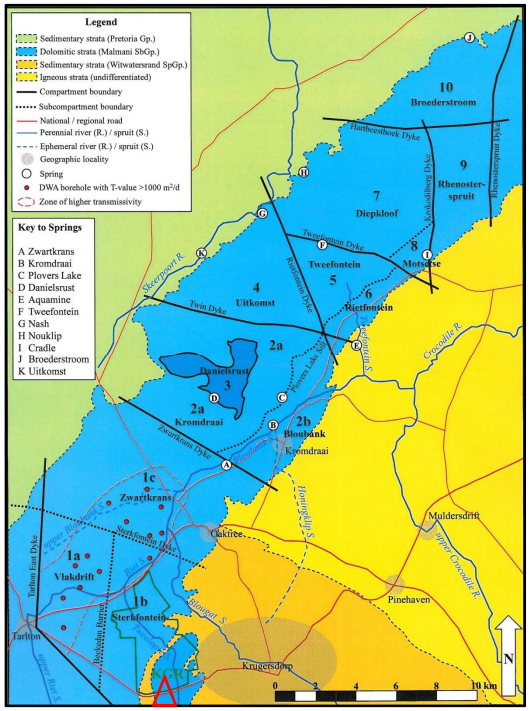

x 10
= 25 ML/d
TDS load
~ 100 t/d
Treat. cost
R5 M/m
West Rand
Basin


20t
20t
20t
20t
20t



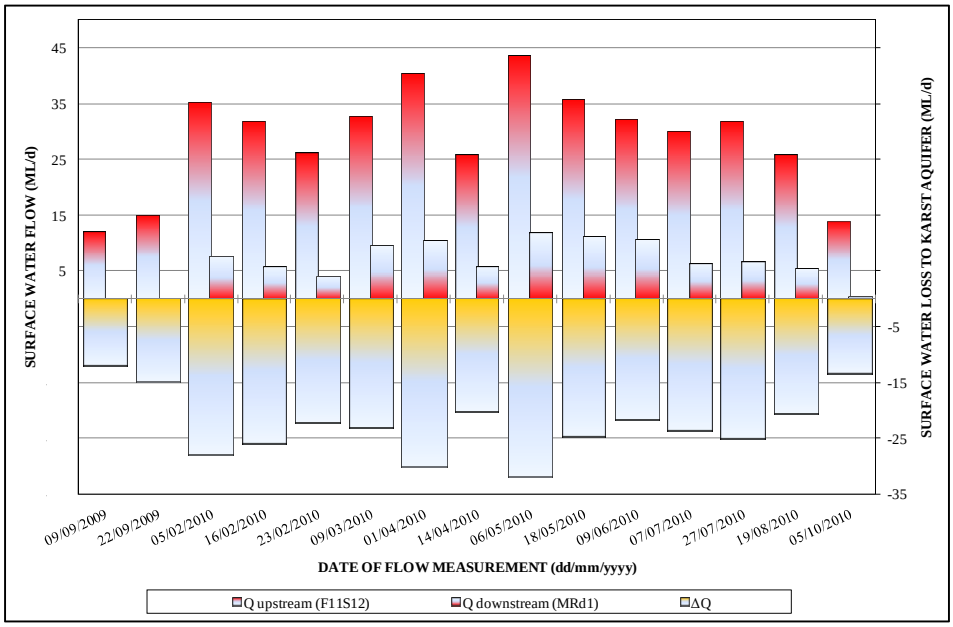
DWA DIRECTIVES FOR MINE WATER QUALITY RELEASES

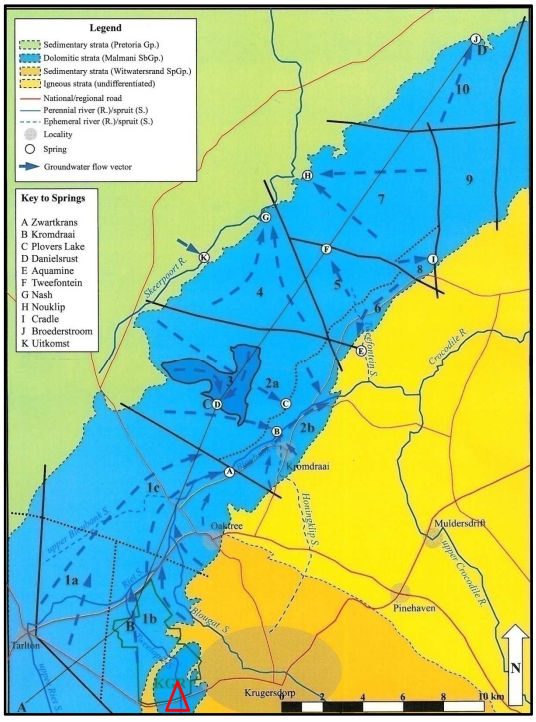
Directive Metadata	Variable and Value
Reference: 16/2/7/C231/C/257 Date issued: 29/03/2005 Expiry date: 31/03/2006 Validity period: 12 months	pH 6.5 – 8.4 EC 70 mS/m TDS 475 mg/L NH_4 0.12 mg N/L NO_3+NO_2 0.45 mg N/L SO_4 200 mg/L F 0.1 mg/L Na 56 mg/L Mg 23 mg/L PO_4 0.1 mg P/L Cl 36 mg/L Ca 72 mg/L B 0.03 mg/L Al <0.06 mg/L Mn 0.07 mg/L Fe <0.1 mg/L
Reference: 16/2/7/C231/R01 Date issued 24/07/2009 Expiry date: 31/01/2011 Validity period: 18 months(1)	pH 6.5 – 9.5 EC 100 mS/m SO_4 <600 mg/L Al <1 mg/L Mn <10 mg/L Fe <1 mg/L U <0.05 mg/L
Reference: 16/2/7/C231/C068(2) Date issued 26/05/2010 Expiry date: 31/01/2011 Validity period: 7 months	pH 6.5 – 9.5 EC 350 mS/m SO_4 <3000 mg/L Mn <10 mg/L Fe <1 mg/L U <0.05 mg/L
(1) Witdrawn in mid-2010 some 11 months after issue. (2) Directive in force at completion of this study.	



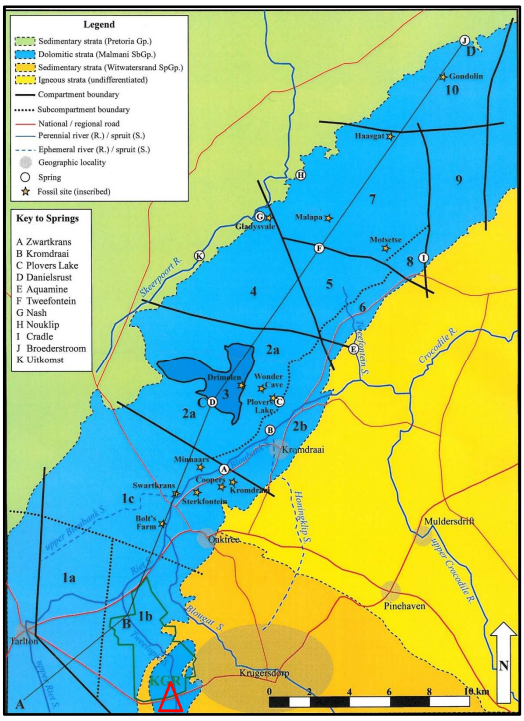
GROUNDWATER COMPARTMENT MAP

STREAMFLOW LOSSES IN RIET SPRUIT



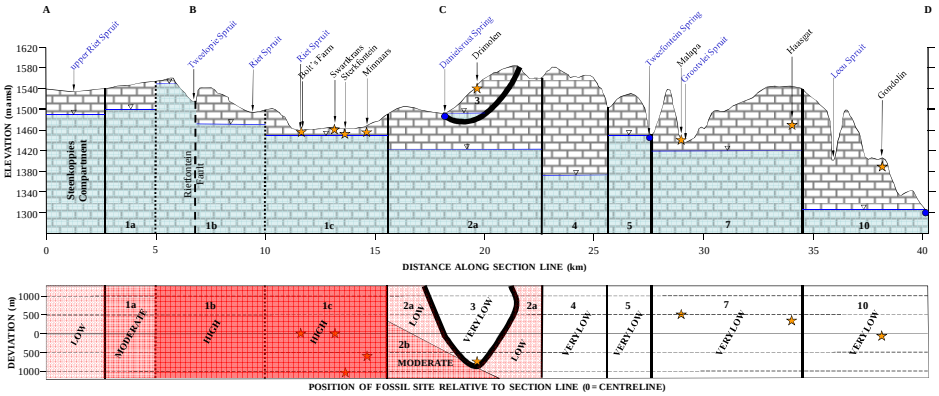


GROUNDWATER DRAINAGE MAP



FOSSIL SITE MAP

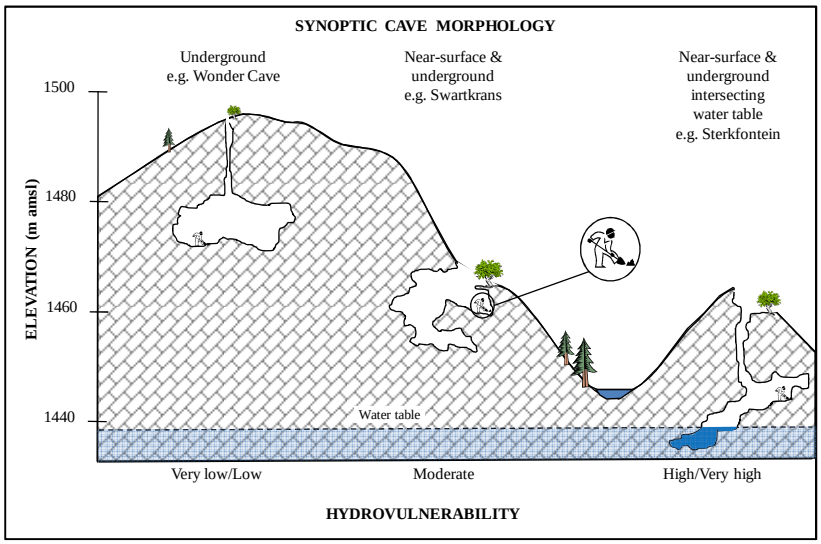
LONGITUDINAL X-SECTION THROUGH THE DOLOMITIC STRATA + FOSSIL SITES



Key to compartments/subcompartments:

1a = Vlakdrift Subcompartment
1b = Sterkfontein Subcompartment
1c = Zwartkrans Subcompartment
2a = Kromdraai Subcompartment
2b = Bloubank Spruit Compartment
3 = Danielsrust Compartment
4 = Uitkomst Compartment
5 = Tweefontein Compartment
7 = Diepkloof Compartment
10 = Broederstroom Compartment

FOSSIL SITE HYDROVULNERABILITY



FOSSIL SITE HYDROVULNERABILITY RANKING

Fossil Site	Groundwater Compartment	Surface Elevation (m amsl)	Cave Base Elevation (m amsl)	Groundwater Elevation (m amsl)	Separation Distance[1] (m)	Hydrovulne-rability
Bolt's Farm	Zwartkrans	~1480 – 1505	<1448[2]	~1448	0	Very high
Swartkrans		~1470 – 1480	<1465	~1440	<25	Moderate
Sterkfontein		~1470 – 1485	<1437	~1437	0	High
Coopers		~1465 – 1475	~1460	~1435	<30	Low
Kromdraai		~1470 – 1475	~1465	~1432	<35	Low
Minnaars		~1455 – 1460	<1450	~1437	<20	Moderate
Plovers Lake	Krombank	~1430 – 1440	<1425	~1420	<5	Moderate
Wonder Cave		~1500 – 1510	~1440	~1422	>20	Low
Drimolen	Danielsrust	~1545 – 1555	~1540	~1490	~50	Very low
Gladysvale	Uitkomst	~1415 – 1425	~1350	~1365	0	Low
Motsetse	Motsetse	~1495 – 1505	~1490	~1415	>80	Very low
Haasgat	Diepkloof	~1470 – 1480	~1465	~1420	~45	Very low
Gondolin	Broederstroom	~1385 – 1395	~1380	~1340	~40	Very low
Malapa	Diepkloof	~1435 – 1445	~1430	~1375	~55	Very low

(1) Approximate distance between lowest surface elevation and current groundwater elevation.
(2) Associated with cave accessed from entrance in the western sidewall of Sterkfontein Quarry.

DO WE HAVE A PROBLEM ?

HELL NO!

EISH !!

WE HAVE A CRISEISH !!

THANK U

12.2 Governance Session Abstracts and PowerPoint presentations

Towards Integrating Water Resources and Water Services Management Tools:

The Conceptual Framework

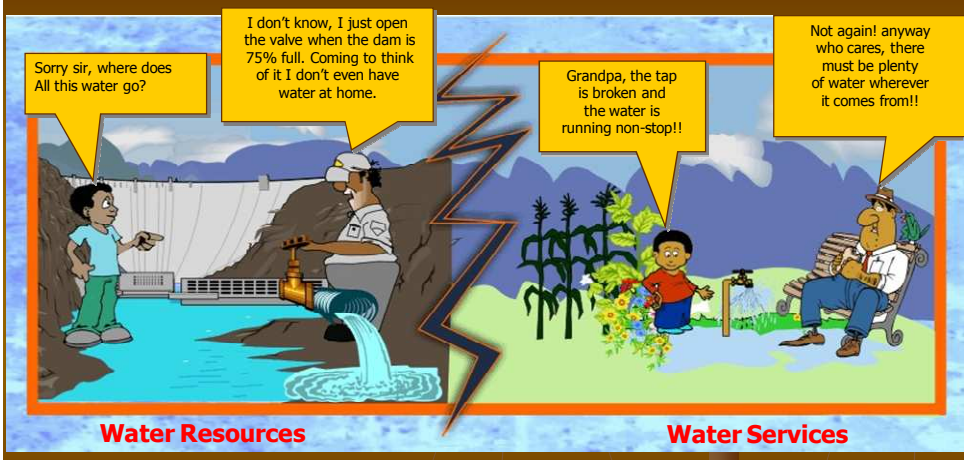
A. Jeleni[1]
[1]*Muondli Consulting and Projects CC, Pretoria, South Africa,* Albertj@muondli.co.za*, 012 549 5126*

Abstract

Although Integrated Water Resource Management (IWRM) is still an evolving concept with not one universally agreed definition, there is widespread agreement on what IWRM should achieve and a great deal of common ground in most definitions i.e. it is commonly agreed that IWRM is about integrated and 'joined-up' management.
The status quo in South African water institutions conflicts somewhat with the above definition of IWRM. Currently water resources and water services are governed and managed under separate Acts, namely the National Water Act (1998) and the Water Services Act (1997), while water management and use, in the broader environmental and sectoral context, is the responsibility of various government ministries and institutions. There are sound reasons for regulation of water resources and water services to be seen as distinctive competences, guided by separate policies and pieces of legislation, however, this has led to the development of management tools in both water resources and water services which are competent in their own rights but do not embrace the concept of IWRM in a broader sense.
Hence, although the range of tools for managing water and resolving water related problems have been developed and improved significantly in recent years, the usefulness of these tools depends on the logical structure of valuation procedures and on the common system required for defining and discussing complex water problems. These tools if properly integrated and logically structured can be useful for communication between those who have to make the decisions and those who are affected by them. This requires the establishment of a unifying framework that will lead to integrated, appropriate tools for sustainable water management.
This paper presents a Generic Integrated Conceptual Framework which can incorporate relevant and appropriate water management tools that are used in water resources and water services, linked by a common flexible and extensible database for use at strategic planning and management. The Framework will ensure the integration of tools including mobilisation of social, economic, institutional, legal, environmental and technical expertise in the effort to address water resources and water services in an integrated manner.

Keywords: IWRM, Water Services, Water Resources, Management Tools, Integration

TOWARDS INTEGRATING WATER RESOURCES AND WATER SERVICES MANAGEMENT TOOLS



YSF Symposium: 29 and 30 November 2010

By A Jeleni

"Fusing policy and science for sustainable development"

Presentation Layout

- Introduction
- Project Objectives
- Rationale
- Project Approach
- Project Results
- Conclusion

"Fusing policy and science for sustainable development"

Introduction

- WRC Project – (2008 – 2011)
- Lead by Mr A Jeleni
- Final stage of the project

"Fusing policy and science for sustainable development"

WRC WATER RESEARCH COMMISSION

Project Objective

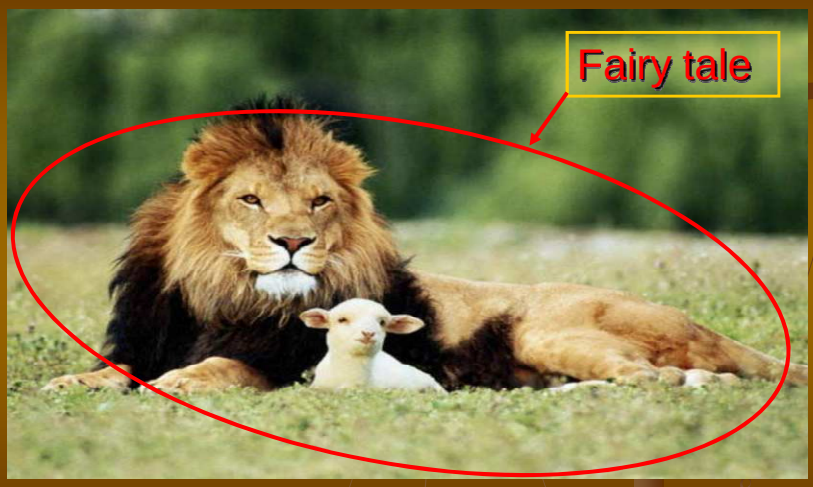
- As in the TOR
  - To assess and review existing knowledge and literature
  - To develop a conceptual framework
  - Investigate and identify new concepts, technology and data sources and make recommendations
  - Develop a case study solution
- Conceptualised
  - Develop A Generic Integrated Conceptual Framework which can incorporate relevant and appropriate water management tools that are used or required for use in water resources and water services management, linked by a common flexible and extensible data-Mart for use at strategic, tactical, and operational planning and management.

"Fusing policy and science for sustainable development"

WRC WATER RESEARCH COMMISSION

Rationale

Why bother ?



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What are my Chances ?

Decidophobia - Decisions making

Soteriophobia - Dependence on others

Atychiphobia - Failure

Ideophobia - Ideas

Gnosiophobia - Knowledge

Sophophobia - Learning

Cainophobia – Newness

Hypengyophobia - Responsibility

Phronemophobia - Thinking

Technophobia - Technology

Tropophobia – Change

Enissophobia - Criticism

Social Phobia - Associating

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The cost of fragmentation

- Duplicati… of
- Separate… and information
- Excessive… accuracy
- Lack… conflicting
- … of available
- Fail… or as a whole

Poor Governance

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…ce for sustainable development"

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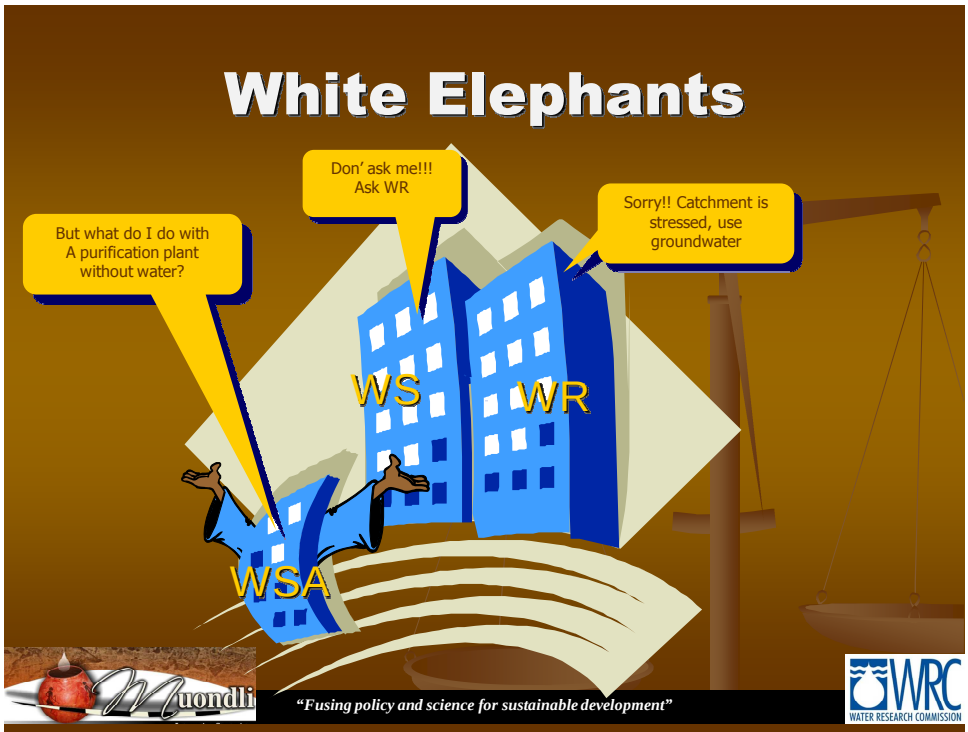
White Elephants
Don' ask me!!!
Ask WR
But what do I do with
A purification plant
without water?
Sorry!! Catchment is
stressed, use
groundwater
WS
WR
WSA
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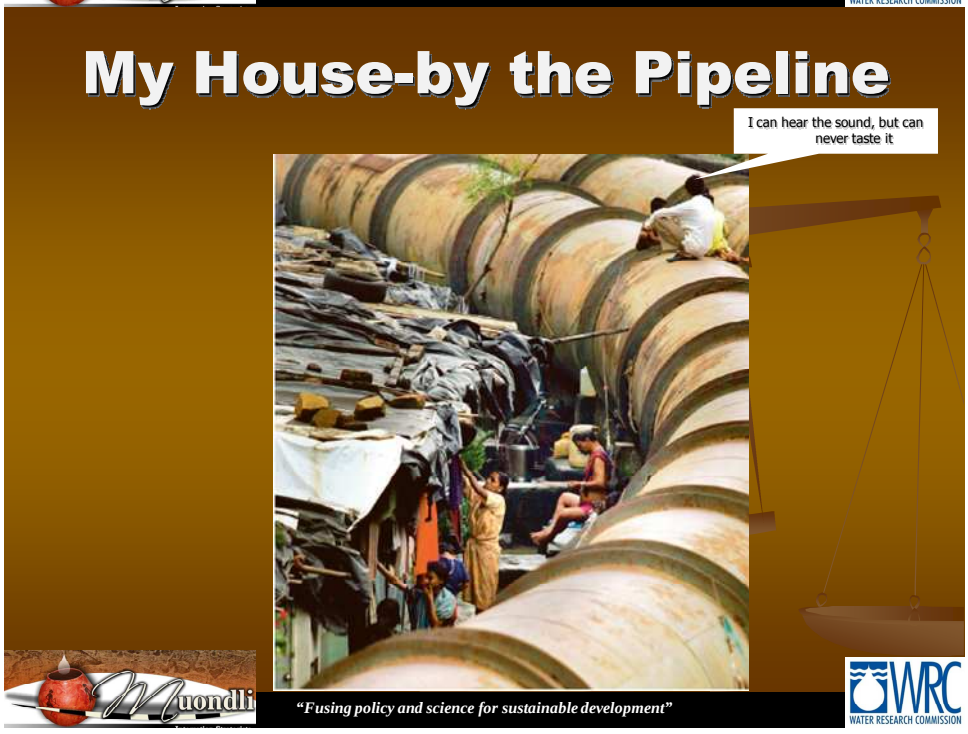
My House-by the Pipeline
I can hear the sound, but can
never taste it
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Integration entails bringing stakeholders together

Across sectors & disciplines / Across institutional roles	Hydrology	Water Supply	Sanitation	Agriculture	Environment	Industry	Energy	Economic Planning	Social planning	etc.....
Central Government										
Local government										
Private sector										
Academia										
Civil society										
etc...										

Need platform for alliance building!

Project Approach


How to integrate WR and WS tools ?
Water Services
Water Resources
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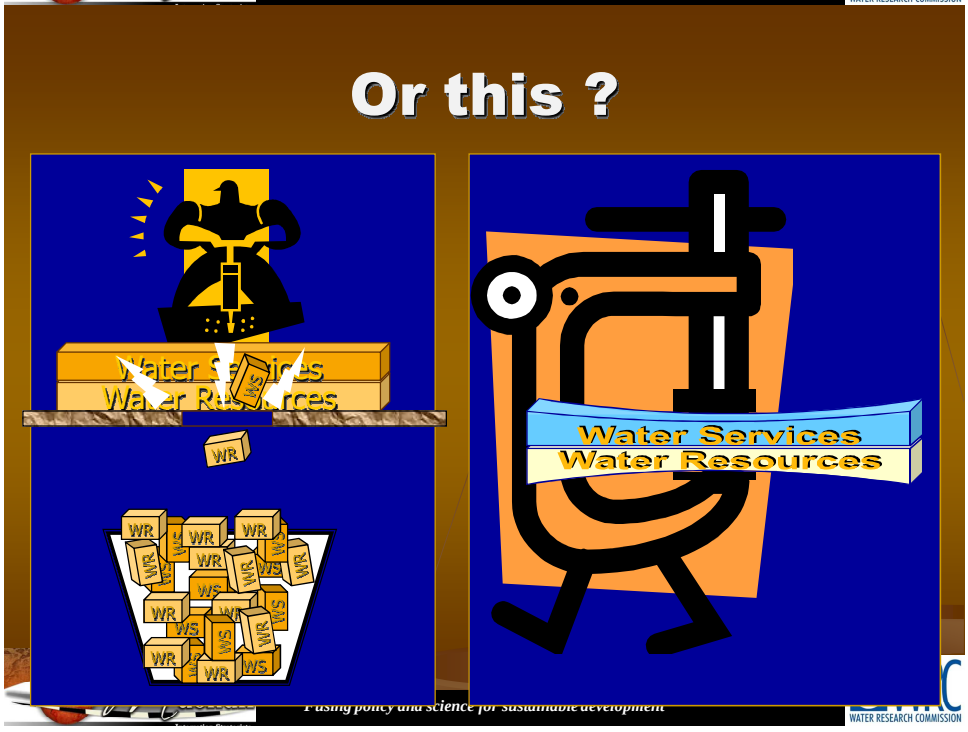
Or this ?
WR
WS
Water Services
Water Resources
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Project Approach

- Why Integrate?
  - Achieve consistency and coherence both in space and time
  - Achieve optimal use of resources
- What to integrate?
  - Activities of supply and demand (Between and within)
- How to Integrate?
  - Understand the business, environment, institutional arrangements (Value chain) and the required support services

Project Results

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Project Results

- ICE Process - Evolution
- Cause-effect (Interrelation) Model
- Integration Process Model
- Governance structure
- Water Business Model
- Integrated Conceptual Framework
- The WATERGRAL System - Prototype

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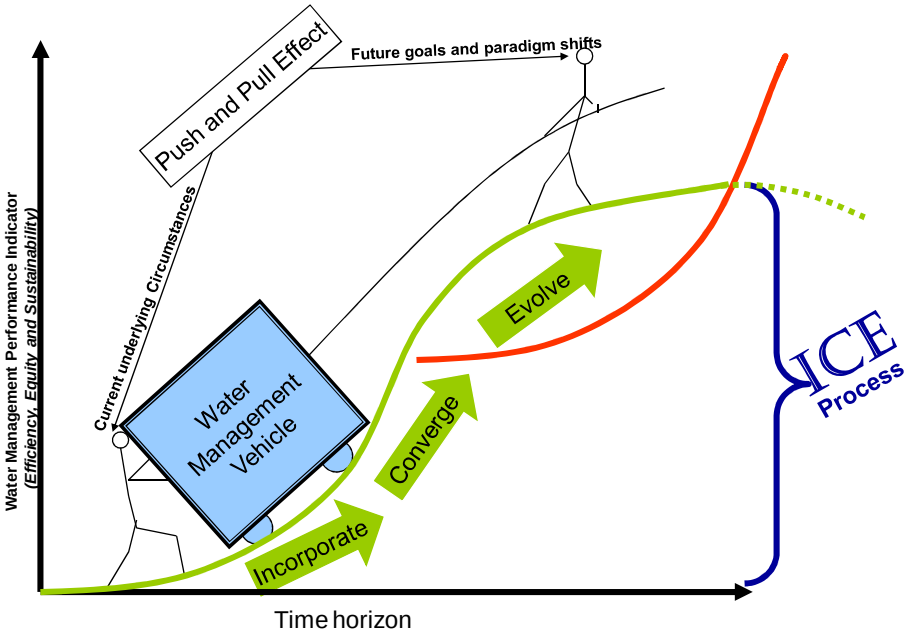
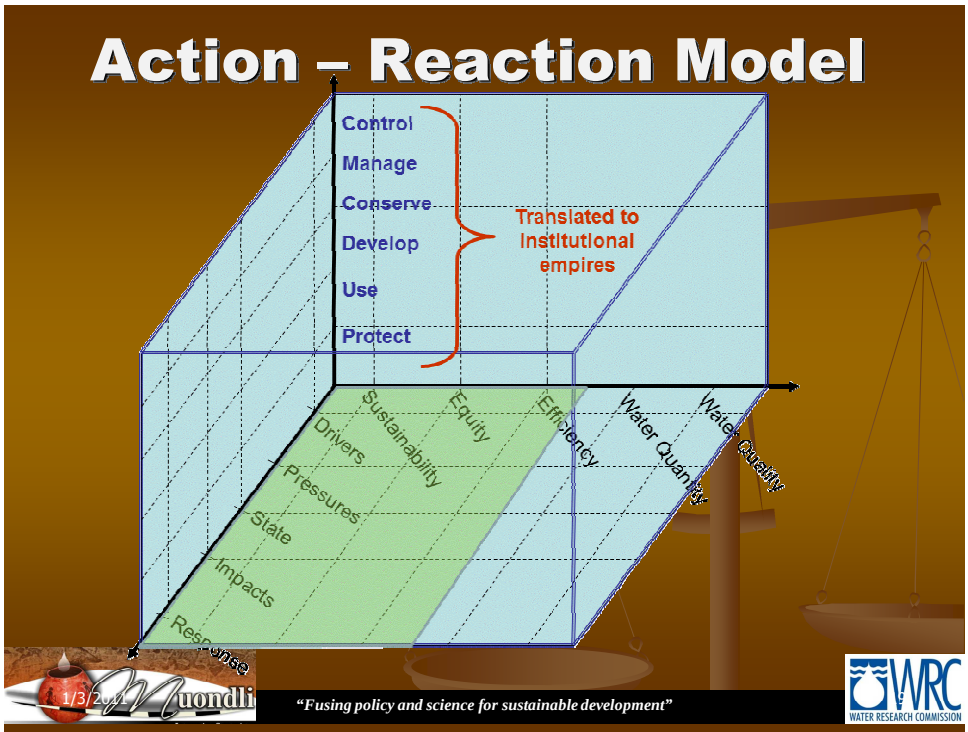
ICE Process




Action – Reaction Model
Control
Manage
Conserve
Develop
Use
Protect
Translated to Institutional empires
Drivers
Pressures
State
Impacts
Response
Sustainability
Equity
Efficiency
Water Quantity
Water Quality
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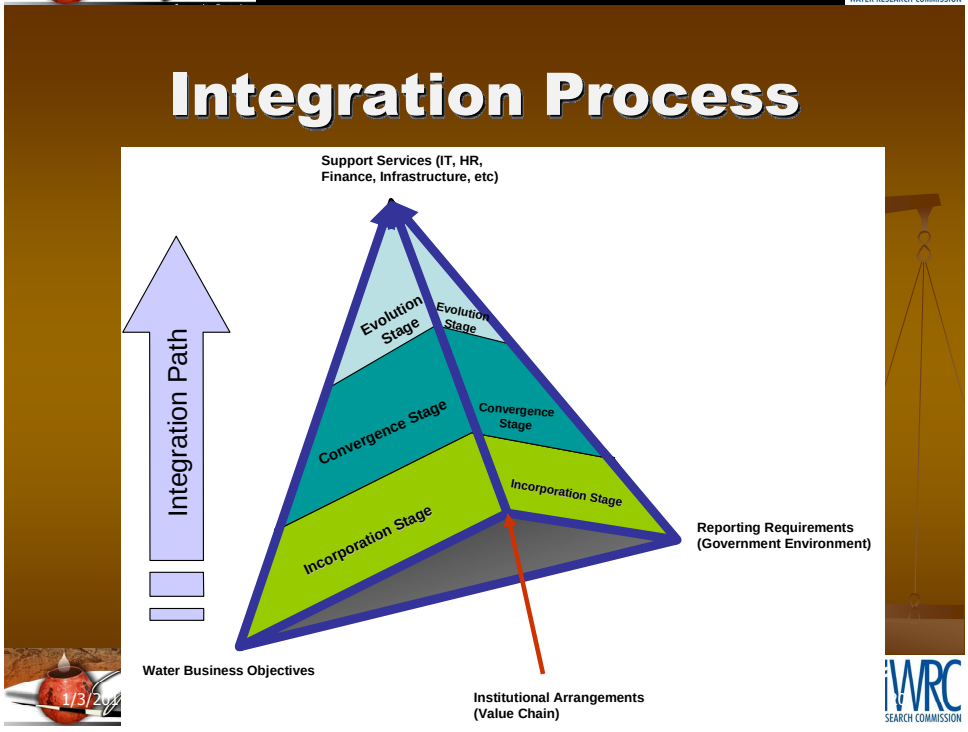
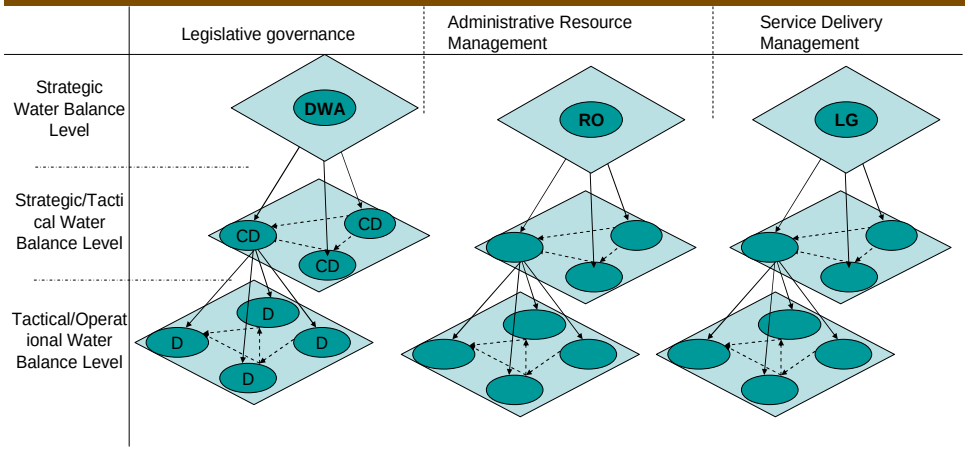
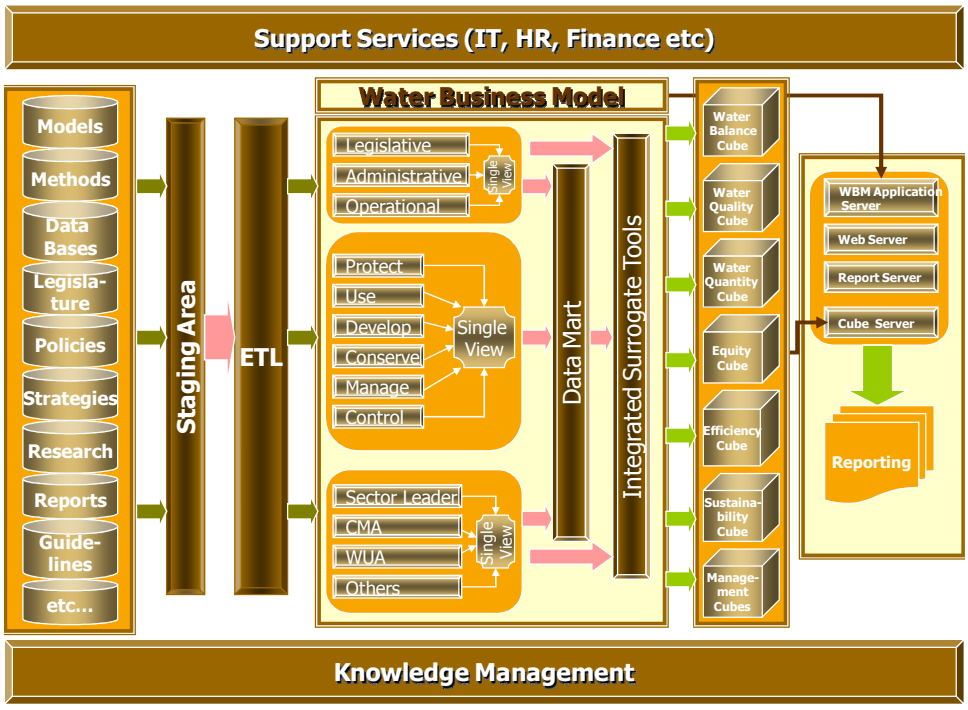
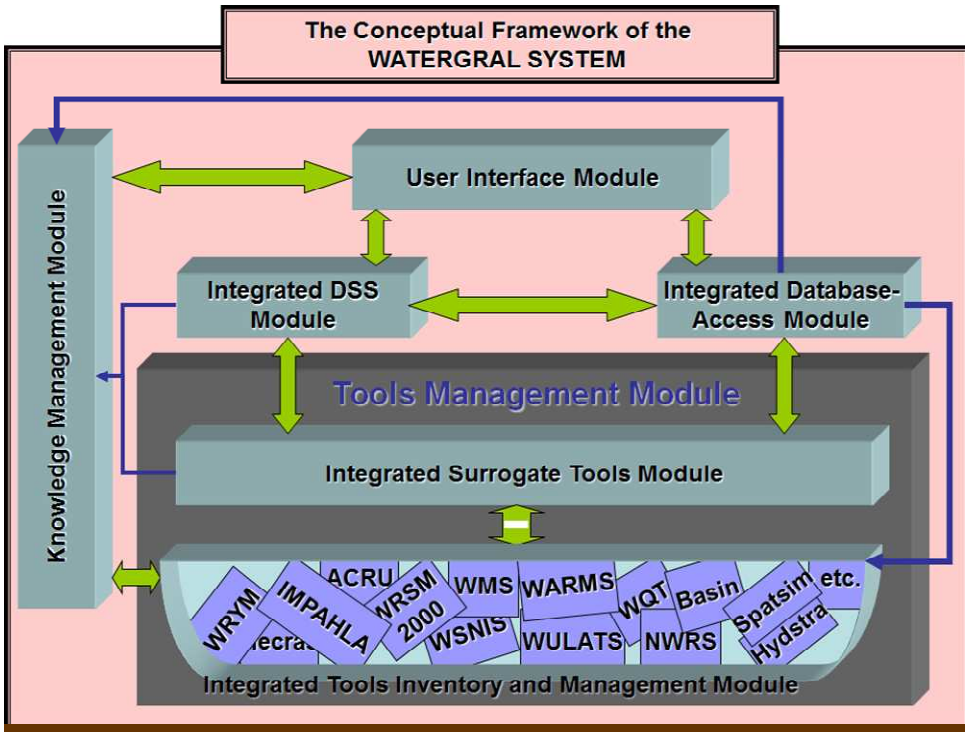

Integration Process
Support Services (IT, HR, Finance, Infrastructure, etc)
Integration Path
Evolution Stage
Evolution Stage
Convergence Stage
Convergence Stage
Incorporation Stage
Incorporation Stage
Reporting Requirements (Government Environment)
Water Business Objectives
Institutional Arrangements (Value Chain)

Governance Structure



CD = Chief Directorate, D = Directorate, RO = Regional Offices, LG = Local Government





Project Benefits

- The significant benefit of the Total System is the resulting emphasis on strategy and alternative implementation methodologies. It will allow users to input different scenarios and compare them.
- The Total System space (Website) will be a place to get dependable answers, a place where efficient and secure access to data, tools and methods is consolidated on an agreed common platform.
- Rather than expending effort re-inventing calculation methods and chasing routine data, stakeholders will focus on developing the results they seek in an accessible, flexible and proven environment that has been delivered with the features they have specified.
- This tool will be the professional computational and communication backbone that will take us towards the sustainable reality in light of i.e. uncertainty, climate change etc

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Project Benefits - Cont

- GICF is in support of the objectives of the Water for Growth and Development Framework (WfGD) recently developed by DWA. i.e.
  - *"The WfGD seeks to strike an appropriate balance between supply (Water Resources) and demand (Water Uses) driven approaches, taking into account the specific constraints (Balance between Equity, Efficiency, Sustainability, Quantity and Quality) pertaining to the resource. Its intention is to place water at the heart of all planning (Integrated Planning) that takes place in the country so that any decisions that rely on the steady supply of water adequately factor in water availability. It seeks to ensure that there is sustained investment in the water sector to avert any potential water crises and to ensure that water management supports social and economic growth targets government envisions for South Africa without compromising ecological sustainability of the resource".*
  - *In order to achieve this objective there is a need to establish a unifying framework that will lead to appropriate integrated tools for sustainable water management.*

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Projects Benefits - Cont

- The Generic Integrated Framework can therefore be seen as the unifying framework and an enabler to the implementation of the WfGD Framework in that:
  - It enables the user to identify and define risks, threats, challenges and opportunities in terms of scenario development.
  - It enables the user to identify and define the water uses in terms of the sectors (i.e. domestic, mining, energy, agriculture, forestry, environment, and recreation) and respective priority.
  - It enables the user to define the intervention options and choices based on for example – the WfGD High Level Recommendations, NWRS and other strategies.

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Projects
Cont
Consolidat
Strategic
Prov
Objec
Good Governance
1/3/2011
ce for sustainable development"
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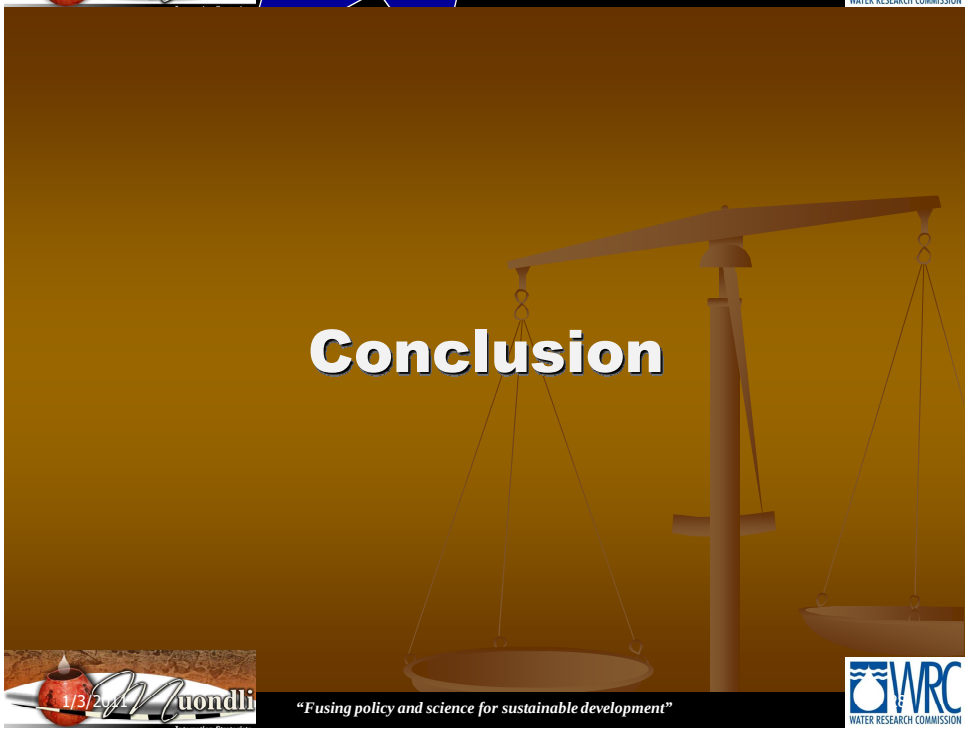
Conclusion
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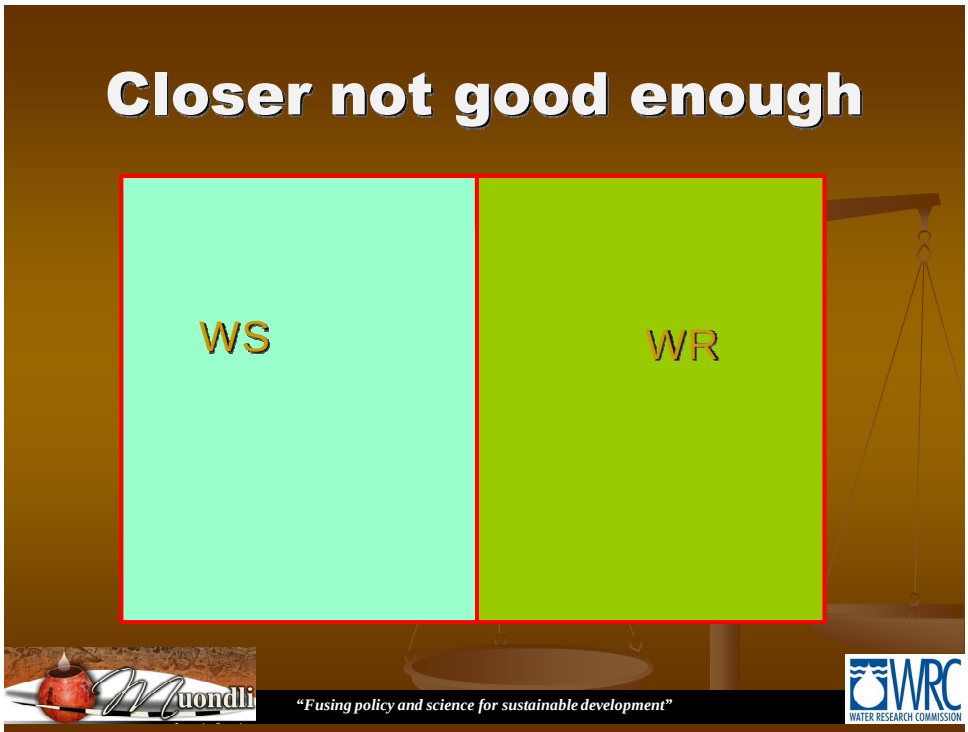
Closer not good enough
WS
WR
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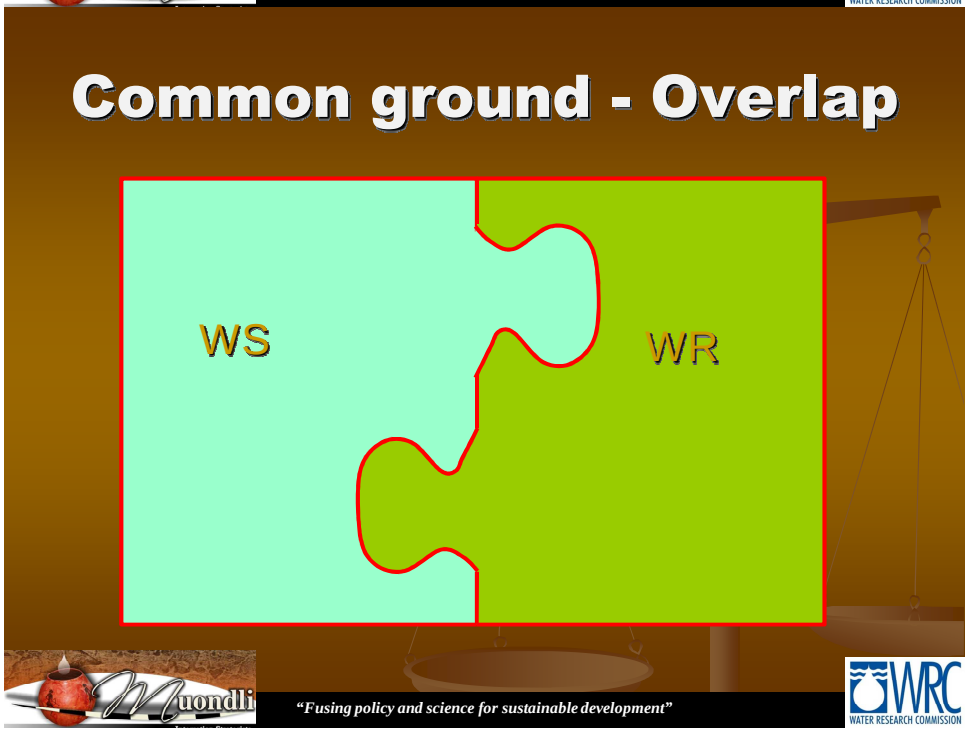
Common ground - Overlap
WS
WR
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Conclusion

- Integration – Survival matters
- Integration efforts mostly fail not due to technical difficulties, but due to management issues
  - Lack of integration on strategic, tactical and operational managers
- So much money spent; so little to show for it
  - Need a unifying framework

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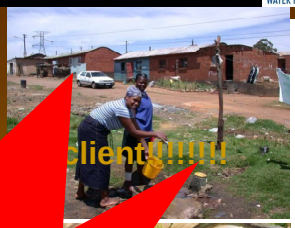
...Finally.....



When all is said and done, We Need "science-policy interface"


Thank You
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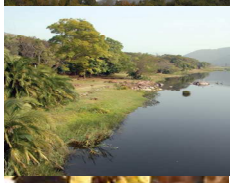
YSF Symposium
Exploring transdisciplinarity to address change in the SADC Water Sector:
Establishing the role of social scientists in this vision
29-30 November 2010

Exploring New Frontiers in Transboundary Water Governance in Africa: Recognising Multiplicity

Dr. Inga Jacobs (PhD, MA)
Natural Resource and the Environment
Council for Scientific and Industrial Research (CSIR)

Presentation Outline

- What is Governance?
- Why is there a need for transboundary water governance and cooperation in SADC?
- Exploring new approaches to transboundary water governance
- Key Factors for Vulnerability and Adaptation affecting Cooperative Governance
- Bringing Water onto the Regional Integration Agenda
- Concluding Remarks



What is Governance?

- Household, tribal, communal, local, national, transnational or global levels.
- Significance of norms - shared or social understanding of standards of behaviour; found in policies, laws, contracts and bargains as well as forms of communication.
- Not the same as government, or policies, or regulations, or agreements, or treaties, or the state.
- Governance is not only practised by the state.
- Both formal (governmental) and informal (non-governmental).
- Society has created complex problems that goes beyond the capacity of the state to solve. Cooperation is needed.
- Governance is about the relationships between society's actors and the norms that guide their interaction.

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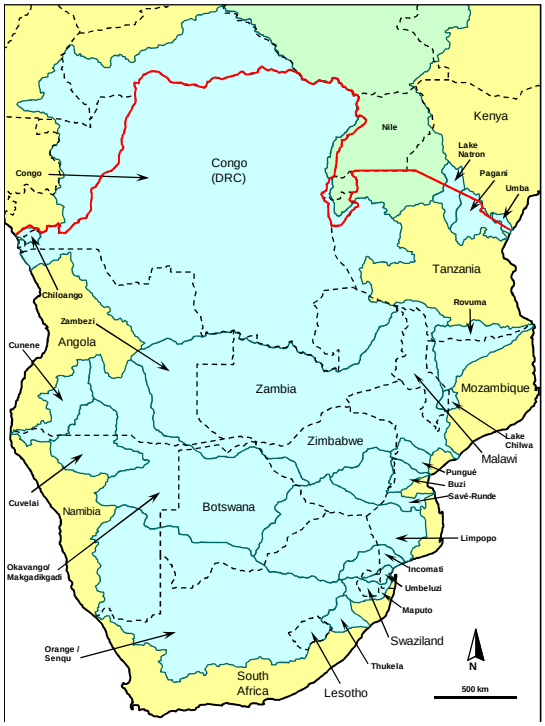
Why is there a need for transboundary water governance and cooperation in SADC?

- SADC contains 21 international river basins to which one or more SADC Member States are riparian.
- Some of the most economically developed Southern African states have limited water resources.
- Several centres of economic development are not located on large rivers, lakes or seafronts but have been built on watershed divides.
- Pronounced developmental differences - some countries are more able to mobilise the necessary human, financial and technological resources to address water scarcity and related human welfare needs than others.
- Social challenges: population growth, urbanisation, climate change, refugee movements, and diseases such as cholera, malaria, tuberculoses and HIV/AIDS.

All these issues will affect and be affected by the way in which water is managed. Thus

"Governance issues form the central obstruction to sound and equitable water sharing and management."

(UN World Development Report 2: Water a shared responsibility: 2006)



Shared River Basins in Southern Africa (red line demarcating SADC boundary)

Source: Ashton, 2008

Key Factors for Vulnerability and Adaptation affecting Cooperative Governance

Political, Social and Economic Factors			Environmental Factors	
Equity, transparency and efficiency of water governance	Increased water demand and pollution	Historical conflict lines and experiences of violence	Environmental change	Decreasing water availability
Access to water at affordable prices, good quality and enough for livelihoods, drinking and hygiene	Agriculture, Urbanisation, Changing lifestyles, population growth	Political, regional, ethnic, religious or other dividing lines and conflicts	Drought, desertification, hurricanes, rising sea levels, increase in water temperatures, salinisation of groundwater, increased evaporation due to high temps	Decreasing rainfall in many regions, less availability of melting snow and glaciers due to warmer winters

Increased Vulnerability	Adaptive Capacities
Food insecurity, Lacking access to sufficient and clean water, Health problems, Jeopardised livelihoods, Threatened infrastructure	Technical and financial capacities for water infrastructure, Political legitimacy of leaders, Governance structures allowing adaptation measures and ensuring equity and transparency, Established mechanisms of conflict resolution

Successful Adaptation	Migration	Increased Competition	Violent Conflict
No water conflict	Potential conflict in destination region	Need for cooperative solutions	Threat of local, regional, or international escalation

Source: GTZ, 2010 "The Water Security Nexus"

Exploring new approaches to transboundary water governance

- Building transdisciplinary capacity (what and why)
- Multiplicity of actors, perceptions, interests and power disparities (who)
- Multiplicity of scale (how)

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Building Transdisciplinary Capacity

- Traditionally, the technical and scientific communities have been called on to respond to the concerns of the water sector.
- Emerging challenges and complexities are demanding more integrated levels of ingenuity and expertise from a diverse set of backgrounds.
- Examples: Business models, Culturally Embedded Approaches, creating a business case for water.

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Multiplicity of actors, perceptions, interests and power disparities

Source: Nienaber, 2010

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Multilevel Governance

- Tendency to prioritise the hydrological basin as the primary unit of analysis but this notion is broadening in scope to include the unique socio-political and socio-economic communities they have formed: from the watershed-to the problemshed-to the virtual basin-to the social basin.
- Changing definition of international river basins – encompassing "lived in" social spaces i.e. The sum of social practices and discourses that exist within the biophysical space.

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Bringing Water onto the Regional Integration Agenda

- Is water availability a driver for development?
- Is it about the way we use water for agriculture, industrial development, services? What about improved sanitation services and access?
- The challenge is to develop analyses that can enable national decision-makers to allocate more funding to water resources and water supply development – and to see these as investments in growth and development - Importance of cross-sectoral coordination
- This also needs to be combined with wider decision-making within regional economic communities, particularly as these communities become part of bilateral or multilateral trade agreements with other trading blocs and given their inherent links to river basin organisations.

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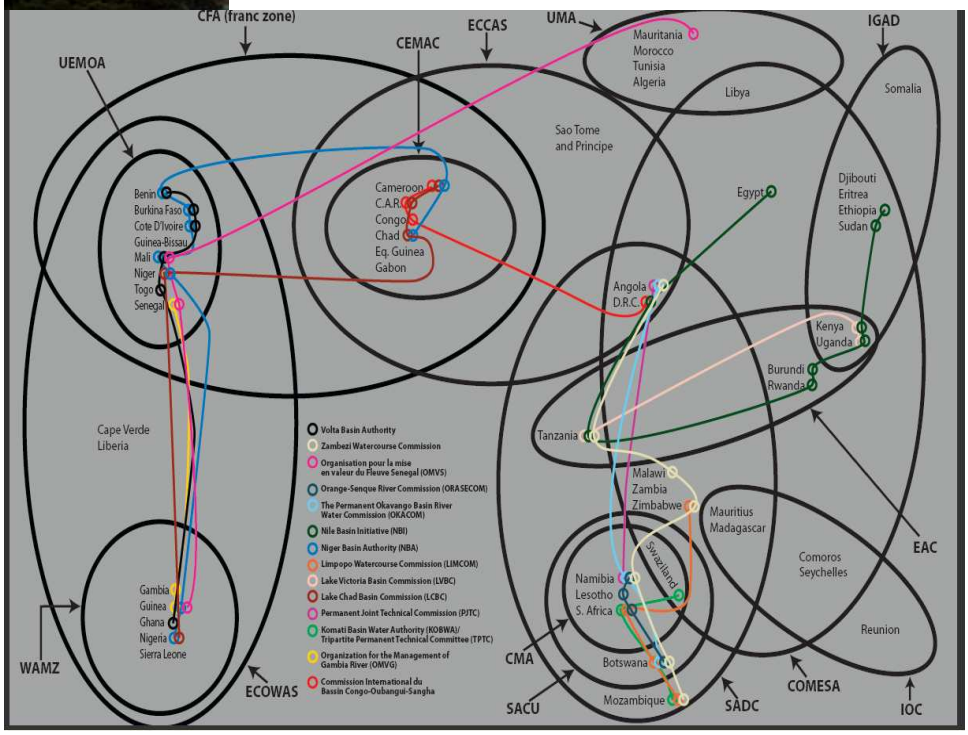

Bringing Water onto the Regional Integration Agenda continued…

- Basins are part of an increasingly complex landscape of policies, trading relations and sectoral demands.
- This institutional complexity presents challenges but also opportunities for the water sector to increasingly integrate with other sectors in terms of decision-making in agriculture, energy, industry and urban development in particular.

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Concluding Remarks

- There is a need to address important resource questions in an integrated manner. Challenge is to move from policy to action.
- One size does not fit all.
- Need to interrogate both institutional hardware and software.
- Pressures on the resource will be huge, but this will also present an opportunity to harness water effectively in support of economic growth and development.

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Thank you
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12.3 Acid Mine Drainage Session Abstracts and PowerPoint Presentations

Environmental activism in South Africa:
The case of acid mine drainage on the West Rand in Johannesburg

Nikki Funke, Shanna Nienaber and Christine Gioia

South Africa has many environmental challenges and problems that affect the country's ecological biodiversity and its socio-economic and socio-political security. One of the most prominent land-water related challenges is acid mine drainage (AMD).

In order to deal with a challenge like AMD an array of actors, expertise and action is needed. Scientists are needed to understand the magnitude of the problem and how to respond to it. Policy makers need to commit political will, energy and resources to responding to the problem and recommendations on how to deal with it. Mines need to be made to take responsibility for the environmental damage that they are causing or have caused. Civil society needs to mobilise in order to understand and educate about the risks associated with this pollution, to coordinate community response to this problem and place pressure on government to deal with the issue.

Whilst there is a large amount of activity and research coming from the scientific community on this topic, there has been less activity, action, concern and analysis of government and civil society response to this problem. Thus, this paper aims to address part of this gap in understanding by exploring existing environmental activism in relation to AMD in South Africa.

Focussing mainly on activist efforts around AMD on the West Rand in Johannesburg, this paper firstly explores the phenomenon of AMD and briefly explains the problem through a scientific and more broadly, a socio-ecological lens. Secondly, the legislative context within which mining is regulated in South Africa is described. Thirdly, the phenomenon of environmental activism in South Africa is unpacked as an important potential driver for environmental, social, economic and political change. Fourthly, the chapter focuses on the chief executive officer (CEO) of the Federation for a Sustainable Environment (FSE), Mariette Liefferink. She has dedicated her life to whistle-blowing and AMD activism to oppose malpractice by large mining corporations and the South African government. Her activist agenda and techniques as well as her strengths and weaknesses are uncovered to create a picture of the climate within which an environmental activist operates in South Africa.

In conclusion, the paper offers some recommendations on how current activist efforts in relation to AMD could be improved. These recommendations centre on the need for transdisciplinary action and thinking in relation to this problem; and include issues like the need for environmental activists to network and build solid and mutually beneficial relationships, to approach a range of potential funders to increase their independence and to support increased knowledge production and dissemination on the effects of AMD.

Environmental activism in South Africa: The case of acid mine drainage on the West Rand in Johannesburg

29 November 2010

Nikki Funke (CSIR), Shanna Nienaber (CSIR)
and Christine Gioia (Kings College, London)

Paper Outline

- Introduction
- The Acid Mine Drainage (AMD) challenge on the West Rand
- The legislative context with which AMD exists and interacts
- Environmental activism in South Africa
- AMD activism on the West Rand (agenda, techniques, strengths, weaknesses)
- Conclusion and recommendations for improvement

Paper Inputs

- Literature
- Field visit
- Liefferink interaction

Why focus on Acid Mine Drainage (AMD)?

- Purpose of chapter
- Chapter's link to symposium theme
  - Change
  - Transdisciplinarity
  - Role of Social Science

What is AMD and where is it worst?

- It is triggered by a chemical process that results in water becoming acidic, rich in sulphates and metals
- It occurs when groundwater begins to refill underground mining shafts, or when runoff water comes into contact with open pit mines or tailings dams
- It is particularly problematic in closed or abandoned mines where pumping has stopped
- It is a serious environmental hazard and has adverse effects on human health
- In 2002 the West Rand of Johannesburg began to decant AMD after discontinuation of mining in 1998
- Central Basin spill due in 18 months

AMD spillage into Krugersdorp Nature Reserve

The legislative context

- Complex and overlapping legislation from various sectors interacts with the AMD issue:
  - Mineral and Petroleum Resources Development Act (MPRDA)
  - Mineral and Petroleum Resources Development Amendment Act (MPRDAA)
  - National Environmental Management Act (NEMA)
  - National Water Act (NWA)
- Principles: sustainable development, responsibility not to pollute or degrade the environment, polluter pays principle

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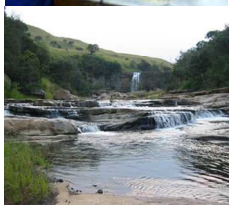

AMD related challenges:

- Weak implementation and enforcement of legislation
- Lack of clarity about AMD risk levels in legislation
- Lack of government co-operation and co-ordination across different departments and sectors
- Dealing with the cumulative impacts of mining (health problems, sink holes, devaluing of property, environmental destruction, pollution)
- Reluctance of mining companies and the government to take ownership of AMD and related problems
- Footing the bill for the astronomical cost of environmental remediation

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Environmental activism in SA: AMD in focus

- Environmental activism around the issue of AMD is an important contributor to solving the AMD problem

- Some roles of the environmental activist are to:
  - "Give the earth a voice"
  - Create platforms for informing the public (particularly the poor) so that they can represent their threats and concerns
  - Challenge the government to better regulate the mining sector and implement legislation

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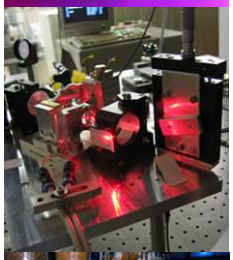


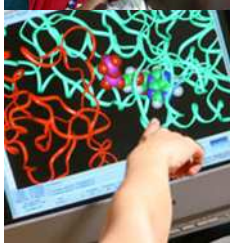

Environmental activism in SA: AMD in focus

- AMD activism in SA is:
  - Made up of different structures, organisations and movements
  - Uses a range of activities, including research, violent protest, passive resistance and whistle blowing
  - Is difficult to define concisely because it has no coherent centre or tidy margins

- Actors involved in AMD activism
  - NGOs (e.g. Chronicle Group, Green Cross, Groundwork, the Legal Resources Centre)
  - Media and researchers
  - Mariette Liefferink as CEO of Federation for a Sustainable Environment

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Liefferink's AMD activism on the West Rand

- This takes the form of oppositional activism: highly critical of the damage that business (mining) can cause the poor and the environment

- **Liefferink's activism agenda:**
  - Hold government accountable
  - Exposes mining companies
  - Raises public awareness
  - Puts pressure on government and mines to remediate environmental damage on the West Rand
  - Builds capacity, empowers and informs mining communities through community involvement and participation

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Liefferink's AMD activism on the West Rand

- **Liefferink's activism techniques:**
  - Examines environmental management plans and collects evidence to determine if the mining companies are guilty of any infractions
  - Sees her role as disclosing controversial information to the public and pressurising government to act
  - Interacts with government through official channels and is a member of the board of the National Nuclear Regulator
  - Mining community workshops to raise awareness among people living close to mines
  - Raises awareness amongst the general public
  - Whistle-blowing.

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The successes and strengths of Liefferink's AMD activism

- Focuses on human health and wellbeing (not just environmental protection) – government responds to this "angle" and is increasingly acknowledging AMD as a problem
- Highly transparent in her activities and has no political, economic or commercial agenda
- Careful issue framing in her campaigns e.g. emphasis on radioactivity
- Supports establishment of public fora: Wonderfontein Regulators Steering Committee, etc.
- Strong media relationship and presence – this is certainly raising public debate and awareness
- Instigated policy change – National Environmental Management Amendment Act

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Weaknesses and challenges of Liefferink's AMD activism

- Funded by the mines whose behaviour she is trying to expose
- Her stand alone efforts and fierce independence may be obstacles in trying to raise more funding
- Apathy of the general South African populace
- Media challenges: sensationalist agenda creates uncertainty and fear amongst middle class actors
- Gold mining is being prioritised over environmental protection

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Recommendations for improving AMD activism on the West Rand

1. The importance of networking
   - Amongst NGOs (national and international), between NGOs and communities, and between NGOs, mines, government and civil society
2. Find funding that "sets you free"
   - Try to link up with more powerful international NGOs, link up with other local NGOs, diversify the funding base
3. Enhance information and its dissemination
   - Enhance AMD knowledge and science
   - Communicate science effectively
   - Be aware of the risks of sensationalism
   - Information dissemination needs to be packaged to target multiple stakeholders

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Considerable challenges exist to manage AMD but the battle to hold mining companies and government accountable must continue!
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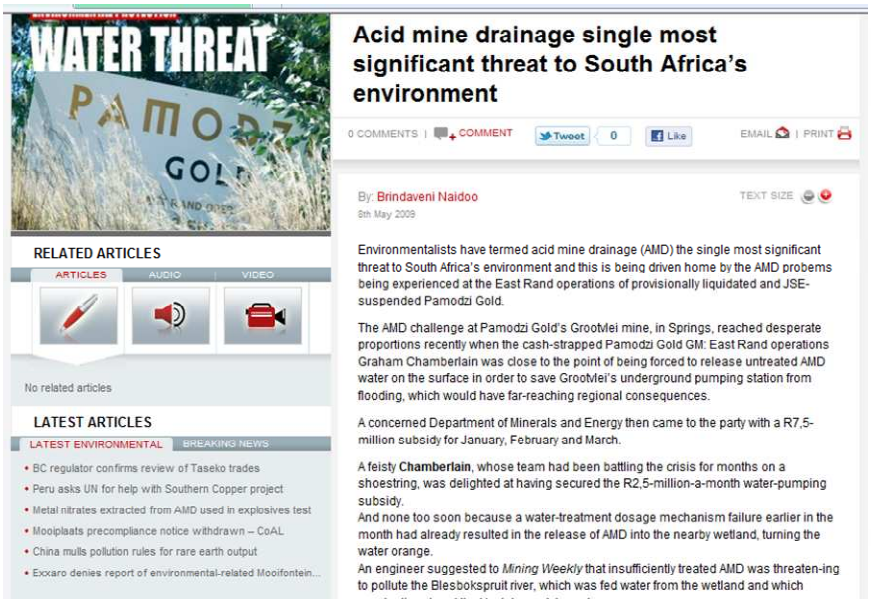
Challenges of implementing mine water projects

Jo Burgess

29th November 2010

Argh! Run away!



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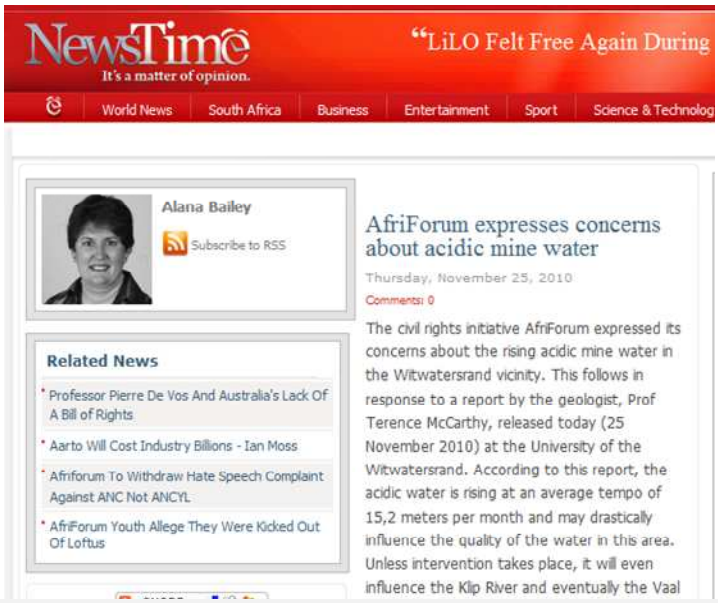

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Argh! Run away!

4

What is acid mine (rock) drainage, anyway?

- The science bit… take a deep breath.

5

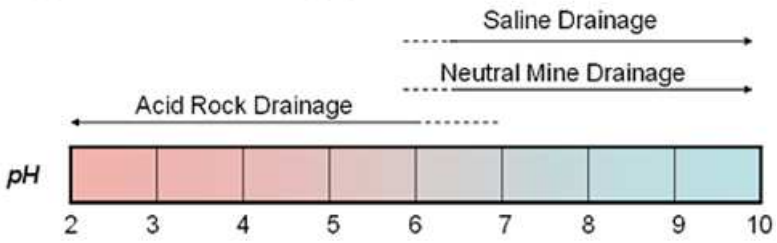
What is acid mine (rock) drainage, anyway?

- Water leached from rocks, produced from sulphide mineral oxidation, often termed:
  - *acid rock drainage* (ARD),
  - *acid mine drainage* or *acid and metalliferous drainage* (AMD),
  - *mining influenced water* (MIW),
  - *saline drainage* (SD), and
  - *neutral mine drainage* (NMD).
- Formed by the **natural** oxidation of sulphide minerals when exposed to air and water.
- Activities that involve excavation accelerate the process.
- The drainage produced may be neutral to acidic, with or without dissolved heavy metals, but always contains sulphate.
- Results from a series of reactions and stages that typically proceed from near neutral to more acidic pH conditions.

6

What is acid mine (rock) drainage, anyway?

Typical relation to drainage pH:



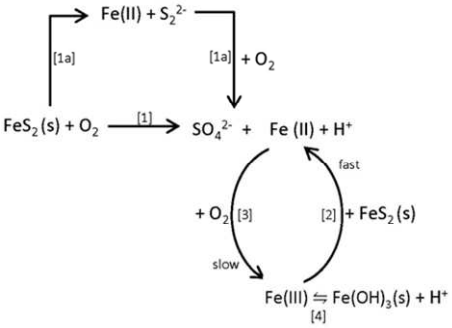
Typical drainage characteristics:

Acid Rock Drainage:	Neutral Mine Drainage:	Saline Drainage:
• acidic pH • moderate to elevated metals • elevated sulphate • treat for acid neutralization and metal and sulphate removal	• near neutral to alkaline pH • low to moderate metals. May have elevated zinc, cadmium, manganese, antimony, arsenic or selenium. • low to moderate sulphate • treat for metal and sometimes sulphate removal	• neutral to alkaline pH • low metals. May have moderate iron. • moderate sulphate, magnesium and calcium • treat for sulphate and sometimes metal removal

7

How does it form?

- [1] or [1a]: chemical pyrite oxidation, abiotic or biotic
- [2] aqueous ferric iron can oxidize pyrite as well but the reaction rate is limited by [3] , required to generate and replenish ferric iron
- Environmental importance related to ARD generation pertains to the fate of ferrous iron resulting from reaction [1]; it can be removed from solution and form iron (hydr)oxide ([4]).
- When [1] and [4] are combined, generally the case when pH > 4.5, pyrite oxidation produces 2x the amount of acidity relative to reaction [1]:
- $FeS_2 + 15/4O_2 + 7/2H_2O = Fe(OH)_3 + 2SO_4^{2-} + 4H^+$



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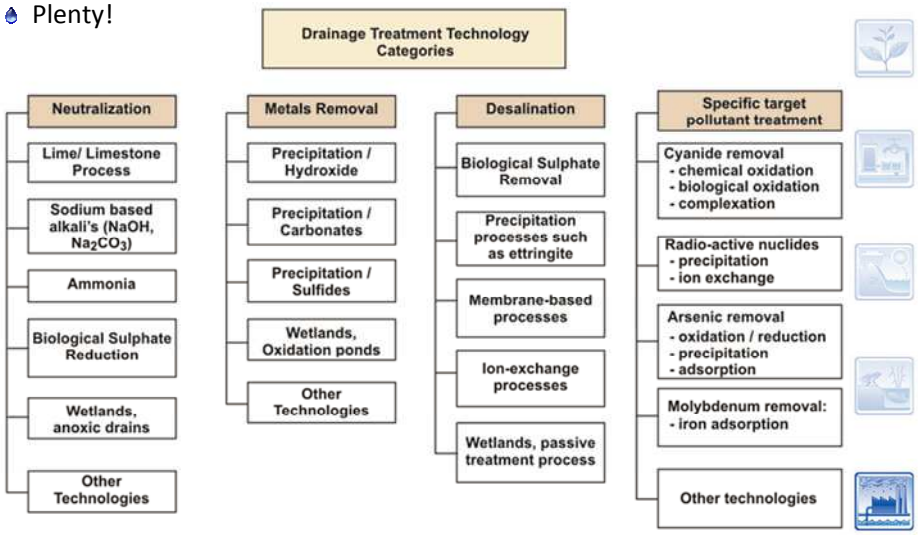
And what can we do about it?

- Plenty!



9

So why are we panicking?

- We have the technologies. We have the will…

So why are we panicking?

- Oh, here's the problem.

Times LIVE

Defence report bombshell

Low morale, poor pay and budget cuts in the defence force have led to the departure of highly skilled military personnel - a situation which might compromise national security.

MARKETS / JSE: 3

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Water solution caught in red tape

Nov 24, 2010 3:30 PM | By Sapa

The country's water crisis is past the eleventh hour as red-tape and interdepartmental bureaucracy remain major stumbling blocks to addressing the problem, trade union United Association of SA (UASA) said on Wednesday.

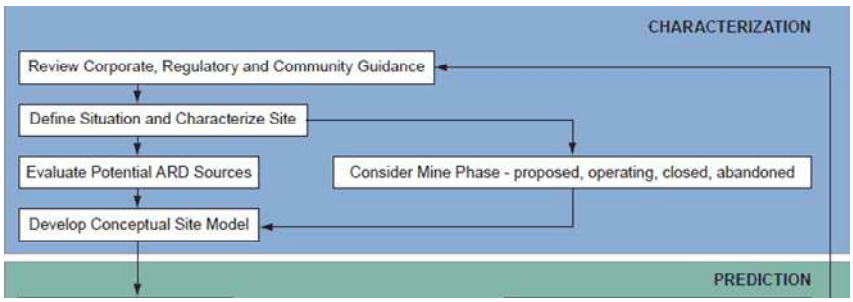
"Since March this year, it has taken the trade union UASA three well-publicised high-level seminars, an authoritative impact study, numerous meetings and a Section 77 application at Nedlac (National Economic Development and Labour Council) to bring home the message that South Africa is facing a gigantic water crisis," the union said in a statement.

Tweet 3 Share 3

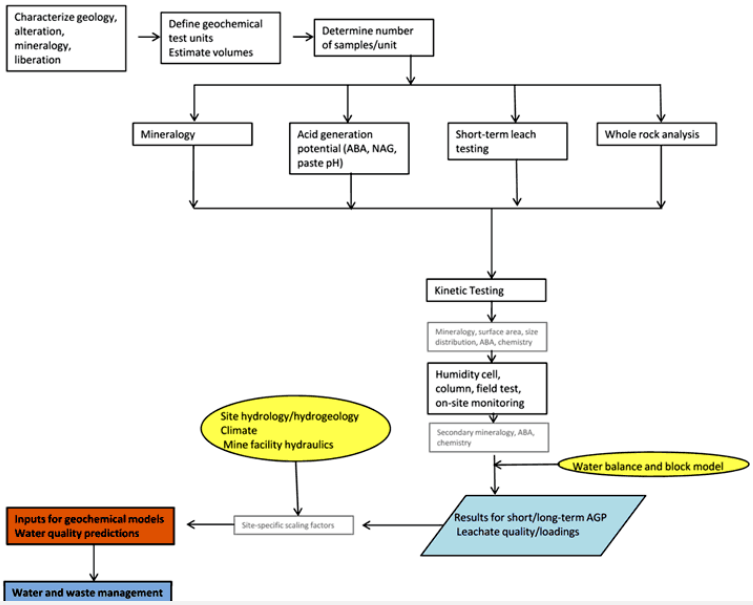
The union said its water security crusade, labelled "H2O 4 Life", has "awakened" government, organised

Why is this difficult?

- Because it's complicated.
- 1: Characterization of the unique situation.



1: Characterization



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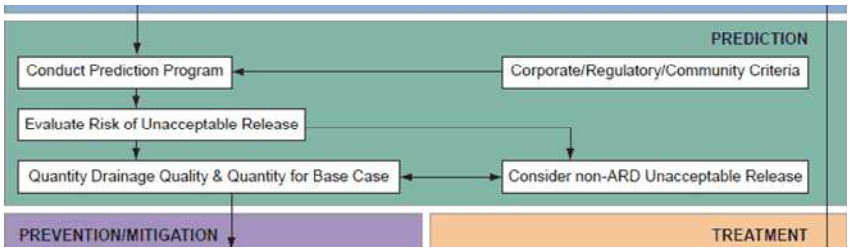
Why is this difficult?

- 2: Prediction of mine water formation.



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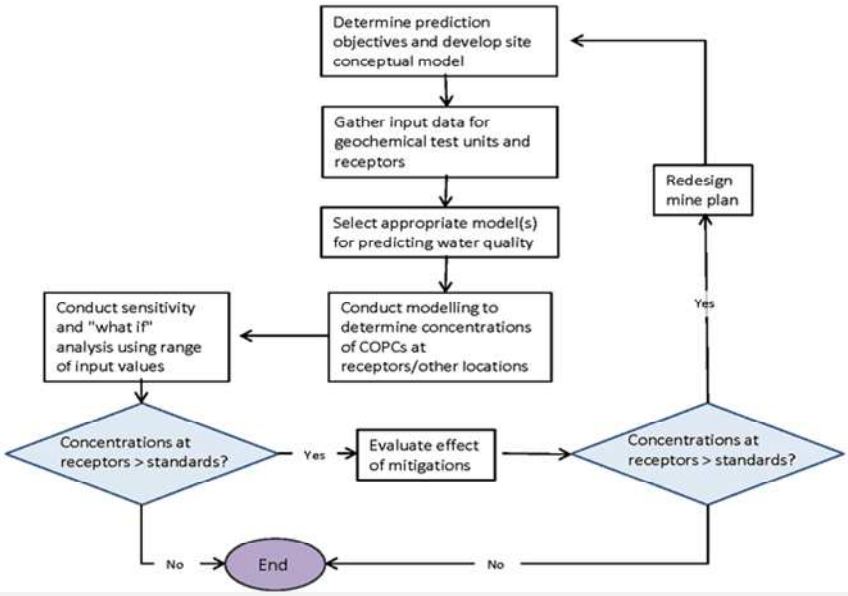
2: Prediction



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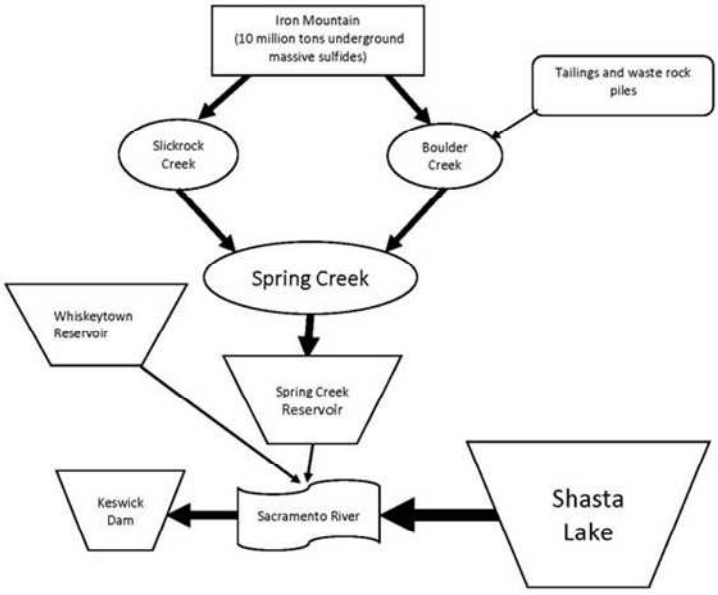
2: Prediction



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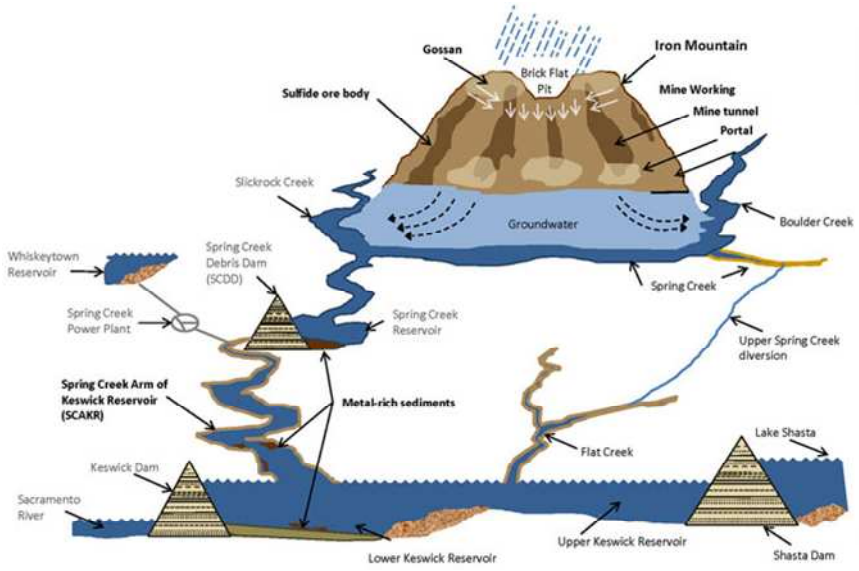
2: Prediction



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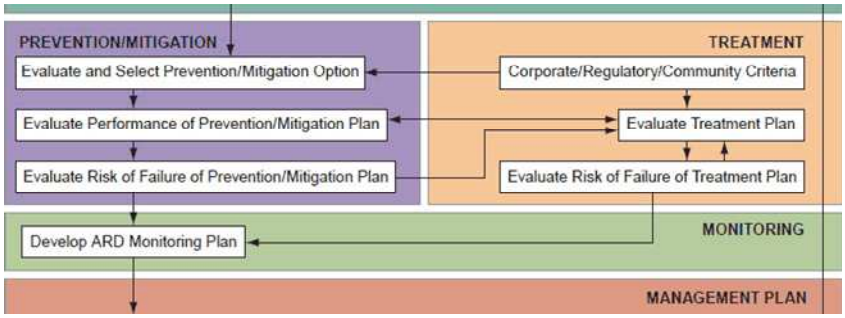
2: Prediction

18

Why is this difficult?

- 3 & 4: Prevention and treatment, leading to monitoring.



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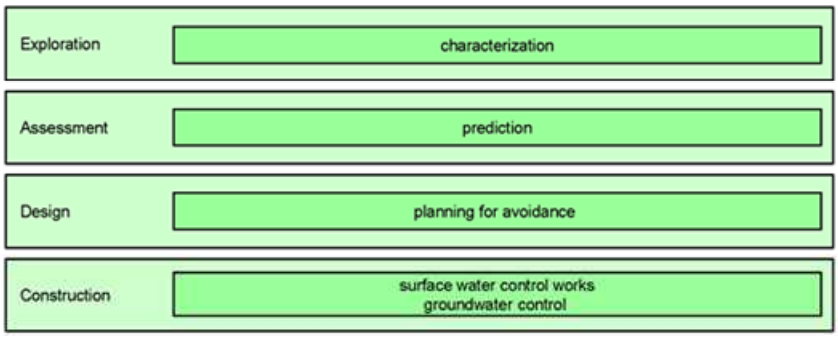
3: Prevention / mitigation

- Before mining...



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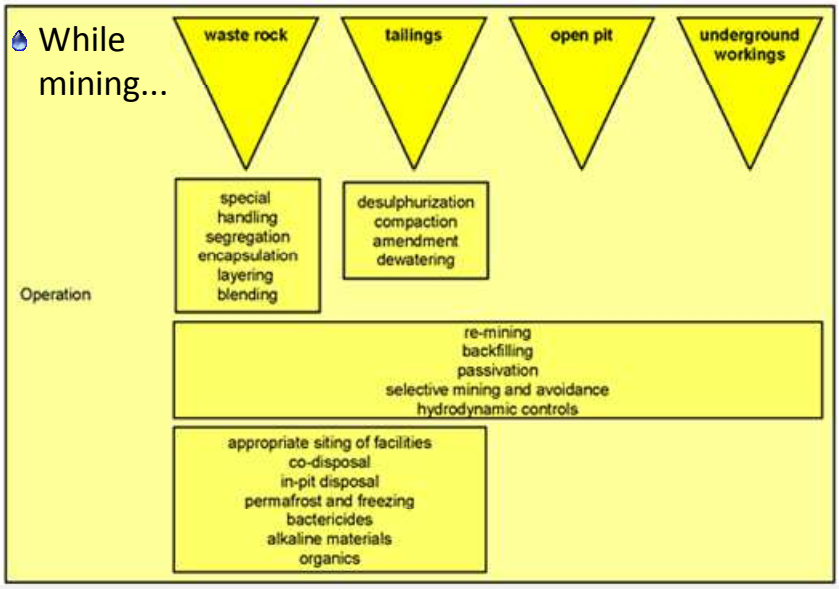
3: Prevention / mitigation

- While mining...



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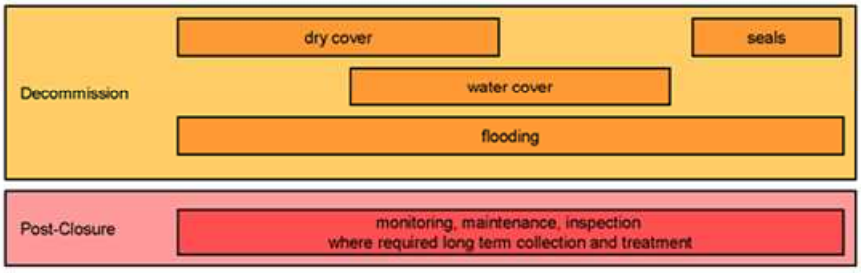
3: Prevention / mitigation

- After mining...



- All of which activities <u>themselves</u> are transdisciplinary.

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4: Treatment

Selection Criteria	Mine Drainage Treatment Technology			
	Chemical Precipitation	Membrane Treatment	Ion Exchange	Biological Sulphate Removal
Proven technology on commercial scale	Proven with many demonstration scales, large commercial plants	Proven, with several large commercial plants	Demonstrated on pilot scale, no large commercial plants	Proven, with a limited number of commercial plants
Specialized application	General application to high metals, high SO_4 mine water	General application, but with appropriate pre-treatment	Demonstrated for $CaSO_4$ type waters, with appropriate pre-treatment	Specialized application to high SO_4 mine waters
Water recovery	High water recovery > 95%	High water recovery > 90%	High water recovery not confirmed	Very high water recovery > 98%
Waste sludge/brine production	Large waste sludge production	Sludge and brine production	Large waste sludge production	Small waste sludge production
Potential byproducts recovery	Potential for $CaSO_4$ recovery	Potential, but not demonstrated	Potential for $CaSO_4$ recovery	High potential for Sulphur recovery
Chemicals dosing	High chemicals dosing	Limited chemicals dosing	High chemicals dosing	Process depends on carbon source

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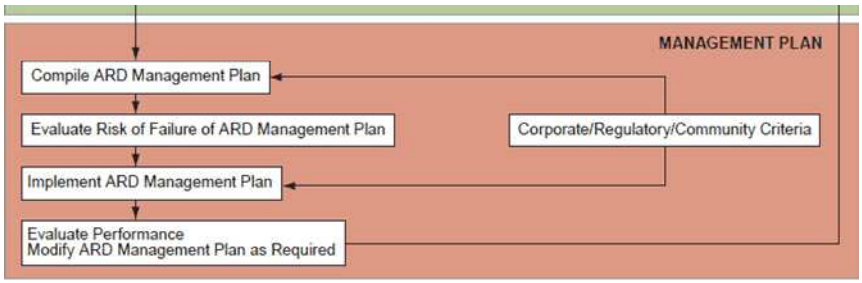
Why is this difficult?

- 5: Long term management.



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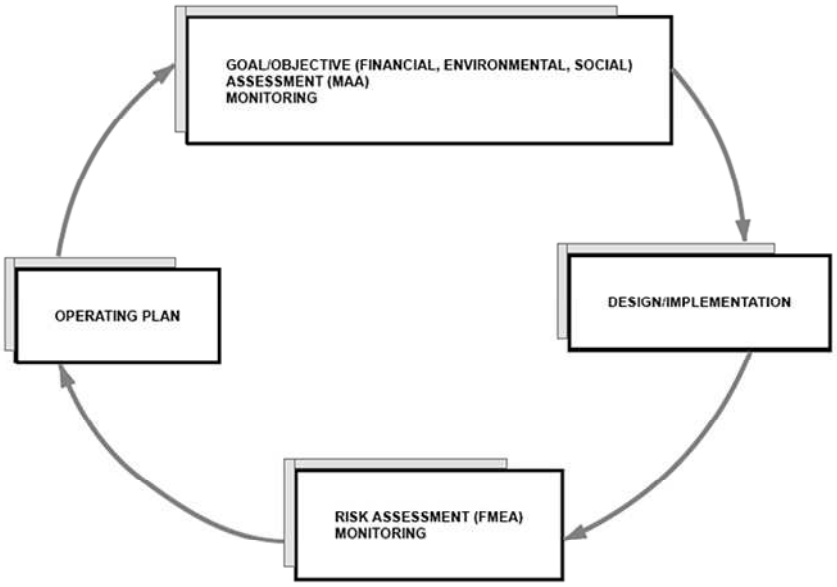
5: Long term management



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Sustainable mining

- In ARD management, sustainable development involves the mining company engaging stakeholders and finding optimal solutions that minimize risk, maximize benefits to multiple stakeholders, and manage trade-offs.
- It is a matter of exercising socially responsible practices.
- Sustainable development requires looking for the solution from a whole society and a whole mine-lifecycle perspective.
- Favours prevention of ARD over mitigation and treatment.
- Considers the long-term cost of ARD management in assessing the feasibility of a mine project, including the closure costs and post-closure site activities.

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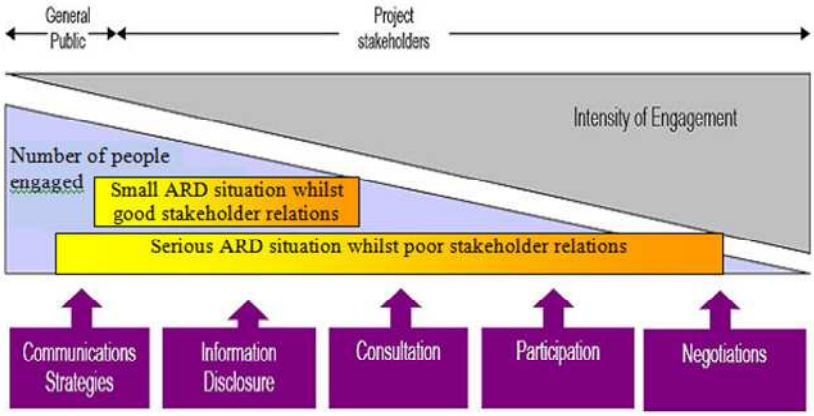
Sounds nice, so why is *this* difficult?

- Types of stakeholder engagement and the intensity with which people are engaged:



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The number and diversity of PEOPLE

1. Geology
2. Mineralogy
3. Geochemistry
4. Mining engineering and planning
5. Mineral processing
6. Analytical chemistry
7. Water treatment
8. Geotechnical engineering
9. Social sciences
10. Hydrogeology
11. Metallurgy
12. Hydrology and limnology
13. Soil sciences
14. Agronomy/botany forestry
15. Biology/ecology
16. Environmental law
17. Accounting and financial management
18. Contract management
19. Project management and supervision
20. Senior management

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For scientists / engineers, the 'soft issues' are hard…

- The GARD Guide is 389 pages, of which **7** are devoted to 'the future'.
- Communication issues between disciplines of engineering, let alone those of you who don't speak Geek.
- Historical baggage is costing us the future?

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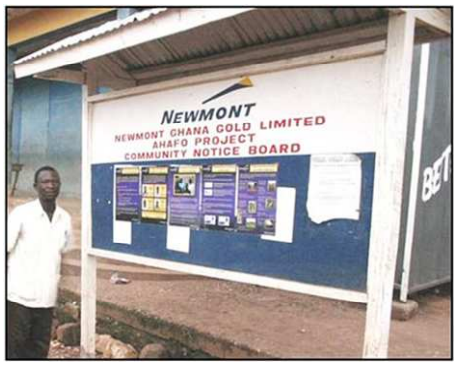
For scientists / engineers, the 'soft issues' are hard…

- 'The public' is a scary, many-faced monster…
- How is a poor geologist to talk to him? or to him?



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It's up to us – WE can change things!

- TALK to each other!!
- Be constructive – we do share a common goal, we just may have differences in the end result we imagine.

12.4 Water and Health Session Abstract and PowerPoint presentations

TITLE: The effects of reduced water quality in Loskop Dam on the health of Mozambique Tilapia (Oreochromis mossambicus)

NAME: Jackie Brown (University of Pretoria/CSIR)

ABSTRACT: Water quality in Loskop Dam has been deteriorating in recent years as evidenced by an increase in the frequency and abundance of fish mortalities. Several anthropogenic activities in the upper catchment contribute to reduced water quality creating complex impacts that range both temporally and spatially. These include acid mine drainage from coal mines in the Witbank and Middelberg area, agriculture, urbanisation and atmospheric deposition. Preliminary bioaccumulation studies in the upper catchment have shown high concentrations of metals including Aluminium, Iron and Manganese. We aim to investigate fish health in the Loskop Dam using Mozambique Tilapia (*Oreochromis mossambicus)* as a model species. Fish resident in the dam as well as fish introduced to cages in the dam from an aquaculture facility with good water quality will be sampled. Samples from both of these sources will be compared to the control site at Kranspoort Dam. Metal concentrations will be measured in fish gills, liver, muscle and bone and related to metal concentrations in sediment and water samples using multivariate statistics. Both chronic and acute environmental stress can prompt an increase in the concentrations of faecal glucocorticoid metabolites in organisms. These will be analysed in fish from Loskop Dam and compared to a control site. Acute effects will be measured in fish introduced to the dam in cages, and chronic effects measured in fish that reside in the dam. Several fish health indices including condition factor (Cf) and hepatosomatic index (HSI) will be utilised to describe the general condition of the fish.

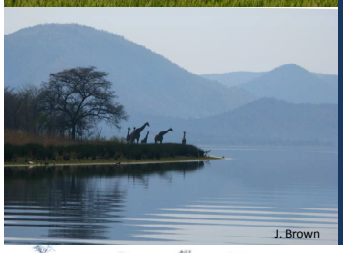
The effects of reduced water quality in Loskop Dam on the health of Mozambique Tilapia (*Oreochromis mossambicus*).

Jackie Brown

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

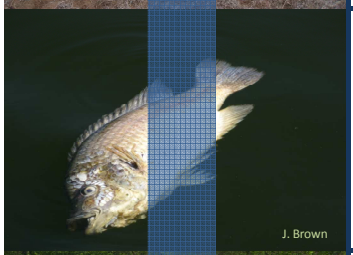
YWP YOUNG WATER PROFESSIONALS

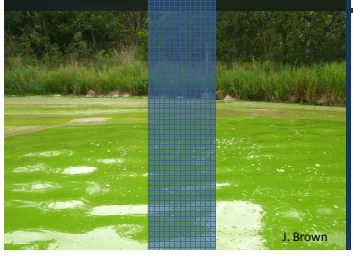
CSIR our future through science



Background

- Loskop Dam & irrigation canals completed by 1938
- Supply capacity of 362 million m^3
- Irrigation canals 480km
- Wheat, tobacco, cotton, citrus, vegetables, peanuts
- Loskop Water Scheme supplies 667 farms (jobs!)
(source: Loskop Irrigation Board)
- Nature reserve 25,000 ha incl. the dam
- >70 mammal species
- Fishing for carp, bass, tilapia, mudfish, barbel
- Upper Olifants River catchment is 11464 km^2
- Land uses include mining, urbanisation, agriculture





Recent Observations

CROCODILES (Secondary consumers)

- Die-offs in Loskop Dam and Kruger National Park (170)
- 30 in 1984 (some report as high as 80) -> 8 in 2009
- None currently of a reproductive age
- Pansteatitis in crocodiles

FISH (Primary consumers)

- Multi-species fish kills in Loskop Dam (2003 - 2007)
- Spring die-offs of *O. mossambicus*
- Pansteatitis in fish

ALGAL BLOOMS (Primary producers)

- Manifestation of eutrophication
- *Microcystis* spp. & *Ceratium hirundinella*
- Regularly attain bloom proportions

What is pansteatitis?

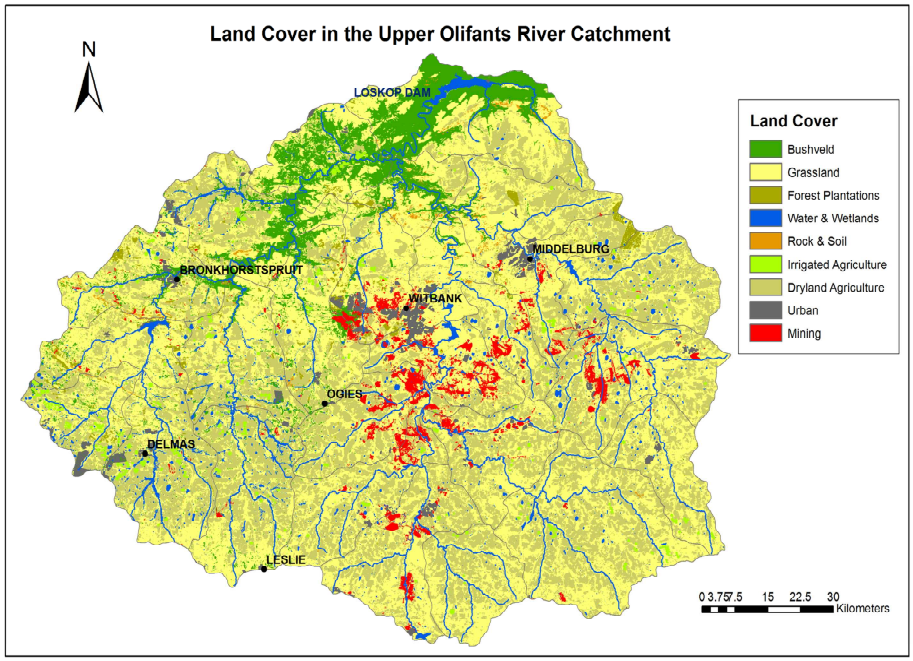
- Diagnosed in domestic cats, trout, aquarium fish, rats, crocodiles, herons, kangaroos, horses, pigs, chickens, mink
- Dietary origins: low vitamin E; high polyunsaturated fats
- Crocodile symptoms: yellow, hardened fat; stiff & lethargic; stomach empty; low vitamin E levels
- Fish symptoms: obesity; yellow, hardened fat; stomach empty; fat intrusions in liver (floats in formalin), lipofuscin concentrations
- Steatitis vs. Pansteatitis

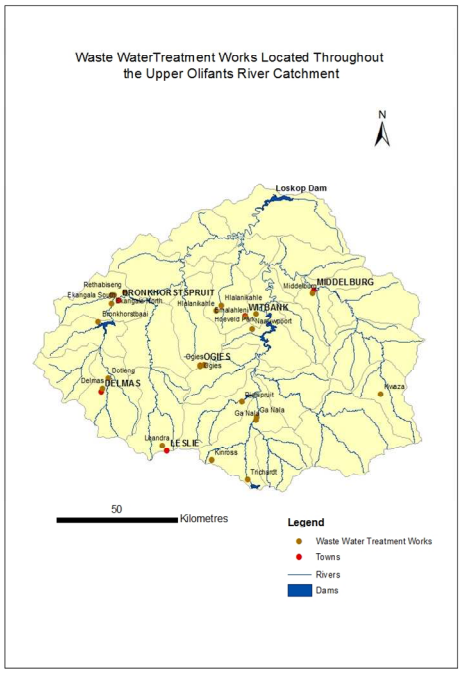
Main Threats to Aquatic Ecosystems

(point, diffuse, intermittent or continuous)

Urbanisation	Sewage	Eutrophication Algal blooms Pathogens (human health) Endocrine Disruptors (EDCs)
Coal Mining	Acid Mine Drainage	Mobilise metals Sulphates
Industry	Discharge	Sulphates Toxic chemicals
Agriculture	Fertilisers	Eutrophication
	Pesticides	EDCs & toxic chemicals
Power stations	$SO_2 \rightarrow H_2SO_4$ (acid rain)	Mobilise metals Sulphates

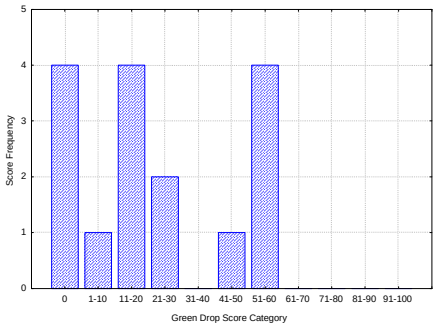
Spatio-temporal complexity!

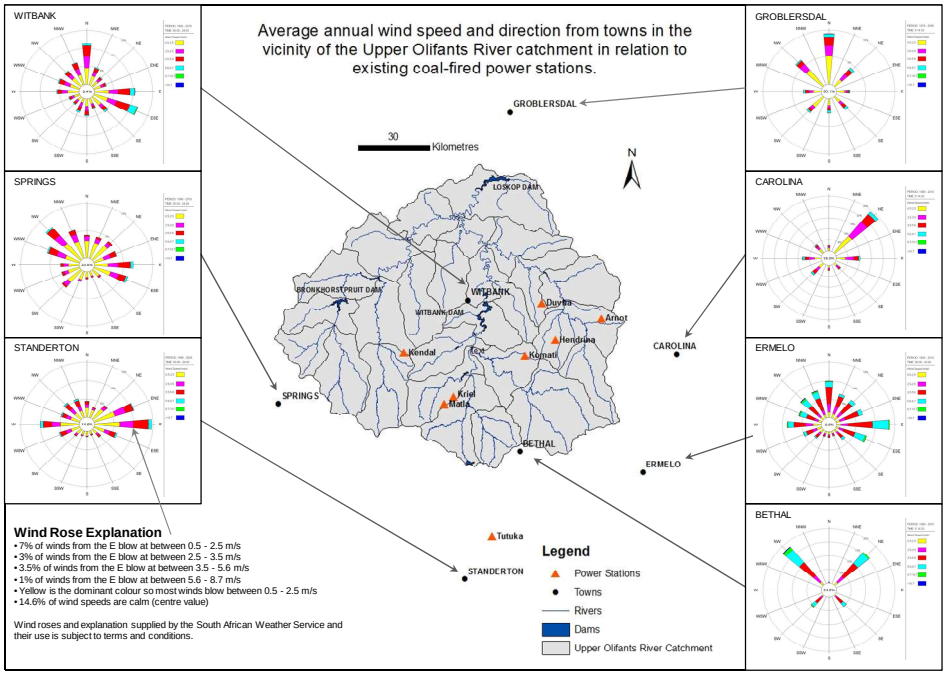




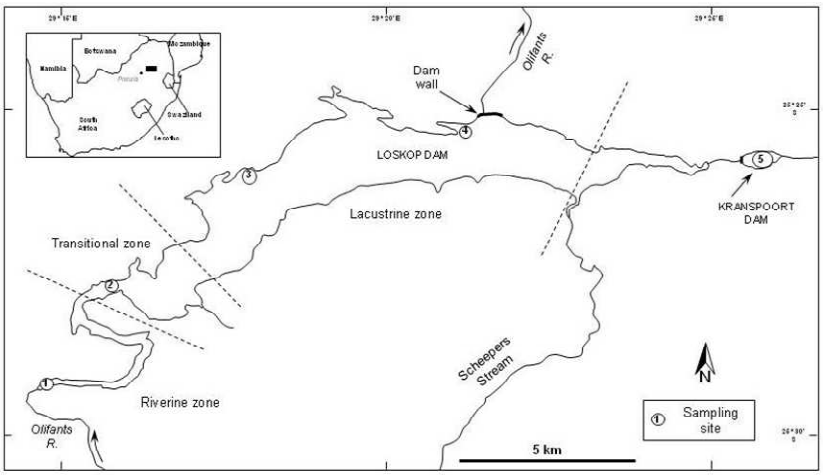
Impact: *Sewage*

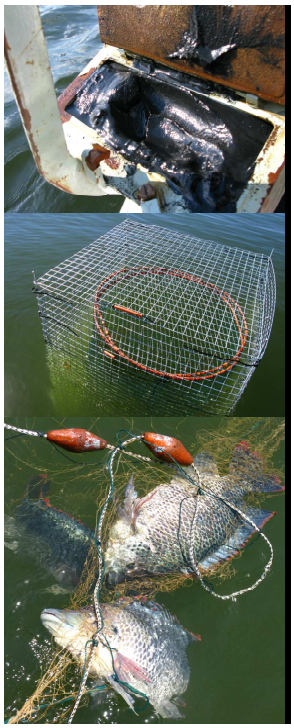
- Several waste water treatment works in catchment
- Average to very low scores on preliminary Green Drop report (2009)
- Highlights need to upgrade infrastructure, improve processes, employ skilled personnel





Methods: Site Selection





Methods

WATER (monthly)

- Monthly testing of 27 constituents (metals, nutrients, ions)
- Surface water pH, DO, TDS, Temp, Secchi depth
- Depth profiles of Temp, DO, pH

ALGAE (monthly)

- Phytoplankton and zooplankton samples

SEDIMENT (monthly)

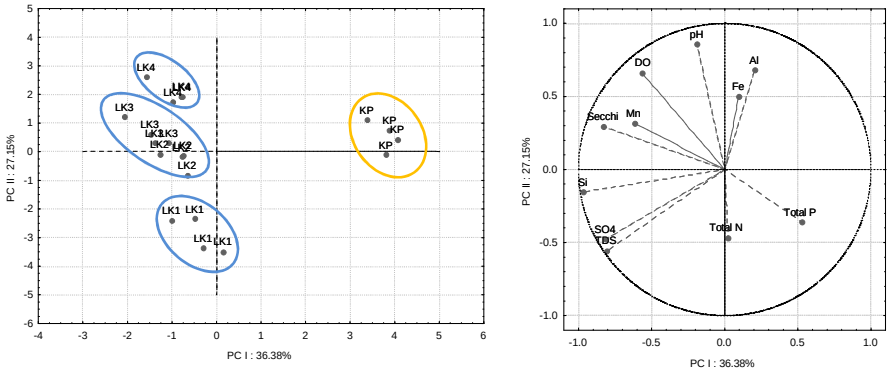
- Monthly testing of S, Al, Fe, Zn, Pb, Mg, Mn, Cu
- % C and particle size analysis

FISH (Low flow, Aug – Oct)

1. **Wild population**
   - 20 fish each from Loskop and Kranspoort Dams
2. **Biomonitoring cages**
   - Cages installed at 3 sites in Loskop, and 1 at Kranspoort
   - 20 fish per cage from Tompi Seleka
   - 6 week exposure in each cage
   - Measure parasite communities, metal concentrations, health indices, hematology, faecal glucocorticoids, EDCs
3. **Natural Mortalities**
   - Collected *ad hoc*

Results

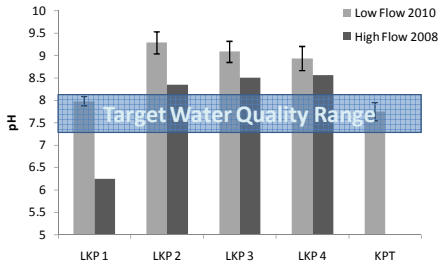
Water Quality

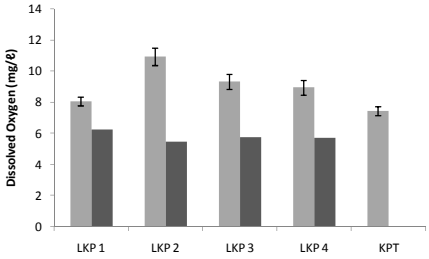


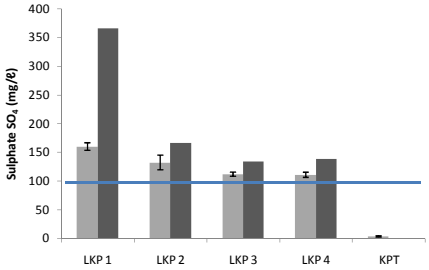
Principal Components Analysis (PCA): water quality in Loskop and Kranspoort Dams
PC 1 = 36.38 % variation
PC 2 = 27.15 % variation

Results

Water Quality



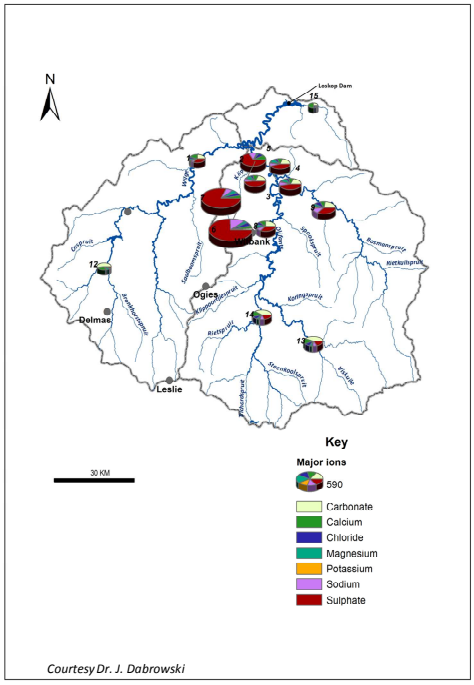




Low flow 2010 = July – October
High flow 2008 = January – June *

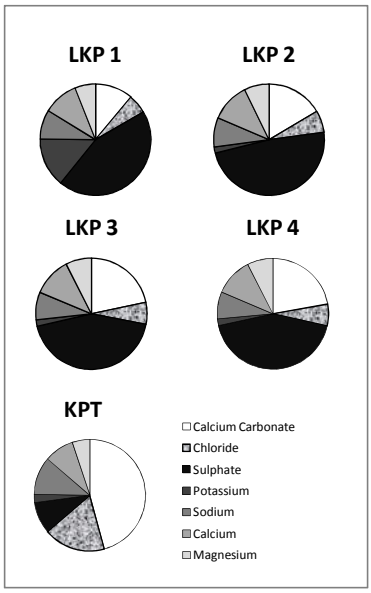
Mean values from comparable sites in Loskop Dam

* Adapted from Oberholster *et al.* 2009



Courtesy Dr. J. Dabrowski

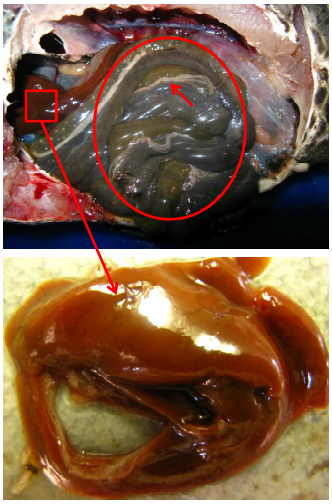
Major ions in Loskop Dam and the upper Olifants River catchment.



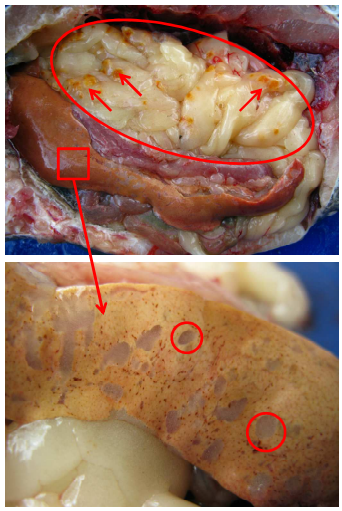
Results

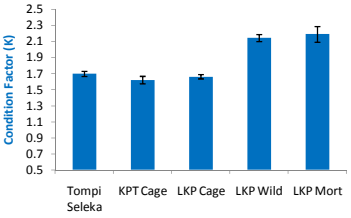
Fish Health: Wild population in Loskop Dam

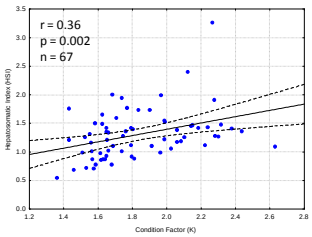
REFERENCE CONDITION

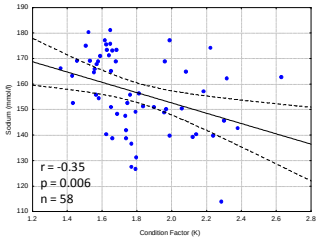


WILD LOSKOP DAM FISH









Fish Health Continued

Fish Health Parameters	Assessed
Condition Factor (K)	✓
Hepatosomatic Index (relative liver size)	✓
Gonadosomatic Index (relative gonad size)	✓
Splenosomatic Index (relative spleen size)	✓
Blood Sodium levels	✓
Hematocrit (red blood cell volume)	✓
Fish Health Assessment Index (HAI)	X
Metal analysis (liver, gills, muscle, brain)	X
Endo and Ectoparasite communities	X
Endocrine Disrupting Compounds	X
Histopathology (liver, gills, fat)	X

Conclusions for Loskop Dam so far...

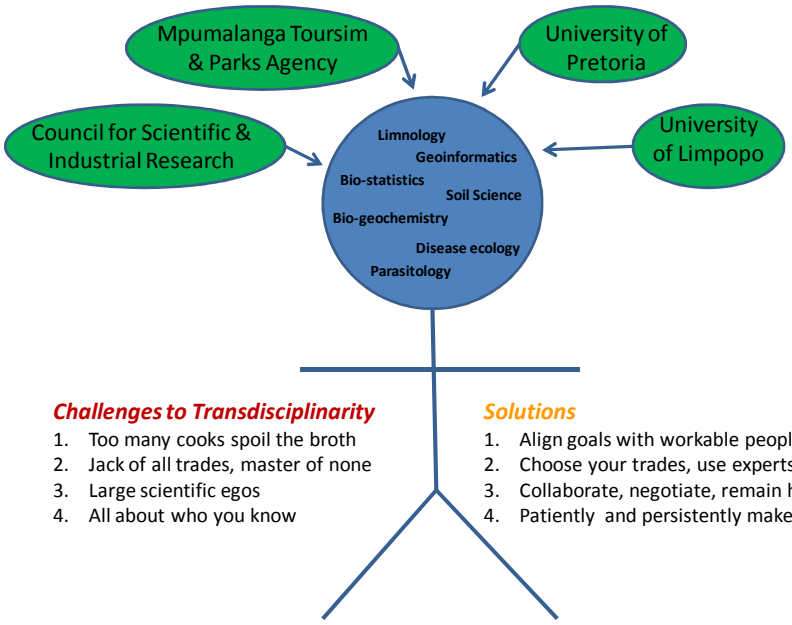
1. WATER QUALITY

- ✓ Eutrophication was the biggest impact observed during this study period
- ✓ Conditions in the transitional zone are highly variable
- ✓ Frequent blooms of *Ceratium hirundinella* and *Microcystis* spp. observed
- ✓ Evidence of mining and industry impact in high SO_4 and TDS concentrations

2. FISH HEALTH

- ✓ Both male and female *O. mossambicus* are affected by steatitis
- ✓ The condition appears to be progressive with larger fish more affected
- ✓ The majority of large *O. mossambicus* in Loskop Dam are affected by steatitis
- ✓ Fish in the transitional and lacustrine zones also have steatitis
- ✓ Pansteatitis also found in *Labeo rosae* (red-nosed mudfish) natural mortalities

The Transdisciplinary Individual



Challenges to Transdisciplinarity

1. Too many cooks spoil the broth
2. Jack of all trades, master of none
3. Large scientific egos
4. All about who you know

Solutions

1. Align goals with workable people
2. Choose your trades, use experts elsewhere
3. Collaborate, negotiate, remain humble
4. Patiently and persistently make contacts

Thank you to the following people for assistance:

Jannie Coetzee (MTPA)
Andre Hoffman (MTPA)
Dr. Paul Oberholster (CSIR)
Dr. Jan Myburgh (University of Pretoria)
Dr. Wilmien Powell (University of Limpopo)

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CSIR
our future through science

Household Water Filter Project K5/1994
Presented at the CSIR November Symposium – Transdisciplinarity and Change in the Water Sector

"Water Quality Concerns in Water Filtration Devices"

Presented By:
Ms. CA. Robertson
Doctoral Candidate
Water and Health Research Unit
University of Johannesburg
Faculty of Health Sciences

Project Supervisor: Dr. TG. Barnard (Director WHRU)
Project Co-Supervisor: Dr. C. Bartie (NIOH)
Project Co-Supervisor: Dr. I. Jacobs (CSIR)

Executive Summary

- Recent outbreaks of cholera and other waterborne diseases in SA have resulted in a public perception that tap water is not safe for drinking purposes.
- **Major challenge** → control of microbial contamination risks from water treatment plants to the consumer's taps.
- **Intervention** → control and maintain the microbial quality of water at POU household level.
- **Therefore** → POU water purifying filtration systems are popular with consumers as a countermeasure to remove waterborne pathogens and undesirable chemicals from water.

Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Executive Summary

- **Problem** → consumers buy devices in good faith on the basis of claims of efficiency made during marketing campaigns, "the unit will remove 90-100% of all harmful microorganisms".
- **However** → claims often made by manufactures are not substantiated by independent research (products are usually tested in-house and mostly only for their capacity to remove traditional indicator bacteria).
- **In SA** → it seems there are limited policies in place when endorsing these devices for public sale approval.
- **Overall** → this can have a huge impact on water health???
- **Therefore** → a need exists for a transdisciplinary study to evaluate POU devices currently manufactured and sold in SA, in concern with regulation and commercialization of these devices against the claims that are made by these manufacturers.

Ahammed and Meera, 2010; Devi *et al*., 2008 Berney *et al*., 2008; Varbanets *et al*., 2009; Manus, 2009; Hunter *et al*., 2009

What is the current tap water quality situation in SA and how is it regulated???

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Provision of Safe Tap Water →

- **The provision of safe tap drinking water supplied by local municipality is ensured by:**

1. National and regional government → Water Supply and Sanitation Policy (SANS 241:2006).

2. DWA → Minimum potable water quality guideline (ensures bacteriological, appearance and chemical quality of urban water is acceptable for the protection of human health).

3. Blue Drop Certification Programme → regularly informs general public on the drinking water quality management levels per service system in various cities and towns of SA.

SABS, 2001; De Lange *et al*., 2010; Friedrich *et al*., 2009; DWAF, 2009; Polasek, 2009

Provision of Safe Tap Water → **Public Perspective on Water QC** →

- **Public perspective on the current water quality status in SA:**

1. Microbiologically polluted water in SA → associated with the transmission of gastroenteritis, cholera, typhoid fever etc.

2. Delmas diarrhoea outbreaks from 2005 to 2009 caused alarming concern in SA residents, despite governmental assurances.

3. Result → public questions integrity of DWAF and rely on POU filtration devices to improve water quality.

4. SA households spend R1.8 billion annually on bottled water and home water filter treatment systems.

5. Suppliers of POU systems use scare tactics of in-house "false" water testing to warn the public of poor water quality to convince them to use POU devices.

Kahinda *et al*., 2007; Kamara and Sally, 2003; Lang, 2007; Strydom, 2009; Nealer, 2009; Sobsey *et al*., 2008; Kaiser, 2010; NBWS, 2009; Manus, 2009

Provision of Safe Tap Water → Public Perspective on Water QC → Criteria of Interest for Water

- **Criteria of interest of common household tap drinking water contaminants and interest of removal capabilities of POU water filtration systems:**

Categories	Type of Contaminants	Potential Health Effects from Ingestion of Water
Pathogens	Bacteria (Campylobacter, Cholera, Shigella, Salmonella, Mycobacter and Legionella)	Mostly cause gastrointestinal illness (e.g., diarrhoea, vomiting, cramps).
	Viruses (Rotaviruse, Adenoviruse, Noroviruse, Enteroviruse , Hepatitis A and E)	
	Parasites (Entamoeba, Bilharzia, Cryptosporidium, Giardia, Helminths)	
Toxins	Heavy metals	Mostly cause gastroenteritis or damage the kidneys, bones, blood, liver or nervous system.
	Nitrates and other non-metals, minerals	
	Asbestos fibers	
	Algae toxins	
Organic Chemicals	Volatiles (VOCs)	Increased risk of cancer and provide a substrate for bacteria to grow on.
	Pesticides, THMs, herbicides, other non-volatiles	
Radioactive Substances	Radon	Increased risk of lung cancer and kidney toxicity.
	Uranium and radium	
Additives	Chlorine disinfection and its by-products	May cause nose and eye irritation, stomach discomfort or anemia. May cause liver, kidney or central nervous system diseases, risk of cancer.
	Fluoride	
	Flocculants	
	Organic by-products	
Tastes and Odours	Hydrogen sulphide and other volatiles	Can cause severe discoloration of water and unpleasant metallic taste and odour, but no ill health effects.
	Dissolved minerals	
	Mineral and organic particles	
Appearance	Turbidity	Turbidity may indicate the presence of disease causing organisms.
	Colour	

APEC International, 2010

What should the public consider before purchasing a POU water filtration device in SA???




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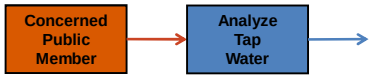


- **Analyze tap water for possible contaminants:**

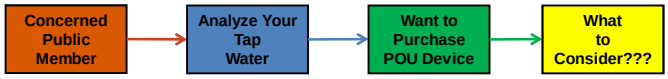
1. Consult Annual Water Quality Report (AWQR) from DWA.
2. Blue Drop Certification Program website → view drinking water quality management levels per service system.
3. Water testing institutions → privately analyze tap water.
4. Sometimes there is a difference between the AWQR, and what comes out of the actual tap → invariably additional contaminants are picked up through municipal water distribution systems and through household plumbing.

DWAF, 2009; Polasek, 2009; SABS, 2001 ;SMI Analytical, 2010; NRDC, 2010

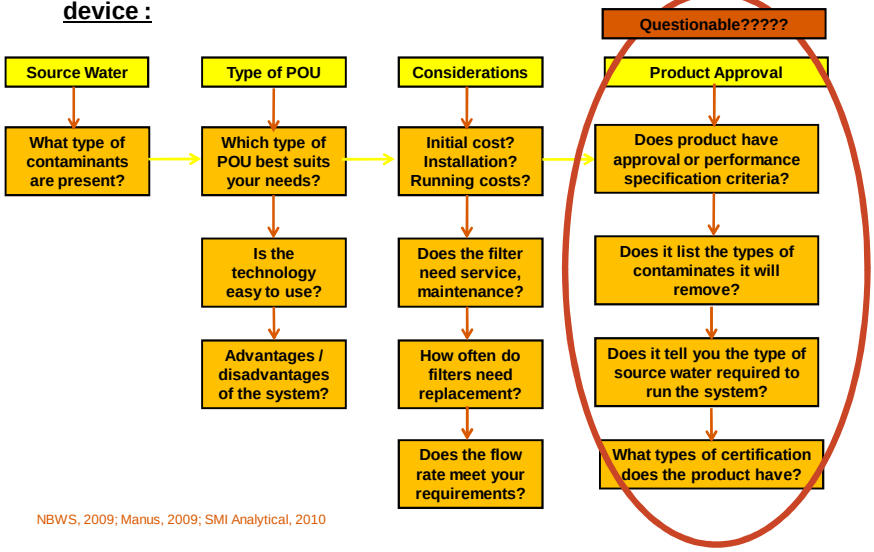
- **Still want to purchase a POU home filter device:**

1. There are many different types of technologies available on the market.
2. Each have their own advantages and disadvantages.
3. Some of these technologies are used in combination.
4. Some are fitted to a tap, some under your sink and some on top.
5. This can be confusing to the public?????

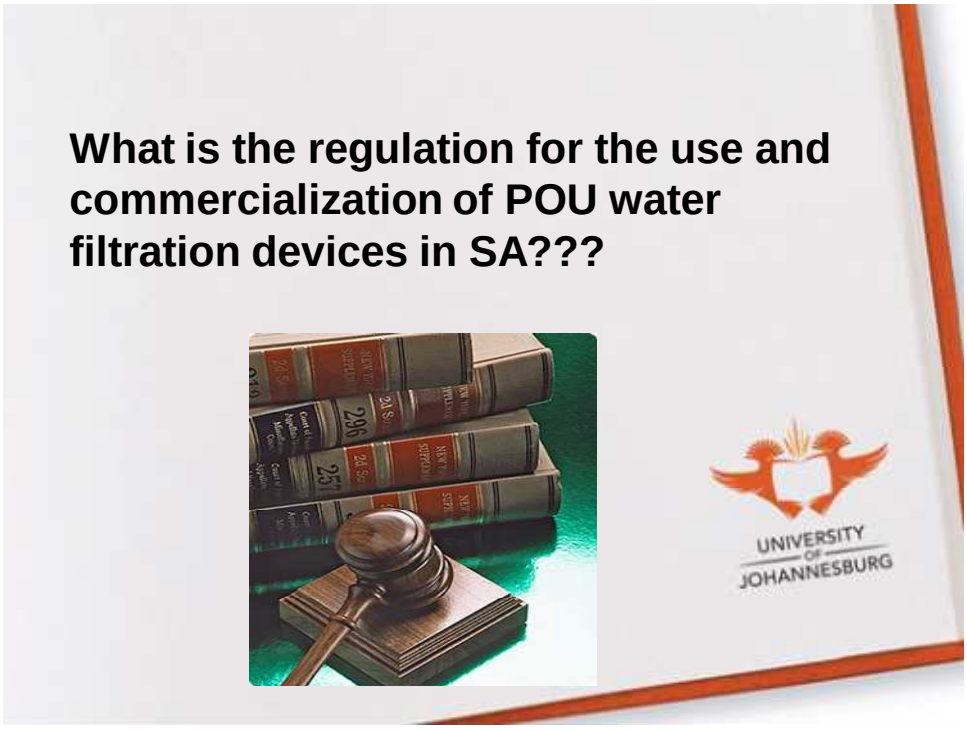
De Lange *et al*., 2010; Friedrich *et al*., 2009; Polasek, 2009

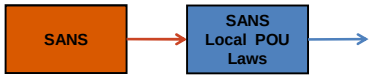


- **What to consider before purchasing a purchase a POU home filter device :**



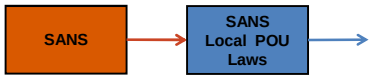
NBWS, 2009; Manus, 2009; SMI Analytical, 2010





- For POU water filtration units manufactured locally SANS has a single policy in place SANS 1865:2006 “POU Drinking Water Treatment Systems”.
  - Evaluates the performance of POU units intended to be used for lowering the concentration of hazardous substances to human health.
  - However, microbiological requirements in this policy state that POU units must comply with the drinking water standards given in SANS 241:2006 policy.
  - This standard is the exact same criterion that local municipal suppliers of tap water are required to meet in SA.
  - Hence consumers are currently installing POU devices to their taps that potentially “purifies” tap water to “perhaps” a better standard than the local supply, yet both are meeting the same standards and requirements???

SANS 1865, 2006; Buren, 2010; Unger, 2010; Water Quality Management System, 2009; Polasek, 2009; SABS, 2001



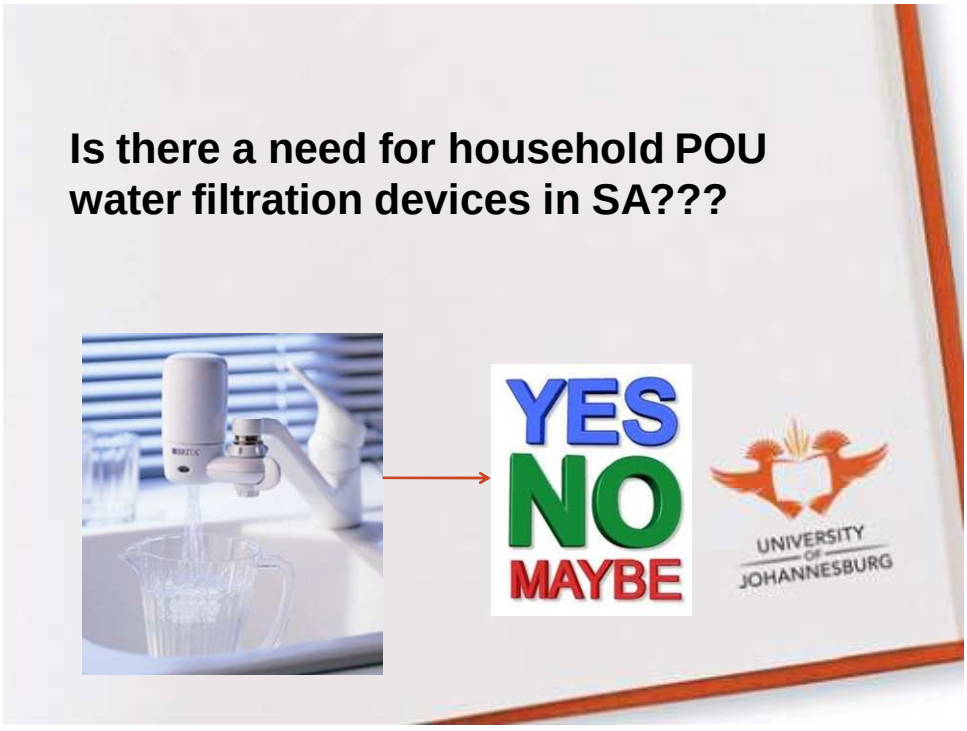
- Thus, if these POU devices have only SANS certification, how are they improving tap water quality after municipal purification?
- If local municipality fails to comply with SANS 241:2006 or perhaps there is an unforeseen outbreak of waterborne diseases, will most locally approved POU water filtration devices be able to aid in protecting tap water???
- Local POU water filter manufactures state → “units should be used with municipally supplied tap water and if the municipal water is not up to standard they are not to blame”.
- SANS 1865:2006 policy also requires that POU water filtration devices meet the standards of SANS 9001:2006 “Manufacturing quality of the system” → misleading to the public, as they believe the unit is approved, however it is only approved within its manufacturing components and not within its water purification abilities.

SANS 1865, 2006; Buren, 2010; Unger, 2010; Water Quality Management System, 2009; Polasek, 2009; SABS, 2001

- The National Sanitation Foundation (NSF) is an international testing and certification program for POU water treatment units.
- NSF has maintained consensus standards and certification programs in public health and safety → leading independent third party testing and certification organization worldwide.
- It is not a requirement in SA for suppliers of POU devices to be registered with NSF.
- However, most European and American governments are making NSF the "golden standard" to be certified with in their water policies.
- Some corporate suppliers within SA choose to be certified with the NSF →registration allows them to have international recognition.

NSF The Public Health and Safety Company.™

NSF International, 2010; Ultimate Water, 2009; NSF, 2010; Buren, 2010; Unger, 2010



NO →

- **According to the consumer's guide on drinking water quality released by government in 2009:**

➢People in areas where drinking water meets national drinking standards **do not** require additional water filtration to meet their health requirements.
➢Recommends → use of POU filters in areas where drinking water is not yet up to standard.
➢ **However:**
  - Units are expensive.
  - May produce clean water, but its not necessarily microbiologically safe water.
  - Water quality after POU filtration depends on the nature of the filter medium.
  - A small amount of chlorine is still required to ensure water is safe to drink.

➢Replaced filters regularly → to limit the build up of microorganisms and chemicals which may be released back into the water, resulting in deteriorated water quality.
➢POU filters are mostly used for aesthetic reasons → they will only improve the taste or smell of the treated drinking water.

Manus, 2009; DWAF, 2009; Strydom, 2009; SABS, 2001

NO → YES →

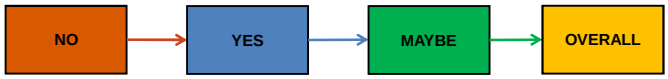
- **The concern of South African consumers about their drinking water is warranted in some instances:**

➢When water is supplied in old iron pipe systems and where lead is used for soldering taps and connections.
➢Lead leaches from these sources and contaminates drinking water.
➢Environmental health risk → lead is known to cause brain damage.
➢Additionally, many tap water sources have undesirable and sometimes harmful turbidity, odour, and hardness that prompt consumers to use of POU filtration devices.
➢However, firstly investigate your household plumbing and check if it needs replacing.

Deshommes *et al*., 2010; Hunter *et al*., 2009; Hendry, 2009; Kahinda *et al*., 2007; Rietveld *et al*., 2009

- If one is considering purchasing and installing a POU filtration device → make an informed decision????
- Ensure there are no misleading marketing strategies used by suppliers that claim water purification without supportive evidence.
- Make certain that the POU device has proper certification and meets local and international standards.
- Check the suggested source water to be used with the filtration device.
- So far 75% of the units investigated by this project are only compatible with municipal tap water and have only SANS certification → so if the tap water supply is not up to standard, they should not be considered.
- If there are potentially health hazardous threats in the tap water, then consider installing a POU unit that meets international NSF standards.

SMI Analytical, 2010; Twain, 2009; NSF International, 2010; Ultimate Water, 2009; NSF, 2010; Buren, 2010; Unger, 2010



- Overall it is the general publics choice to decide whether they require a water filtration device for their tap water and if its need is warranted????
- But, this study could potentially aid the public in making an informed decision and perhaps force suppliers of POU water filtration devices to improve their standards…..

Small scale POU water filtration devices water health impact in a transdisciplinary framework of study???

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Aims of Study

- **Aim** → assess POU water purification units manufactured and sold in SA for their capacity to provide safe drinking water for domestic, public and occupational use in terms of their product approval and regulatory certification standards.

Study Areas of Evaluation

- Evaluate the benefits of POU purification units in SA, in terms of their **livelihood**, **health**, **social** and **environmental** impacts.
- In order to examine under what certification conditions, the benefits of these units can be accepted without damage to the environment and public health.

- **Specific questions that would be addressed are:**
  1. What are the current by-laws for product approval?
  2. What are the health and environmental effects (positive/negative) in relation to the general public using POU units which lack certification?
  3. What are the socioeconomic costs and benefits, when units which are properly certified and approved are used?
  4. What strategies/technologies could be applied effectively to minimise the negative impacts current by-laws have on product approval?

Study Areas of Evaluation

- Study will use a combination of investigative transdisciplinary participatory approaches → literature review, market research, surveys, questionnaires, interviews and case studies.

- The following impacts will be assessed:

1. ***Current certification of units in SA:*** regulation and commercialization.
2. ***Livelihood impacts:*** current impact on consumers utilizing these units.
3. ***Health risks:*** abilities of POU devices to improve/deteriorate water quality and the overall health impact (positive/negative) on consumer's health.
4. ***Mitigation strategies:*** negative impacts of poor policy approval of units and the overall impact on the general public.
5. ***Environmental impacts:*** impacts of devices on the current water quality to improve potability and decrease harmful substances in accordance with manufactures claims and legislation.
6. ***Institutional issues:*** the framework of national policies, legislation and regulations management for POU device approval in SA will be investigated.
7. ***International comparisons:*** current legislation policies in SA will be assessed and compared to those of other international countries, so perhaps our legislation can be improved to reflect those of international standards.

Objectives of Study

- Conduct a survey of units currently manufactured and sold in SA → group them (treatment technology offered, size, claims of treatment capacity, certification and type of unit).
- Provide guidelines / pamphlet of POU units to the public to enable consumers to make informed decisions when purchasing these devices.
- Evaluated sample units in public households → performance and acceptability.
- Provide a comprehensive report → guidelines to manufacturers and suppliers (assist them in providing improved products).
- Conduct a workshops with manufacturers and suppliers → discuss the findings of the study and the way forward.
- Produce a comprehensive final report with recommendations for various governmental organisations on the approval criteria of POU water purification units and include suggested policy changes to help mitigate the certification of such products.

Water Health in Relation to POU Devices

- **<u>Scientific knowledge of water health hazards and public perception and behaviour:</u>**
  - Public perception of good water quality is based upon organoleptic aspects → taste, odour, turbidity, colour, and salinity.
  - When unpleasant taste results from water disinfection through chlorination, people are pushed by commercial advertisement → "drink bottled water or purchase a POU device".
  - Negative reactions also come from poor information given by the media → specifically on the meaning of any chemical quality standard.
  - Neither the media, nor the public understand that a standard is a compromise between what is desirable, and what is feasible.
  - Also, if POU water filtration devices are not regularly maintained → can negatively impact the overall water quality of tap water.



Kahinda *et al*., 2007; Kamara and Sally, 2003; Lang, 2007; Strydom, 2009; Nealer, 2009; Sobsey *et al*., 2008; Kaiser, 2010; NBWS, 2009; Manus, 2009

Water Health in Relation to POU Devices

- **<u>The public generally believes their water is the constant problem of ill health due to compromised water quality:</u>**
  - *"Chlorine makes me sick"* → to ensure water is safe to drink and contains no pathogens, the municipality allows a small amount of chlorine to remain in the water that is supplied to your tap to prevent bacteria growing in pipes (it's not harmful to your health).
  - *"My water is murky, its contaminated"* → generally its dissolved air that causes this cloudiness due to pipe pressure.
  - *"My water has a bitter or metallic taste"* → investigate your household plumbing before blaming the municipality (corrosion of copper, iron or galvanized pipes can cause poor water quality and this is an internal localized problem).
  - *"My water makes me sick with gastroenteritis"* →consider looking into the basic sanitation conditions of your household, this is generally the most common source of disease transmission.
- **Thus** → through knowledge dissemination the public can be **educated** in these areas and begin to understand the health impacts from urban water supply, before jumping to conclusions.

Kahinda *et al*., 2007; Kamara and Sally, 2003; Lang, 2007; Strydom, 2009; Nealer, 2009; Sobsey *et al*., 2008; Kaiser, 2010; NBWS, 2009; Manus, 2009

Policy and Institutional Environment of Study

- In SA, issues related to the regulation, commercialization and marketing of POU devices involve many governmental agencies →local municipality, DWA, SABS and local government.
- The public suffer from incomplete understanding of the issues involved → especially the livelihood of product certification and the inadequate coordination among agencies involved.
- In the absence of reliable information on existing practices in management and regulation of POU devices it is difficult to make informed decisions on the actual certification of such products.
- Interaction within the study indicates that at field level these gaps are being reflected in various practices → such as false advertising and lack of information available on environmental and health hazards caused by POU devices if they are not maintained or certified adequately.
- **Thus** → in this study, by creating local consultative groups (steering committee and project collaborators), this should sensitize policy makers to the issues related to POU units regulation and provide a forum to facilitate knowledge and information sharing between various stakeholders involved.

SABS, 2001; De Lange *et al*., 2010; Friedrich *et al*., 2009; DWAF, 2009; Polasek, 2009

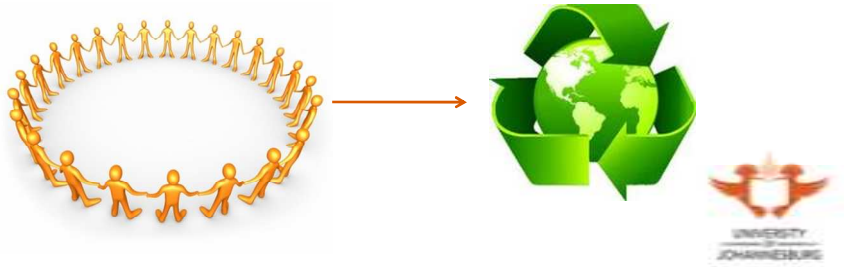
Transdisciplinary Approach

- Striking a balance between the health of ecosystems and the people who live in them (that utilize POU devices) calls for a new research framework.
- A framework that includes not only scientists, but also community members, government representatives, and other stakeholders, so that certification and regulation of POU devices can be controlled.
- This new transdisciplinary research framework is called "ecosystem approach to human health"→ **Ecohealth**.
- Each Ecohealth activity inherently involves four groups of participants:
  1. Researchers and other specialists.
  2. Community members, including ordinary citizens.
  3. Manufactures.
  4. Decision-makers.
- The last two categories include everyone with decision-making power → not only representatives of government or other key stakeholder groups, but also those with informal influence based on their knowledge, experience and reputation.
- The goal of each transdisciplinary Ecohealth activity is to include all these categories.

Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Transdisciplinary Approach

- The Ecohealth transdisciplinary approach would be based on three methodological pillars:
  1. **Transdisciplinarity** → implies an inclusive vision of ecosystem-water related health and certification problems associated with POU devices (this requires the full participation of each of the four groups mentioned previously)
  2. **Participation** → aims to achieve consensus and cooperation, not only within the community using POU devices, but also among the manufactures making these devices, scientists investigating these devices and decision-making groups which certify and regulate these devices.
  3. **Equity** → will involve analyzing the respective roles of these various social groups.



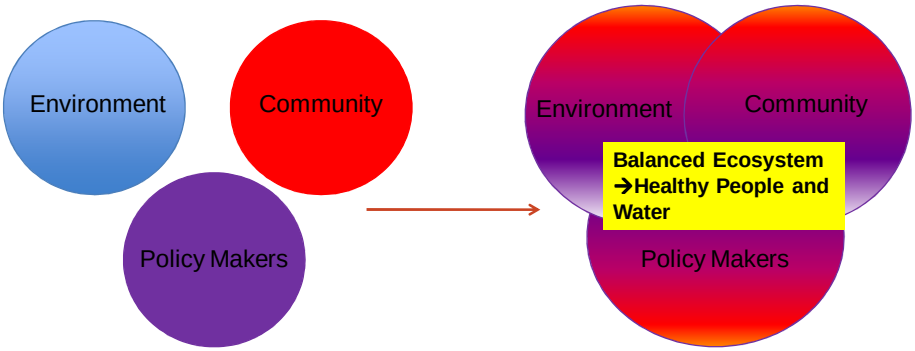
Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Transdisciplinary Facilitation of Research

- Through the use of POU devices, **water** and **human health** cannot be considered in isolation.
- It depends on the quality of the water environment in which people live → **for people and water to be healthy, they need healthy environments.**
- However, the ecosystem also affects human health and the Ecohealth approach recognizes → that there are links between humans and their biophysical, social, and economic environments that are reflected in an individual's health.
- **In this context** → it is impossible to improve the human use of POU devices within their ecosystems without including the human population, with its inherent social, cultural, and political concerns, in the management of resources.
- Thus a sectoral approach is no longer adequate → co-management of human activity and the environment is essential.
- **Therefore** → this challenge requires that disciplines draw together to study the human–environment relationship, so health can be improved upon, through the correct use, certification and regulation of POU devices.

Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Transdisciplinary Facilitation of Research



- Policy, environment, and community needs all affect the health of the ecosystem.
- Focusing on just one of these factors compromises ecosystem sustainability.
- The Ecohealth approach promotes positive action on the environment that improves community well-being and health, by integrating and balancing all three aspects.
- The underlying hypothesis of the Ecohealth approach is that the programs it generates will be less costly than many medical treatments or primary health care interventions.

Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Transdisciplinary Facilitation of Research

- Thus in order to consider water well being and health of an ecosystem, the community needs to be **educated** on their water quality environment and careful consideration of use of POU devices.
- This balance can be attained through POU device regulation of **policy management**.
- So the community can manage their water quality safely, when either consuming tap water alone or when using a POU device (by making an informed decision).
- **Therefore** → overall health of the community can improve without the deterioration of water quality, since they understand their environment and are protected by legislation.
- However, societies and their leaders often face a difficult choice → resort to simple, quick, and sometimes expensive means of tackling complex problems.
- Such as POU devices, the public is concerned about their water quality, POU devices are being manufactured, the public wants them made available....
- So policies and legislation are implemented without careful consideration and can sometimes fail in the longer term.
- To properly address the sources of environmental degradation and to work with all of the relevant stakeholders → essential to go beyond simple health or environmental perspectives and to look into adequate certification and regulatory policy.

Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Transdisciplinary Framework

- Study = **transdisciplinary framework** → since it involves both **individuals** and **decision-makers**.
- This approach will allow for various aspects of POU device problems to be assessed by closely involving the local population as well as decision-makers.
- When these POU device problems are articulated in questions that can be addressed in a scientific process, communities are able to express what they expect from scientists and decision-makers → this, in turn, leads to "socially robust" **solutions**.
- This study therefore requires the **participation** not only of scientists but also of community representatives and other actors who, in addition to possessing particular knowledge of the problem at hand, have a role and a stake in its solution.

Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Transdisciplinary Framework

- This transdisciplinary approach gives them the right to be heard by decision makers and thereby share their experiences, knowledge, and expectations.
- This will enables researchers from different disciplines and key actors to develop a **common vision** when considering POU devices, while preserving the richness and strength of their respective areas of knowledge.
- By adopting this approach the research team will avoid carrying out parallel studies whose results are pooled only at the end.
- The integration of knowledge and the adoption of a common language will take place while the problem of POU water filtration devices is being defined → this is the core of a transdisciplinary approach.

Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Challenges of Transdisciplinary Water Quality Research

- Even though, in theory, transdisciplinarity now enjoys high standing in the scientific community, it still remains a challenge for this Ecohealth study.
- Going beyond one's own discipline requires a great capability for synthesis as well as sensitivity to the strengths and limitations of others.
- Succeeding in a transdisciplinary initiative requires defining a research protocol, finding ways of integrating the community in problem definition, and ascribing appropriate importance to the various ecosystem components.
- Equally challenging is assembling a team and organizing the work of members from extremely different disciplines.
- Supervising a transdisciplinary project is all the more difficult when the original concept stems from a particular discipline and the researchers are not aware of the transdisciplinary nature of the problem.
- It is therefore only to be expected that the development of a transdisciplinary project is time-consuming.

Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

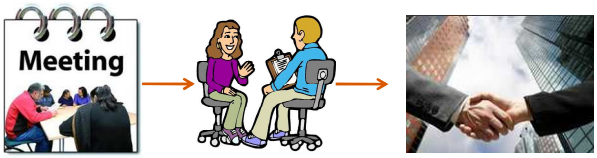
Challenges of Transdisciplinary Water Quality Research

Challenges in Transdisciplinary Research
A. The groups or key players participation
• Scientists wanting to work directly for community well-being. • A community and manufacturers ready to collaborate in a development process that uses research as a tool. • Decision-makers who are able to devote time, knowledge, and expertise to a process of consensus-building.
B. The steps to overcome these challenges
• Establish dialogue among the key players through informal meetings and exchange of letters and emails. • Solicit the financial support required to fund problem definition in a preproject workshop that brings together key players. • Organize a preproject workshop to: – Define the problem based on the views and knowledge of each group (focus group, maps, interaction, data) – Identify common areas of concern – Agree on common objectives – Specify the methodological approach of each group or actor – Define roles and responsibilities – Establish a schedule for team meetings. • Iterate protocols on the basis of the results achieved. • Translate research results into concrete action programs. • Ensure the project's long-term sustainability and monitor progress.

Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Knowledge Dissemination

- In terms of POU devices stakeholders at different levels include → the public, manufactures, DWA, local municipality, SABS and local government.
- A dissemination strategy will therefore operate at different levels.
- The main thrust is on personal or group **meetings** and **interviews** with different stakeholders, over sufficiently long periods.
- This continual interaction will be maintained through regular group **discussions** and email.
- As pertinent information is gathered it will be shared through discussions / workshops with senior management, manufacturers, NGO groups and researchers.
- Interim **reports** would be shared with relevant stakeholders for feedback.
- At policy making level engagement of policy makers and politicians would be secured through a repetitive process and followed up by **agenda**, **briefing** and **minute notes**.
- **Workshops** will be conducted and **pamphlets** will be distributed.
- People worldwide can benefit from the results of this research → as findings and other interesting insights would be posted on **websites** for wider access to researchers, academia, the general public and those engaged with the policy processes.



Ahammed and Meera, 2010; Fengyi *et al*., 2009; Devi *et al*., 2008; Lang, 2007

Conclusion

- The overall objective envisaged by this project would be to **improve** the **regulation** and **commercialization** of POU devices through tighter by-laws and policy restrictions, through findings and recommendations from this study.
- In order to **protect** the **rights of consumers** in SA by providing sustainability, while safeguarding the well-being of all members of society, when it comes to water health concerns and implications through the utilization of POU devices.

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12.5 Climate Change Session Abstracts and PowerPoint Presentations

An integrated scenario based approach in dealing with climate change uncertainties in Wami/Ruvu catchment, Tanzania

Mwanikah M[1], Jewitt G[1] and Mahoo H[2]

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[2]Soil and Water Research Management Group, Sokoine University of Agriculture, Tanzania

Abstract

Purpose: The values and benefits attributed to water resources, land and the environment in sub Saharan Africa are great. However, with varying climatic patterns, highly ranked sectors such as water, agriculture and changing land uses are facing major challenges that still remain uncertain in the next years to come. This study was set to explore the potential benefit of integrating socio-economic and climate scenarios, in order to tap the expertise and perspectives of locally important stakeholders in potentially identified and sensitive sectors within the Wami/Ruvu River catchment in Tanzania.

Design/methodology/approach: Participatory scenario planning was used as an important instrument to think of the future with 84 selected small holder farmers and their leaders across 6 villages within the catchment. Triangulation of some of the information has been captured with 199 household quantitative surveys.

Findings: The outcome has been participatory development of four thematic scenario categories featuring water resource use, land use, and management and agriculture sectors. The results indicate that change in climate will influence land use, agricultural productivity and water resource use and management.

Practical implications: The use of scenario has proven to be a useful tool in development planning, while taking into consideration interacting risks and uncertainties. This tool may be adopted by local farmers, leaders and regional institutional frameworks and policy makers that could improve the responsiveness to any unexpected changes and risks coupled with integrated collaborative management.

Originality/value: Rain fed agriculture remains the backbone of rural livelihoods in the catchment. Most of the farmers operate at subsistence level with very little or no capital to invest. This also means an expansion in the crop farming and diversity, which contributes to soil loss and decline in soil fertility, and decrease in arable land leading to lower crop yields. This therefore shows the need for suitable at the same time sustainable water use and management systems, land use and farming practices that will increase productivity which are resilient to climate change impacts.

Paper type: A research case study

Key words: scenario planning, agriculture practices, environment, development

Corresponding author email: mercyojoyi@yahoo.com

Integrated Scenario Approach in addressing Vulnerability to Climate Change for Wami Ruvu Catchment, Tanzania

Mercy Mwanikah Ojoyi
PhD student-University of KwaZulu-Natal

Outline

- *Introduction*
- *Goal & Objectives*
- *Methods*
- *Data Analysis*
- *Results*
- *Discussions*
- *Conclusions*
- *Acknowledgements*

Introduction

- *Climate change is recognized as a risk to peoples' livelihoods in Sub-Saharan Africa (IPCC 2007)*
- *Wami Ruvu catchment is experiencing significant variability in temperature, rainfall, LGP resulting to frequent floods & droughts (Thornton et al. 2006)*
- *Some of the sectors affected include: agriculture, water catchments & natural ecosystem functions (NAPA 2007)*
- *Pressure is exerted on land leading to negative rapid changes on resources thus affecting people's livelihoods*

Definition of Scenarios

- *Scenarios present a series of pictures or images of how the world could look like under different conditions (Alcamo 2001; Kemp-Benedict, 2004)*

Justification

- *Climate change related problems are having major impacts on water, land and natural resources; which eventually affects livelihoods.*

- *However, there exists a huge gap on how to bridge sectoral gaps on local knowledge with current technology into an informed decision with the emerging climatic impacts felt*

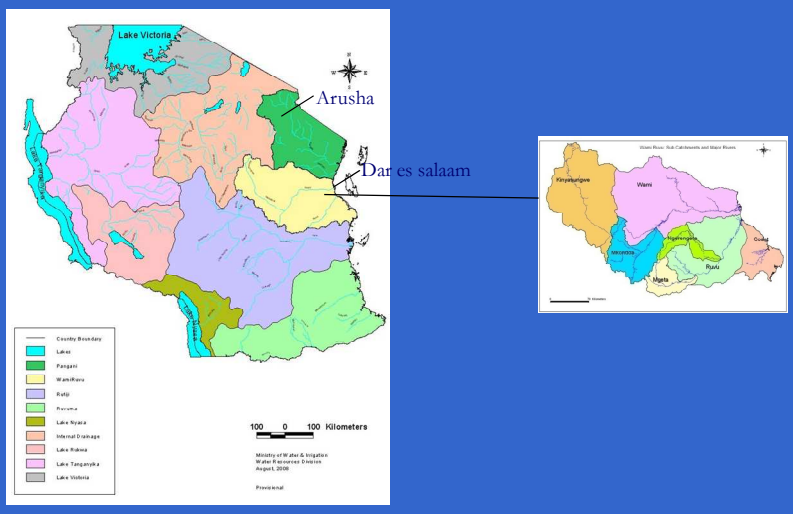
Key Goal of Research Paper

The use of scenario planning in design of appropriate use and management of water and land resources while enhancing agricultural productivity in Wami Ruvu catchment

Specific Objectives

- *To identify changing trends in water, land and agriculture*
- *Assessment of major driving forces/ factors*
- *Projected participatory planning in use and management of resources through integrated scenario processes*

Study Area



Map showing river/lake basins in Tanzania and 7 catchments of Wami/Ruvu Basin

Selection of Villages & Participants

- *6 Villages chosen upstream, downstream & middle stream*
- *199 Household surveys conducted for key themes information*
- *84 farmers and their agricultural village experts selected for the scenario procedure*

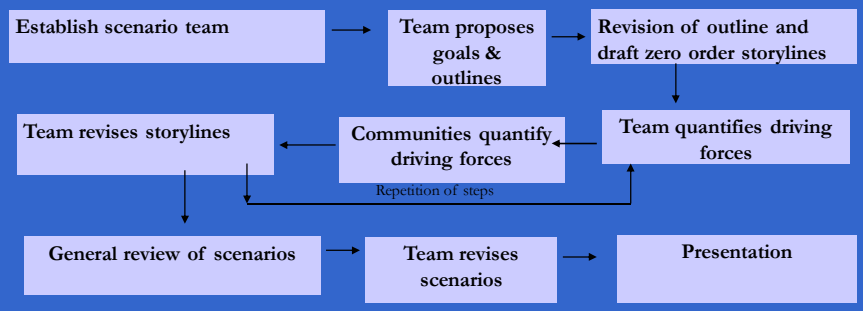
Study Area description

- *Temperatures in Tanzania range between 24°C - 34°C*
- *Mean annual rainfall varies from below 500 mm to over 2500 mm annually*
- *The region faces major climatic impacts e.g. frequent floods, increased dry spells, changing rain fall seasons*
- *This influences length of growing seasons affecting food security that consequently affects people's livelihoods*
- *Participatory approach can enhance effective use and management of resources within the catchment, while providing a window for positive change through resilience*

Methodology

- *Trend Analysis of Secondary Data-from previous data statistics, national reports and research documentation*
- *Key theme information on water, land and agriculture captured from 199 quantitative questionnaires*
- *Story and Simulation Approach adopted in projected scenario Process with 84 scenario participants (Alcamo 2001)*

Participatory Scenario Procedure



Adopted from SCENES (Story and Simulation Approach to scenario development, Alcamo 2001)

Data Analysis Tools

- *Trend Analysis carried out for Secondary Data*
- *Statistical Packages Analyses for Quantitative data*
- *Content Analysis-Qualitative surveys*
- *SAS (Story & Simulation Approach-Alcamo 2001 Adopted)*

Outline of Results

- *Trends in water resources, land and farm productivity*
- *Statistics of relationships between climate change and main actors*
- *Major driving actors from scenario procedures*
- *Highly ranked actors*
- *Scenario categories developed*
- *Follow-up activities proposed*
- *Conclusions*

Water resources/Land uses/ Productivity

- *Decline in water levels in Wami & Ruvu river Systems*
- *Increased dry spells : short lived 'masika' rains; fewer or lack of 'vuli' rains*
- *Population statistics have increased over the years: exerting pressure on water resources*
- *The frequency of floods and droughts has risen*
- *Rapid Change in land uses realized*
- *Decrease in food security for the region due to changes in seasonality (unreliable 'vuli' rains, fewer 'masika' rains)*

Sources: NAPA 2006, United Republic of Tanzania Government reports, Shongwe et al.,2009, Paavola 2008

SPSS Analyses

Relationship between climate change & main actors/drivers of change

- *Pearson chi-square tests: p Value =0.000: shows high level of significance*

Major Driving Actors from Scenario Procedure

Driving force	Better	Moderate	Worse
Finances	72	0	12
Drought	42	36	6
Climate change	78	6	0
Hand hoe use	6	14	66
Agricultural inputs	72	0	12
Knowledge and extension services	66	0	18
Changes in planting seasonality	24	6	54
Seed usage and availability	72	0	12
Irrigation	18	0	66

III. Driving forces highly ranked by scenario participants

Driving forces	Worse (%)	Moderate(%)	Better(%)
Drought	18	54	0
Knowledge and extension services	0	42	36
Agricultural practice	18	48	12
Environmental protection	0	36	42
Financial constraints	6	30	42

Categories of Scenarios Developed

Actors/ Factors	Status of Actors/Factors	Scenario A	Scenario B	Scenario C	Scenario D
Drought	Increase/decrease	Increase	Increase	Decrease	Decrease
Knowledge and accessibility to technology	High level of awareness/low level of awareness	Low	Low	Relatively high	Very high
Agricultural productivity	High/Low	High	Low	High	High
Environmental Conservation	Weak environmental conservation/advanced environmental conservation	Weak	Weak	Advanced	Advanced
Economics	Stable/low	low	low	better	Stable

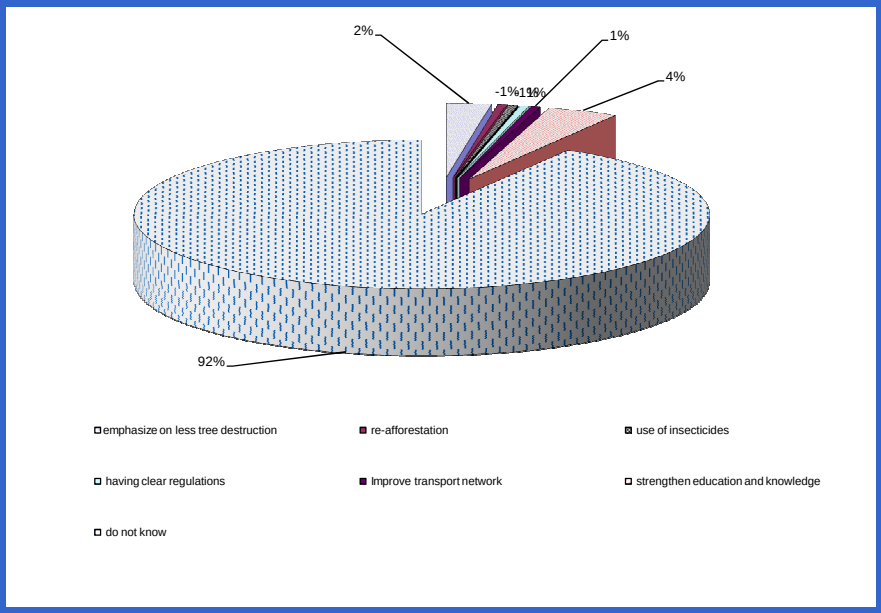
Scenario Interpretation & Significance

- Explanation for each of the scenarios storylines developed and what it meant for the participants
- Relevance of scenarios to climate change resilience for Wami Ruvu Catchment
- Significance of Scenario approach used for the community
- Scenarios and Resilience development

Applications

1. Management of risks and uncertainties
2. Future Planning: development, budget planning, resource distribution, e.t.c.
3. Development pathways proposed

Sustainable Follow-up Activities by participants



Conclusions

- *Major relationships identified between changing land uses, water resources, climate change and agricultural productivity*
- *Scenario as a tool was very practical in identification of major factors influencing changes in the agro-landscape*
- *SAS approach used was helpful in integration of stakeholder ideas at all stages of the scenario development process*
- *The four scenario categories identified uncertainties in each category and helped in developing a development pathway for the future of Wami Ruvu Catchment*
- *The results of the scenario process provided useful windows for positive change in the catchment*

Acknowledgements

- ***University of KwaZulu-Natal, South Africa-Training***
- ***Sokoine University of Agriculture, Tanzania-Training***
- ***Wami Ruvu Basin Water Office, Tanzania-Financial***
- ***Collaborative Research for East Africa Territorial Integration; EU-Research Financial support***
- ***UNESCO-IHE for Study Financial support***
- ***CSIR- Travel support to the meeting in Pretoria***

Supervisors

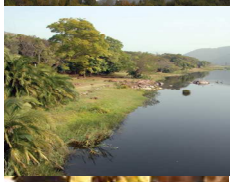
- *Professor Graham Jewitt, University of KwaZulu-Natal, South Africa*
- *Professor Henry Mahoo, Sokoine University of Agriculture, Tanzania*

On Climate Change, El Niño and La Niña, a Looming Water Crisis and Baloney

By

Richard Meissner

Paper presented at the Young Scholars Forum
29 - 30 November 2010
Knowledge Commons, CSIR Campus, Pretoria



Nature is a book whose history, whose evolution, whose 'writing' and meaning, we 'read' according to the different approaches of the sciences, while all the time presupposing the foundational presence of the author who had wished to reveal himself therein – Pope Benedict XVI

Students who can begin early in their lives to think of things connected, even if they revise their views every year, have begun the life of learning – Mark van Doren

The important thing is not to stop questioning – Albert Einstein

Introduction

- Complexity
- Transdisciplinarity
- Mashup
  - Climate change
  - El Niño and La Niña
  - Water crisis
- Conclusion

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Complexity theory

- Societal contradictions indicate the futility of linearity and orderly and steady patterns
- Complexity as a powerful conceptual model is pertinent to explain the current period
- Attributes of complex governance systems
  - Large number of elements
  - No clear boundaries between the system and the external environment
  - No control or fixed hierarchy
  - History is the memory
  - They are adaptive systems
- Complexity theory is no panacea (universal remedy)
  - No concrete policies that will minimise uncertainties
  - Incapable of predicting the future
- Its utility...
  - Alternative view of society challenges prevailing assumptions of linearity and tidiness
  - Basis for anticipating general patterns within specific events

our future through science

Transdisciplinarity

- Roots are in the rise of the knowledge society
  - Increasing importance of scientific research in all fields
- Problems escape the confines of one discipline
- Transgressing the mismatch between academic knowledge and problem solving knowledge
- Science should also involve the lay person – collaborative learning
- A diverse scientific and societal view is needed
- Silos have no place any longer

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Climate Change, El Niño and La Niña and Southern Africa's Climate

- Uncertainty = complexity
- Central to climate change and ENSO
- IPCC – climate change natural and human activity
- Temperature is rising by between 2℃ and 3℃
- An increase in precipitation in some areas while a decrease in others Africa CC models.docx
- Based on the same climatic principles, models show different strengths of climate system feedback loops
  - Cloud feedbacks
  - Oceanic heat sinks
  - Carbon cycle feedbacks
- IPCC and SACCNet treat uncertainty through transdisciplinarity
- IPCC criticised Climate Change Critics.docx Africagate.docx
- ENSO's impact is also uncertain ENSO satelite.docx Spinning El Nino and La Nina Graph.docx ENSO and Africa Rainfall.docx

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Water crisis

- CDE April 2010 report
- Is there a looming water crisis?
- Challenges give rise to serious water problems
  - Quality – AMD
  - Quantity – physical shortages
- 'Poor design of new water policy framework' is to be blamed
- Report proposes solutions contained in 7 vital steps
  - Government and presidency leadership is needed
  - Improve water management and institutions through good governance and skilled personnel
  - Maintain existing water infrastructure
  - Address AMD – state must take the lead
  - Water prices must reflect the cost
  - Long-term sustainable focus and not short-term gain
  - Society must minimise waste
    - Government must take lead to reduce water losses and businesses, communities and households must use water more efficiently
    - Government must educate

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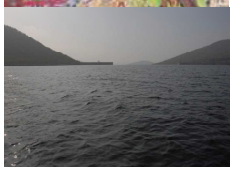

Conclusion

- Complexity demands a transdisciplinary approach to problem solving
  - IPCC
  - SACCNet
  - ENSO
  - CDE?
- Issues and actors re. water governance is multi-varied and multi-layered
- Researchers have a role to play
  - See things as connected and complex
  - Don't stop questioning
    - This will force us out of our reductionist mould
  - Better policy options could be in the offing
  - Researchers are change agents
  - Improve change agency through questioning and complexity thinking
  - 'Mashup' things – creativity could flow from it!!

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THANK YOU
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APPENDIX C:
Participant List

Name	Institution
Dr. TG Barnard	University of Johannesburg
Garth Barnes	WESSA
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Karin Breytenbach	Monash University
Jackie Brown	University of Pretoria/CSIR
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Dr. Marius Claassen	Council for Scientific and Industrial Research
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Leani de Klerk	Council for Scientific and Industrial Research
Linda Downsborough	Monash University
Nikki Funke	Council for Scientific and Industrial Research
Jason Germanis	Council for Scientific and Industrial Research
Prof. Willie Grabow	Private
Phil Hobbs	Council for Scientific and Industrial Research
Dr. Inga Jacobs	Council for Scientific and Industrial Research
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