THE REVIEW, RE-CONCEPTUALIZATION AND RE-DESIGN OF THE SHARED RIVERS INITIATIVE

Report to the
Water Research Commission

by

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(WRC Project No. K8/964)

A DESCRIPTION OF THE
SHARED RIVER BASINS RESEARCH PROGRAMME

Towards realization and implementation of Integrated Water Resources Management (IWRM) through a SHARED RIVER BASINS RESEARCH PROGRAMME (SRBRP): Learning to share limiting benefits in socially and ecologically complex river basin systems"

How do we deal with perceptions that each person's use of the resource subtracts from the welfare of others? (Pollard and Cousins 2008)

When long-term relationships matter in multi-stakeholder contexts such as integrated water resources management, it should be clear that all of the underlying characteristics indicate the universe of interest based bargaining as opposed to zero sum positional negotiations (Bodhanya 2010)

EXECUTIVE SUMMARY

This report sets out a programmatic strategic research response of the Water Research Commission (WRC) to the South African Government's commitment to Integrated Water Resource Management (IWRM) as expressed by the National Planning Commission (NPC), the National Water Resources Strategy (NWRS) and the Water for Growth and Development (WfGD) strategy.

The South African Government has committed to Integrated Water Resource Management (IWRM) the basis of which is acceptance that the different uses of water are interdependent. Four principles direct IWRM (Cap-Net.org):

1. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment
2. Water development and management should be based on a participatory approach involving users, planners and policymakers at all levels
3. Women play a central part in the provision, management and safeguarding of water
4. Water has an economic value in all its competing uses and should be recognized as an economic good.

If we are to progress with implementation of IWRM we will have to develop within society a willingness to embrace these principles. But to do so requires that society is enabled to frame the issues that confront us and to develop and apply the requisite knowledge. This will not be easy because "IWRM is a challenge to conventional practices, attitudes and professional certainties. It confronts entrenched sectoral interests and requires that the water resource is managed holistically for the benefit of all" (Global Water Partnership, Cap-Net.org). To realise the goal 'for the benefit of all' requires that we learn to share the benefits in ways that combine efficiency and equity.

The WRC responded to this by funding a project entitled, the Shared Rivers Initiative (SRI) (Mitchell 2007; Pollard and du Toit 2010). This project was completed in 2010 and addressed the IWRM challenge through acknowledging the complexity inherent in IWRM and adopting a transdisciplinary, action research approach in which "the domains of science, management, planning, policy and practice are interactively involved in issue framing, knowledge production and knowledge application" with the intention of achieving co-evolution of understanding, alignment of purpose and harmonized action across these domains" (Roux et al. 2010).

The SRI also recognized that IWRM in South Africa requires significantly more research support in the near, medium and long term.

This report draws on the progress made in the SRI project conducted by Pollard and du Toit (2010) and an assessment of progress within the SRI (Water Research Commission 2010a), and proposes an approach for a significant further phase of research.

This proposal has five key features:

1. It is programmatic, and therefore consists of a number of sub-programmes, each of which comprises multiple projects.
2. It expands research focus from river systems to basin-wide systems, which is a requirement if the research is to deal adequately with complex socio-ecological systems (SES).
3. The proposal is framed within three analytical frameworks. These frameworks intend to direct the scope for research projects.
4. The nature of the research is envisaged to be transdisciplinary and action research focused.
5. The research programme is intended to culminate in a knowledge partnership, achieved through active engagement and investment by research and funding organizations.

This document proposes a theoretical foundation and administrative structure for the Shared River Basins Research Programme, drawing on experience gained from projects supported by the WRC over a number of years. The nature of the challenge of WfGD is that can only be achieved through an integrated approach to water resources management (IWRM). As such it must be informed by research that acknowledges the complex and dynamic interactions between social and ecological systems. Developing the knowledge, understanding and competencies for collaboration that are required to create the foundation for a sustainable knowledge partnership in support of IWRM requires a programmatic approach that is sustained for at least five years. The envisaged timeframe is therefore 1 April 2011 – 31 March 2016.

It is envisaged that the programme will be co-funded by those whose mandates overlap in the implementation of IWRM and who therefore have a vested interest in the establishment of the knowledge partnership. The vision for this programme requires significant research investment over a five-year period with a relatively small investment in Year 1 and escalating annually as the programme matures.

The intention of this document is to propose a national, strategic and transdisciplinary approach for research into IWRM. It does not address the details of what projects may be addressed. Developing the strategy further is understood to be a collaborative process engaged by those who have a stake in the establishment of the knowledge partnership. Eight actions are recommended:

- Presentation to WRC Chief Executive Officer
- Negotiations between WRC, DWA, SANBI, DEA, DAFF, SANParks, drawing up of MOUs, etc.
- Establish Policy Committee
- Appoint Programme Director and consider the need for an Administration Director
- Establish Programme Policy and Development Committees
- Develop Strategic Plan (as envisaged in section 2.2)
- Appoint subprogramme managers
- Commission Projects

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LIST OF ACRONYMS

CMA	Catchment Management Agency
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environment Affairs
DWA	Department of Water Affairs
GWP	Global Water Partnership
IWRM	Integrated Water Resources Management
MCM	Marine Coastal Management
NPC	National Planning Commission
NWA	National Water Act
NWRS	National Water Resource Strategy
SADC	Southern African Development Community
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SBI	Shared Basins Initiative
SES	Social-ecological system
SRI	Shared Rivers Initiative
SRBRP	Shared River Basins Research Programme
UNDP	United Nations Development Programme
WfGD	Water for Growth and Development
WRC	Water Research Commission
WUA	Water User Association

1 BACKGROUND

1.1 Review of the Shared Rivers Initiative (SRI)

The Water Research Commission, acknowledging that "issues of implementation and compliance are difficult within an international river context because river systems are complex, comprising interlinked social and ecological subsystems" concluded that "Research into these issues should therefore be holistic and framed within the concept of complex social-ecological systems" (Mitchell 2007). This understanding led to the design and implementation of the Shared Rivers Initiative, Phase 1 of which was scheduled for April 2007 – March 2009. The aim and objectives are shown in the text box below.

A summary of Phase 1 of the Shared Rivers Initiative is available in a separate report (Water Research Commission, 2010a). A workshop was convened on 26 July 2010 to consider the future of the Shared Rivers Initiative. Whilst acknowledging the important contribution made during Phase 1, a concern expressed was that the initiative was not structured and implemented in a manner that was explicit in terms of the structure and functioning of complex social-ecological systems.

SHARED RIVERS INITIATIVE PHASE 1

The overall aim of the Shared Rivers Initiative is to understand and effect change in the implementation of policies and legislations relevant to the wise use of the Lowveld river systems

The objectives are:

- To explore water policy implementation as a complex social-ecological problem from a theoretical perspective
- To initiate an action research programme that combines research, learning and implementation to secure institutional and operational competency in river management
- To understand and learn in order to inform the management of Lowveld Rivers following a cooperative, international and basin wide approach
- To improve broad stakeholder awareness and compliance that leads to the implementation of real solutions to real problems, the outcome of which delivers the river ecosystem goods and services upon which people depend
- Five Themes are proposed for laying the foundation:

Broadening engagement; Building a foundation for a co-learning culture; Short-term action research initiatives; Preparing for future phases; and Seeking funding

The WRC commissioned a study with the following Terms of Reference:

1. Conduct a strategic review (gap analysis) of the Shared Rivers Initiative and related work.
2. Develop a conceptual framework that will facilitate common understanding of the philosophy of shared resources and potential benefits that can be derived, taking into consideration the trade-offs and consequential risks within the context of resource apportionment.
3. Develop a research programme description that:

   a. Embodies the conceptual framework outlined in 2 above
   b. Provides the rationale and strategic direction for trans-disciplinary collaborative research
   c. States the vision, mission, goal and objectives for the programme
   d. Proposes priority projects, suggesting objectives for each
   e. Creates a collective identity for the programme
   f. Details the institutional arrangements, leadership, management structure, functions and responsibilities
4. Provide a reasoned proposal for rivers that would be the focus for the research programme.
5. Suggest practical approaches of collaboration, co-management and co-funding of work that addresses the transboundary water resource management.

This report provides a description of the proposed research programme. It draws on reports for 1 and 2 above (Water Research Commission 2010a and b).

1.2 The problem of declining water resource quality

In the most recent version of the Water for Growth and Development (WfGD) strategy, the Department of Water Affairs expresses extreme concern about the declining status of the quality of the country's water resources.

This concern relates to the state of water resources and the impact thereon of detrimental land use management practices.

Impacts highlighted by the WfGD report include negative water quality effects, loss of productivity, negative health impacts, eutrophication, groundwater contamination and various other impacts with tangible and intangible economic and environmental consequences.

The WfGD report recognizes that much of these problems originate at a basin level and include the agricultural and industrial activities, poorly managed waste water treatment works and human settlements, acid mine drainage and similar activities.

Thus, a research initiative that addresses the pervasive problem of declining water resource quality requires an approach that extends significantly beyond the scope of the recently completed SRI project with its strong focus on environmental water requirements.

1.3 A Shared River Basins Research Programme (SRBRP)

The report proposes a further phase of research entitled the Shared River Basins Research Programme. It acknowledges that sharing in the benefits that derive from rivers arises at multiple scales from very local to international and in varied contexts, and suggests an approach to developing understanding that can facilitate constructive engagement across the multifaceted boundaries (spatial, functional and temporal) that separate stakeholders. The design is based on the successful precedents of the Kruger

National Park Rivers Research Programme and the Estuaries Research Programme, both funded by the WRC. Lessons are also drawn from the design and management of the River Health Programme (RHP), which was co-funded by the WRC.

The proposed Shared River Basins Research Programme has five key features, each of which is discussed in more detail in the proceeding sections of this report. The five key features are that:

1. The aim of the research programme is to inform and leverage change in support of Integrated Water Resources Management
2. It is programmatic, and therefore consists of a number of sub-programmes, each of which comprises multiple projects.
3. It expands research focus from river systems to basin-wide systems, which is a requirement if the research is to deal adequately with the complex socio-ecological systems (SES) that are inherent in IWRM (refer to section 1.5).
4. The proposal is framed within three complimentary analytical frameworks. These frameworks intend to direct the scope for research projects within the complex field of SES.
5. The research programme is envisaged to be transdisciplinary, employing different approaches and including a strong emphasis on action research that requires committed, ongoing engagement between researchers and other stakeholders.
6. The research programme is intended to culminate in a knowledge partnership which will be achieved through engagement, commitment and investment by several research and funding organizations.

1.4 Why should we adopt a programmatic approach to research?

The overall aim of Phase one of the Shared Rivers Initiative was to understand and effect change in the implementation of policies and legislations relevant to the wise use of the Lowveld river systems (Mitchell et al. 2010). Although there was a widely held appreciation that this would be achieved through collaborative, trans-disciplinary research, prevailing circumstances resulted in the Shared Rivers Initiative being initiated as two projects rather than as a consciously designed research programme. The implications of this approach are considered below (see also Roux et al. 2010).

In the past when user demands and impacts were small in relation to the resource, user needs and problems could mostly be addressed by a research approach that could be characterised as small, single discipline research projects. Over time the influences of use of water resources have become widespread and the cause of, or solution for a local problem has increasingly to be sought within a wider context. And, decisions made at international scale can hold profound consequences for users at local scale. We are challenged to acknowledge the complex and dynamic nature of social-ecological systems and to adopt a programmatic, transdisciplinary approach to research that enables society to respond to issues in an integrated way across the range of scales from local to international.

The **research project** is the current unit of research practice as well as the unit of research management and associated accountability. Typically, it has clear objectives and outputs, and a series of milestones to chart the journey between them. Research projects have fixed budgets and timelines, with team members selected to perform specific functions. Research project leaders are accountable to deliver against the defined goal or tangible output as laid out in a contract.

As the scale of investigation increases to landscape-level studies related to social-ecological systems, the issues of concern may be too broad and complex to be addressed by a single project. To address such issues would require integration and synthesis of insights and findings from a number of research projects covering multiple disciplines (Figure 1). Component projects may run in parallel or may need to run sequentially. A dynamic **portfolio of inter-dependent research projects** could be conceptualized as a **research programme**. However, the programme is not just a collection of related projects, but a stated intention to strive for a desired goal that will not be reached by summing the tangible products of the component projects.

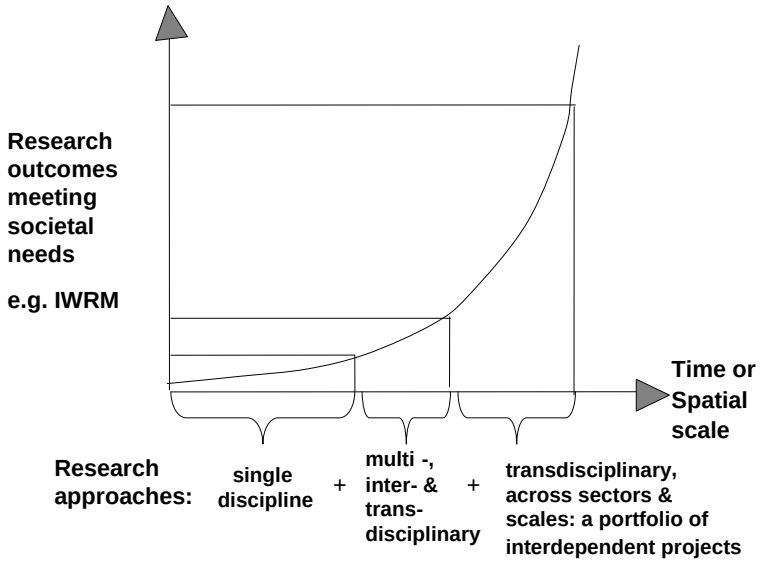


Figure 1. This diagram illustrates the need to develop a programmatic approach to research, particularly as it relates to IWRM. An explanation is given in the text. Adapted from Palmer 2010.

Research programmes seek to produce new knowledge, new alliances and new understanding that will influence the longer term management and governance of the use of a particular resource. Effective research programmes require us to build knowledge

systems that span disciplinary, research, policy, and operational domains, and this takes much more time and requires more persistence and investment in social capital than what is typically afforded by research projects. Strategies to promote such systems require a sufficiently long-term perspective that takes into account the generally slow diffusion of ideas and new scientific information in practice (Cash et al. 2003; Van Kerkhoff and Lebel 2006).

1.5 The strategic importance of a shared river basin management approach

In 2009 and 2010, the Department of Water Affairs (DWA) conducted a series of studies in the Crocodile West River system. One of the conclusions of the study was the implementation of the ecological Reserve alone would not improve the ecological state of the system (Prime Africa Consultants 2010). This is because a number of exogenous variables fundamentally influence the functioning of the system. These variables include a variety of land-based and economic activities that fall outside the traditional water and river management domain yet they interact to determine the social and environmental state that pertains in a river basin. Viewing river basins as complex social ecological systems positions research and management to achieve a holistic approach to strategic planning and adaptive management.

The National Water Resource Strategy (NWRS) foresees this type of problem through its definition of Integrated Water Resources Management (IWRM): "… a process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.[1]"

Unfortunately the National Water Act (NWA) restricts the mandate of DWA and the rest of the water sector in the context of integrated water resources management. Water Resources are defined by the NWA to include riparian habitats; instream channels; wetlands; water bodies in lakes or elsewhere; and any source-directed infrastructure (water resource infrastructure such as minor dams, major dams, farm dams, canals, and any other water resource infrastructure considered significant)[2]. Consequently, the large and complex task of negotiating trade-offs around the protection, use, development, conservation, management and control of water resources and the exogenous variables that impact on water resources are left in a quasi mandate gap.

Thus, although IWRM is clearly a responsibility of DWA, the requirements of IWRM (application of appropriate environmental management tools for integration, identification, prediction and evaluation of effects of activities, providing appropriate opportunity for public participation, with consideration of environmental attributes and employ best suited modes of environmental management) has a scope that falls far beyond the management of water resources only. IWRM requires a strategic and concerted management approach

[1] The Global Water Partnership (GWP) - founded in 1996 by the World Bank, the United Nations Development Programme, (UNDP) and the Swedish International Development Cooperation Agency

[2] These are 'assets'

which incorporates the water resources; other biodiversity assets; all beneficiaries (direct and indirect) of aquatic ecosystem services; and public and private infrastructure and their custodians beyond water resources infrastructure. It can only successfully be implemented at a basin-wide level, through collective effort of water resource managers and other biodiversity resource managers.

The Shared Rivers Initiative has been a valuable precursor to understanding challenges to implementing the ecological Reserve in river systems, but this is only one component of IWRM; a much broader approach is required to direct patterns of use toward social and environmental sustainability.

The WRC thus envisages a research and management partnership that informs and enables a wider, IWRM systems approach to be implemented at a basin-wide level.

1.6 An analytical framework for SES research

1.6.1 The socio-ecological context

Life is critically dependent on water and the evolution of most societies has always been linked to and dependent upon surface water resources. Societal well-being was determined by the direct and indirect benefits that could be derived from aquatic ecosystems. Strongly linked social and ecological systems evolved, defined by the boundaries of localised societies and their access to water resources. But, with industrial development and growing capabilities for storing and delivering water to remote locations there emerged societies in which there is little awareness and understanding of the complex relationships between society and water resources. Just how complex this relationship is and how urgent it is that society reconnects and gains both a wider and deeper understanding has been highlighted by Ashton et al. (2008):

“South African water use patterns in four river basins shared with neighbouring states have reached the point where there is little additional water available for new water uses. Population growth and new developments will aggravate this situation. Rural situations in these basins have both a formal and informal water economy with those in the informal water economy the most vulnerable and least influential. Water shortages have different effects on urban and rural communities and shape the social resilience and adaptive coping capacity of these communities. The imbalance in social resilience between rural and urban communities must be accounted for when water resource managers make trade-offs between equity, efficiency and sustainability objectives at different scales. Properly informed decisions need to be made and acted upon to sustain and strengthen social resilience in these river basins.”

This understanding emphasizes the imperative of adopting a systems approach to encourage the deeper reasoning that is necessary for informed collective decision-making around how the benefits we derive from limiting water resources should be shared, particularly as we strive to achieve the necessary balance between equity and efficiency. The system is socially and ecologically complex; options emerge as the capacity of aquatic systems to supply benefits varies in time and space and in response to the choices stakeholders make as they strive to adapt and direct patterns of use

toward equity and sustainability. Our adaptive decision-making is made more difficult by uncertainty; as with all complex systems, our knowledge and understanding is always imperfect and prediction is tenuous. And, social-ecological systems function under forces, such as climate change, the consequences of which are difficult to predict. We must progress through a process of learning by doing in which every decision is temporary, requiring us to be open to learning from the relationships between the decisions we make and the outcomes we experience.

Local, national and regional economies are dependent on the services we can derive from shared water resources. Because these resources are already limiting in our major river basins (Ashton et al. 2008) the distribution of services and the associated benefits is becoming increasingly contested. And issues of rights to access and use of ecosystem services are becoming more complex and difficult to resolve. Chang (2010) observes that "A number of signifiers are pointing the way to a new world order fuelled by the rise of civil society, the green movement, the evolution of social networks and a decline in conspicuous consumption", a society in which "Boundaries such as race geography and culture become less important and shared interests matter more." The challenge we all face is to foster a more social, ethical and empathetically driven approach to the accessing and distributing the benefits that are associated with shared river systems.

If river research is to inform and support the emergence of the 'empathetic economy' envisaged by Chang we shall have to confront complexity and discover how we can integrate understanding, empathy and ethical decision making across social-ecological boundaries from local to international (see also Goleman 2009).

1.6.2 Social-ecological systems

Given our dependencies on river systems and the increasing demand for and relative scarcity of ecosystem services available from shared rivers, we appreciate the imperative for informed, empathetic social-ecological decision making across the range of scales from local to international. The ultimate intention of this research programme is a knowledgeable society; one that is enabled to constructively and creatively engage dialogue around the social, economic and ecological consequences of the difficult choices we will have to make in the allocation of access to and use of the services that derive from shared rivers. To be able to make informed choices requires an understanding of the value of the benefits, how they are distributed, the inherent uncertainty and risks and their influence on social-ecological resilience.

1.6.3 Sustainability and social-ecological resilience

"Sustainability involves maintaining the functionality of a system when it is perturbed, or maintaining the elements needed to renew or reorganize if a large perturbation radically alters structure and function" (Walker et al. 2002). The mounting social and ecological stresses in our shared river basins have the potential to perturb the system and cause it to shift into a state that is conflictual and not sustainable. The intention of the Shared River Basins Programme is twofold:

- to inform management on how to prevent shared river social-ecological systems from moving to undesired states by reinforcing processes that facilitate preferred configurations in the face of external stresses and disturbance; and
- to build adaptive capacity "To nurture and preserve the elements that enable the system to renew and reorganize itself following a massive change" (see Walker et al. 2002).

This will enable the research programme to inform and leverage change in support of Integrated Water Resources Management

Why is it important to conduct research into Shared River Systems

- Shared river systems are a significant reality in South Africa and southern Africa.
- Water (quantity and quality) is a central issue because of the range of benefits society can derive from access to and use of water and the ecosystems that are associated with water
- River systems are complex assets from which society can derive multiple benefits. Both the supply of and the demand for benefits vary in time and space, so it is important that society understands how benefits arise and how it values these at different places and times
- The assets and associated rights to benefit are embedded in a complex mix of property rights regimes
- It is important that society is able to adjust management to enable us to learn and continually balance supply and demand
- Scarcity is a reality and demand for benefits will exceed supply. Society needs to be able to make choices that balance empathy, efficiency and equity (a mix of hierarchical, distributive and egalitarian approaches), and sustainability
- This suggests three issues may be important: Making informed choices around access to services and benefits; Understanding the risks that attend the choices we make; Governance as it affects our choices and apportionment of risk among stakeholders
- Because of the complex social-ecological nature of the issues it will be important to develop trans-disciplinary understanding among resource economists, hydrologists, ecologists, social scientists and policy analysts among others

1.6.4 The nature of social-ecological systems

Social-ecological systems (SESs) comprise two linked subsystems, an ecological system (biophysical system, such as a river) and a social system, in our case a human system

associated with the river. Both contain units that interact interdependently and each may contain interactive subsystems. Anderies and colleagues (2004) identified a broad set of variables and their linkages that describe SESs. Their framework provides a simple structured mechanism for identifying and disaggregating the components of SESs. Because it directs attention to the dynamic relationships among the different components it encourages us to appreciate and respond to the complex nature of such systems. Importantly SESs are envisaged as 'open systems' that are influenced by external drivers of change. These may be biophysical (e.g. climate change and epidemics) and social or economic as we see in South Africa where we have to redress past inequity whilst at the same time respond to expectations of neighbouring countries.

The framework comprises four key components; the resource, the resource users, the public infrastructure associated with the resource and/or users, and the public infrastructure providers (Figure 2). The framework is generic in the sense that it can depict SESs that are founded on quite different ecosystems. It can also be used to depict SESs that are large (international, in the case of shared rivers) or small (in the case of people using a floodplain or an impoundment). This is very important because it facilitates dialogue and learning among people operating at different scales and in different contexts.

Resilience theory provides a way of thinking (mental model) about the management of social-ecological systems. It provides management strategies for sensing and responding that enable buffering against or coping with unexpected change. Rather than attempting to control natural resource systems for stable or maximum production and short-term economic gain, resilience management assumes an uncertain and complex context for natural resource and social systems and strives to achieve sustainable long-term delivery of benefits. In so doing building resilience that offers some protection against unexpected shocks to the system by nurturing a capacity to learn and to adapt.

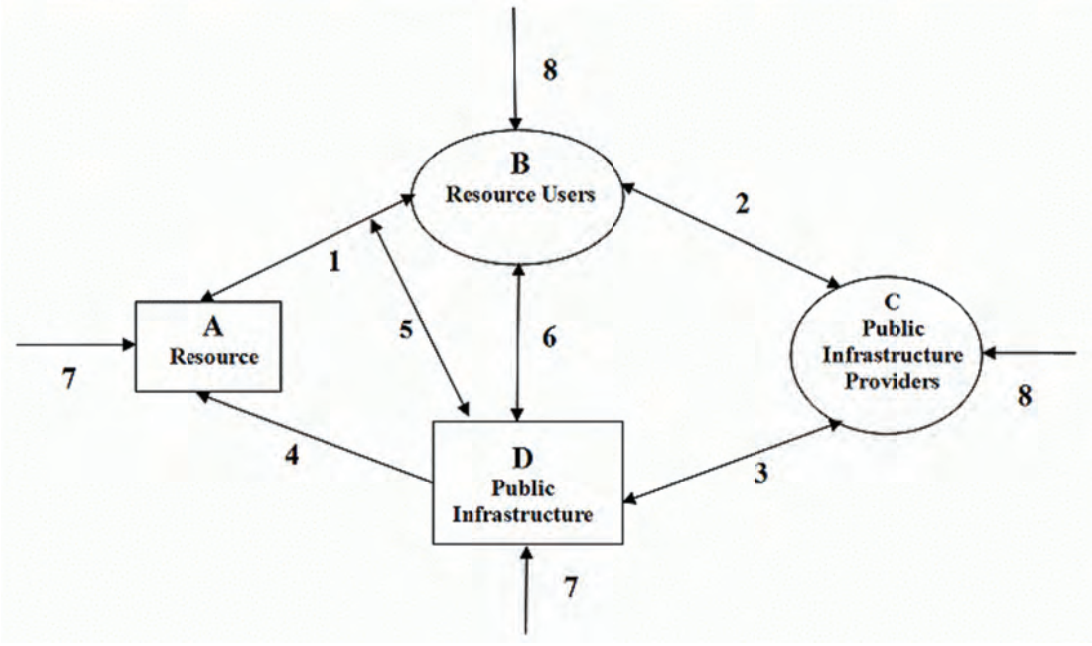


Figure 2. Framework depicting a social-ecological system (Anderies et al. 2004). The concepts and processes are explained in the text

Inherent in the concept of SES is the notion that we can define or 'bound' the system, at least as a subsystem of some larger system. We might consider a flood plain and its interacting people as a SES nested within a larger SES (a river basin within a country) or an even larger SES that straddles countries. Importantly, every SES can exist in a number of states that reflect its responses to drivers of change. Stakeholders seek to manage change to achieve sustainable delivery of a preferred 'basket' of ecosystem services and associated benefits.

The Resource (A in Figure 2)

In social-ecological systems the resource is a chosen ecosystem that delivers ecosystem services from which society (Resource users) derive benefit. The attributes of the resource have a determining influence on those of the social subsystem. For example, the social subsystem assumes quite different attributes when we consider a stretch of river (a flood plain) or a river basin as the resource.

Ecosystem services are components of nature, directly enjoyed, consumed or used to yield human well-being. In the Millennium Assessment (2005) approach ecosystems are considered aggregate assets that yield a flow of services, all of which benefit people, much like other capital stocks. These include **supporting services** (the basic ecosystem functions and processes); **regulating services** (including the absorption of pollutants, storm buffering, erosion control and the like; **provisioning services** (including the production of fresh water, foods, fuels, fibres and biochemical and pharmaceutical products); and **cultural services** (including non-consumptive uses of the ecosystem for recreation, amenity, spiritual renewal, aesthetic value and education) (See table below).

Table 1. Summary of ecosystem services within four categories as defined by the Millennium Assessment (2005;2007).

Ecosystem service category	Services within each category
Supporting services	These cover the basic ecosystem functions and processes that underpin all other services such as soil formation, nutrient cycling, primary production, and water cycling.
Regulating services	These services cover the regulation of air quality, erosion, disease, water, and climate and include the absorption of pollutants, storm buffering, pollination and others.
Provisioning services	Cover the provision of goods such as water, food, fuels, fibers, biochemical and pharmaceutical products, and genetic resources.
Cultural services	Cover the non-consumptive uses of the environment for recreation, amenity, spiritual renewal, education, and inspiration, as well as cultural heritage value and sense of place

The supply of ecosystem services is variable in time and space. A perennial river delivers ecosystem services more consistently than a river with intermittent flow; and, a floodplain for example, will deliver a different 'basket' of ecosystem services from an ecosystem with swiftly flowing water. Because ecosystems are complex systems, the supply of services is also influenced by how we choose to use them. For example, abstracting water (provisioning service) can have a profound effect on the capacity of the ecosystem to provide for recreation (cultural service).

Resource users (B in Figure 2)

Resource users are the people that derive benefit from ecosystem services. In river systems resource users may be widely separated along the course of the river from source to sea, and they may live adjacent to or remote from the river. They may access services continuously e.g. regulating service such as water purification or a provisioning service such as an irrigation farmer or a subsistence fisher. Other services may be accessed intermittently for example by a person who travels to pursue river-related recreation (cultural services). Ecosystems differ in their capacity to deliver services and so availability, extent and patterns of use of ecosystem services vary along the course of the river. For example, the 'basket' of services from an impoundment may be markedly different from that of an adjacent swiftly flowing stretch of river.

Long-term relationships matter in multi-stakeholder contexts such as IWRM and more particularly under conditions of scarcity. Because stakeholders commonly perceive that each person's use of the resource (ecosystem services) subtracts from the welfare of others (Pollard and Cousins 2008), stakeholders are challenged to continually engage interest based bargaining (Bodhanya 2010) as they seek to adjust benefit sharing (a reinforcing process that facilitates system configuration) in ways that prevent shared river

social-ecological systems from moving to undesired states. There are many examples that suggest current distribution of benefits is threatening social-ecological resilience at scales that vary from international to local (Nkhata et al. 2010; Aralal 2009; Nkhata et al. 2009). Ashton et al. (2008) observed: "The extent to which South Africa has exploited the water resources of the four shared basins has led to debate and even controversy amongst representatives of government departments and the wider public – both locally and within the neighbouring states."

Several investigators (e.g. Mohamed 2003; Turton 2003) have reported that some residents of the neighbouring countries resent the fact that South Africa already uses a large (and therefore possibly inequitable) portion of the water resources in the shared river basins. This is perceived to disadvantage the social and economic development aspirations of these countries and indicates stress on social resilience.

It emerges that benefit sharing is a key determinant of both "how the system got to be what it is" (Walker et al. 2002) and how it may be directed toward a more desirable and resilient state. However, despite what seems to be a central role for discourse around the sharing of benefits in the management of water resources, it remains largely underappreciated (Nkhata et al. 2010). Philips and colleagues (2006) noted that: "It is striking when reading the literature that although references to benefit-sharing (or the like) are numerous, little substance is discernible beyond the catch-phrase level. In fact, most of what is termed 'benefit-sharing' falls into one of two traps: either it resembles the previously utilized concept of Integrated Water Resource Management; or it consists of idealistic appeals for what should be done, without entering into a discussion on the real-world viability of such visions".

Benefit sharing should be understood as a social process involving collective identity and collective action (Nkhata et al. 2010; Philips et al. 2006). It is a process that can reinforce social-ecological resilience because collective identity gives members of the user group of ecosystem services an inclusive identity based on those shared meanings, interests and experiences that are required to inform choices and implement collective actions. It provides an effective basis for collective action in egalitarian benefit sharing arrangements (Nkhata et al. 2010). However, while collective identity is considered essential in avoiding the collapse of common pool resource systems, the sustainability of such social ecological systems may not be guaranteed in the absence of effective property rights.

Public Infrastructure (D in Figure 2)

Public infrastructure enables and regulates what, where, how and when Resource Users access and use ecosystem services. It combines two forms of human-made capital, physical capital (engineered works) and social capital (rules that govern management, monitoring and enforcement use, Anderies et al. 2004; Ostrom and Ahn 2003).

It may also include knowledge and scientific understanding. In shared river systems the implications of public infrastructure arrangements are complex because infrastructure (for example a dam or a rule for release of water from the dam) may influence access to and use of ecosystem services for distant resource users, perhaps even those located in

another country, that have no need for the impoundment. Also, rules devised at smaller scales may be impossible to implement because of the influence of rules established at larger (national or international) scales. The situation is complicated further when the sovereignty of national states may confound attempts to devise rules at international scale.

Public Infrastructure Providers (C in Figure 2)

The public infrastructure providers are those people who supply the social and built capital associated with the water resource. They can be from the public and private sectors and depending on how one chooses to define the SES, there may be substantial overlap with some individuals being both resource users (B) and infrastructure providers (C). Social capital can be developed by providers operating at different scales from local groups with shared interests (water users or conservation groups for example) to international institutions developing protocols (e.g. SADC Protocol on Shared Water Courses) and conventions (e.g. Convention on Biodiversity).

1.6.5 Linkages and Disturbances

Every SES is subject to disturbances that arise externally. A flood plain based SES may experience biophysical disruption because flow is altered through abstraction or operation of an upstream impoundment (Arrow 7); it may also experience social or economic disruption through policy changes that introduce new controls over access to resources such as fish (Arrow 8). The influences of such disturbances are propagated through the system with reinforcing feedbacks (Arrows 1-6) making it difficult to anticipate the consequences.

Shared rivers in southern Africa are complex social-ecological systems in which the supply of ecosystem services increasingly limits social and economic development. As there are no substitutes for these services, resource users have to learn to live within the limits of the capacity ecosystems to provide services, and to manage use in ways that will offer better prospects for sustaining a flow of benefits that accommodates both efficiency and equity.

Historically the ecological subsystem of shared river SESs has been drawn upon to meet expanding demands from the social subsystem. The most pressing challenge now is for the social subsystem to become more adaptive to the dynamics of both the ecological subsystem, and those of the social subsystem. With this understanding it becomes evident that the focus of research on shared rivers has much to do with how people learn, adapt and behave in complex social-ecological systems.

1.7 The research approach: systems oriented, transdisciplinary and action focused

Researchers have become used to planning, working and accounting at the scale of projects. Participation in a research programme, as envisaged in this report, may require something different from them.

Roux et al. (2010) reflected on the achievements of several research programmes in South Africa and Australia and point out that:

1. Building transdisciplinary programme teams is difficult. Gaining consensus across funder, researcher and user domains, and turning this into researchable questions, takes a lot of time and emotional energy.
2. A transdisciplinary team is essentially a complex adaptive system in itself. Its overall identity and function is determined by the existence and interactions of the constituent members with their respective backgrounds and worldviews. A certain level of unpredictability and surprise regarding the formation of relationships and the development of shared understanding is inevitable. Emerging patterns have to be managed on an ongoing basis.
3. It is important to find facilitators skilled in the social process of running meetings where people have contested ideas of reality and clashes of culture. The field of social learning may have lessons and principles to offer facilitators and practitioners of transdisciplinary studies.
4. Learning within a research programme is not necessarily ‘‘efficient’’, considering a set of stakeholders with diverse expectations which are clouded (if not misguided) by different world views, which in turn are based on different knowledge forms. Some participants may have to slow down their own learning while others catch up.
5. When dealing with large-scale social-ecological contexts, multiple interdependencies, where the outputs of one project become the inputs of another, must be managed with care. Development of an integrative framework at the outset may help this process. Autonomy within discrete teams is good so long as frequent exchanges are fostered to give teams a chance to learn from each other.
6. Transdisciplinary, systems oriented research requires a long-term commitment. Without a 5-to10-year time frame the considerable upfront costs are unlikely to pay off.
7. Transdisciplinary research in water resources management strives for co-development of knowledge among researchers and stakeholders. It requires commitment to ‘learning by engaging’ and implementing an action research approach.

1.8 A knowledge partnership

The SRBRP is based on the proposition that IWRM is embedded in complex SESs and depends on a holistic approach to management. This requires sharing and co-development of knowledge in ways that challenge conventional practices, attitudes and professional certainties and that confront entrenched sectoral interests.

Thus, the proposed analytical framework of the SRBRP, and its inherent transdisciplinary nature, necessitates a research agenda that extends beyond the mandate of the Department of Water Affairs.

Roux et al. (2010) concluded that research conceptualized as a service “purchased” by funders or users of research has enforced a perception of the researcher as accountable for delivering solutions. Moreover, where complex social-ecological issues are being addressed in a research programme, funders, researchers and resource managers must accept joint accountability for attaining the social intentions of the research programme. To form an effective knowledge partnership, these parties have to dedicate time for learning about each other’s contexts and accountabilities, including their respective motivations and reward systems.

Because the SRBRP is contextualised by aquatic ecosystems and their relationships with society, the principal parties to the proposed knowledge partnership include national government departments, and their public entities, with mandates that make them accountable for protecting and sustaining aquatic ecosystem services.

These are the Department of Water Affairs (DWA), the Department of Agriculture, Forestry and Fisheries (DAFF) and the Department of Environmental Affairs (DEA). The affected public entities are the WRC, SANBI and SANParks.

SANBI and SANParks have significant research involvement and would be important partners. Roles for provincial and local government and civil society are acknowledged but they are not envisaged as core partners for the design, funding and implementation of the SRBRP.

The imperative of engaging with role players beyond the borders of South Africa is acknowledged. It is envisaged that as the SRBRP gains momentum it will be expanded to engage stakeholders across national boundaries.

2 SHARED RIVER BASINS PROGRAMME: RESEARCH FRAMEWORK

It is evident from Section 1 that meeting the challenge of a society that is sufficiently knowledgeable and willing to change “conventional practices, attitudes and professional certainties” and confront “entrenched sectoral interests” (Global Water Partnership Cap-Net.org) requires transdisciplinary research that is both strategic and responsive; it requires a commitment to the co-evolution of knowledge; it requires that research providers, research users, research funders and society in general work together in the search for shared knowledge and understanding (Roux et al. 2010).

Understandably many frameworks have been developed as researchers engage IWRM and the issue of sustainable use. These vary in their philosophical foundations, focus and level of generality and it is improbable that a research programme such as the one proposed here, would draw on a single framework. Nevertheless adoption of a general framework structures the search for knowledge and provides a focus for dialogue. Because there is a risk of the chosen framework becoming a dogma, it must be understood that the framework is nothing more than a guide and its relevance should be regularly assessed.

2.1 Building on the Shared Rivers Initiative (SRI)

The central research question of SRI Phase 1 was '*What factors enable or constrain achieving environmental flows in the lowveld rivers*?"(Pollard and duToit 2010). Although this might suggest a narrowly conceived focus on environmental issues, the research approach assumed environmental flows as a legally defined right that would provide a rationale for adopting a systems and action research approach to gain insight into the factors that enable and constrain progressive realization of IWRM. With this understanding, the ultimate vision of the SRI was expressed as "…to involve key water management role-players in the collaborative research process so as to contribute to, and build, a competent community of practitioners that can function within complex environments and ultimately focus on the development of sustainable water management practices in the catchments of the lowveld." (Pollard and du Toit 2010).

Eight themes (Box) were used to analyse data collected from the catchment based case studies in order to elucidate the factors that enabled or constrained achieving successful implementation of the environmental Reserve.

Themes used for the analysis of data from the case study catchments (Pollard and du Toit 2010)

- Current understanding and embeddedness of concepts of sustainability and the Reserve in water management practices
- Change and lags
- Integration of WRM and water supply
- Unlawful use
- Skills, capacity and ability to monitor and enforce
- Adaptive capacity and change
- Feedback loops and self organization

The SRI acknowledged the complex social-ecological nature of water resource systems. It is widely accepted that in such systems there are 'formative processes' (Walker et al. 2002) that are strongly influential determinants of the structure and functioning of the system and that managing these processes offers the best prospects for promoting resilience. Although Pollard and du Toit do not explicitly suggest that the processes that underpin implementation of the ecological Reserve together constitute such a 'formative process', it seems reasonable to conclude that this is implied in the approach they adopted. Certainly the evidence they present confirms that raising the levels of embeddedness and involvement (Hardy et al. 2003; Gnywali and Madhavan 2001; Uzzi 1997 and Granovetter 1973, 1985) will contribute in a meaningful way to system resilience. However, studies of the Crocodile West River system have concluded that implementation of the ecological Reserve alone would not be sufficient to improve the ecological state of the river (REF). These findings support the view that IWRM can only be successfully implemented at a basin-wide level, through collective learning and effort by stakeholders.

In any chosen social-ecological system it is possible to identify more than one formative process and it is constructive to establish the rationale for selecting one over the others. Our choice is informed by the following interpretations which are modified from the guiding principles of IWRM:

1. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment. In southern Africa it is a limiting resource in that access to and use of aquatic resources regulates the nature and pace of social and economic development.
2. Water development and management should be based on a participatory approach involving users, planners and policymakers at all levels. The limiting nature of water resources dictates that we have to choose between options for use.
3. Water has an economic value in all its competing uses and should be recognized as an economic good. The limiting and central role of water resources in development requires that we understand the economic and social welfare implications of the choices we make.
4. Water resources are renewable and the ecosystem services that provide the options for social and economic development should be sustained.
5. Acknowledging the centrality of aquatic ecosystem services in social and economic development facilitates the emergence of integrated understandings and shared meanings at scales (social-economic and environmental) that enable interest-based bargaining which is necessary for achieving the intent of IWRM (Bodhanya 2010). The resilience of social-ecological systems is thus determined in significant ways by how stakeholders learn about and strive to manage demands for and distribution of the benefits that can be derived from access to and use of aquatic ecosystem services. With this understanding it may be concluded that the process of sharing benefits is a significant determinant of the structure, function and resilience of social-ecological systems that are conveniently bounded at the scale of river basins.

Phase 1 of the SRI has been a valuable precursor to understanding the challenges to implementing the ecological Reserve and its role in social and ecological sustainability, but as this is only one component of IWRM. A river basin scale approach will offer a conceptual framework in which to embed such studies.

SRI Phase 1 Recommendations (Pollard and du Toit 2010)

1. Compliance with the Ecological Reserve

An overarching recommendation is for government to lead operationalisation of the Reserve through a cohesive strategic plan.

2. Current understanding and embeddedness of the Reserve in practice

The overarching recommendation is for the development of a collective understanding of water resources protection measures at the catchment level.

In terms of research this may require exploring innovative ways to understand the Reserve with stakeholders and addressing the transboundary (international) nature of environmental Water Requirements.

3. Developing an integrated, systems view as the basis for planning and action (Links between water resources and water supply/ use)

The overarching recommendation is to develop support for a systemic, integrated approach to IWRM in each catchment (as outlined in the guidelines for the catchment management strategies).There is an urgent need for leadership and action on the co-ordinated planning for water resource management and water supply. There is an urgent need to institute strong leadership ***and appropriate and effective governance in the Olifants, the Middle/ Klein Letaba and the Luvuvhu rivers.*** In the case of the Olifants, this may require fast-tracking the establishment of the Olifants CMA.

4. Unlawfulness and the regulation of unlawful use

The overarching recommendation is that monitoring and enforcement must be strengthened as a matter of urgency and legal support given to the development of legal literacy amongst key roleplayers and in the water sector.

5. Lags in the implementation of the Reserve and emergence of sustainability discourse

The recommended strategic action in respect of this theme is contingent on what the outcomes of the research consultancy but it is likely to entail the need for a better understanding of lags and the legal definition of reasonableness.

6. Self-organisation and feedback loops in adaptive action and management

The key recommendation is that support be given to developing and strengthening coherent, robust and functional feedbacks that provide the basis for action and learning. We suggest that it is the multiple, interacting feedbacks that operate at different scales that confer a more resilient outcome.

2.2 Vision, Values and Goals of the SRBRP

The ultimate intention of this research programme is a knowledgeable society; a society that is enabled to engage constructive dialogue around the social, economic and ecological consequences of the difficult choices that have to be made in the allocation of access to and use of the ecological services that derive from shared rivers. For stakeholders to be able to make informed, wise choices requires understanding and appreciation of the value of the benefits, how they are distributed, the inherent uncertainty and risks and their influence on social-ecological resilience.

2.2.1 Vision

A knowledgeable society enabled by the Shared River Basins Research Programme to understand and appreciate the implications of the choices we make in the use of aquatic ecosystem services.

2.2.2 *Mission*

To establish the Shared River Basins Research Programme as a knowledge partnership, based upon an action research approach through which stakeholders learn together. The programme develops national research competencies by providing the space in which experienced as well as less experienced researchers can experience the fieldwork, teamwork, scientific discovery and producing and communicating novel, relevant and excellent work.

2.2.3 Values

1. Acknowledge and engage complexity
2. Make good use of what we already know
3. Strategic whilst retaining relevance to contemporary issues
4. Collaborative and trans-disciplinary
5. Transparent and supportive of each other and acknowledge learning inter-dependence between components and projects
6. Balanced, combining both theoretical and applied study
7. Ethical
8. Empathetic
9. Open to re-interpret problems and issues
10. Committed to participation and being involved

2.2.4 Goals, objectives, milestones and deliverables

It is ultimately the responsibility of the Programme Management team to develop the Programme Goal and its supporting objectives and milestones and deliverables.

The reasons for this are three-fold. Firstly, there is a fundamental logical linkage between the overall programme goal, its intermediate objectives, and how it cascades, through the projects that ultimately comprise the SRBRP, to milestones and deliverables. As the detailed programme design will be the responsibility of the programme management team, it follows that the finalization of the programme goal and objectives must be done during the detailed planning

phase. Secondly, the parties to the envisaged knowledge partnership (SANBI and SANParks for example) would be expected to provide significant input into the formulation of the Programme Goal and its supporting objectives. These parties remain to be consulted. Finally, the Programme Goal and its supporting objectives must be measurable and realistically achievable and are thus, to a large extent, dependent on the available research budget.

An example of the Programme Goal is for instance: "*By April 2016, the SRBRP has supported all spheres of decision-making that affects water resource quality, by providing useful scientific evidence and intellectual capacity to assist improved and informed decision-making*."

The implications of achieving this goal then have to be disaggregated into several achievable intermediate objectives which need to be implemented by the SRBRP, by 2016.

2.3 Approach

2.3.1 Formative processes

"Sustainability involves maintaining the functionality of a system when it is perturbed, or maintaining the elements needed to renew or reorganize if a large perturbation radically alters structure and function" (Walker et al. 2002). Although in complex social-ecological systems there are a myriad of forces that interact to determine the state and the trajectory of that state there are some processes that appear to play a key determining or formative role. There is consensus that aquatic ecosystem services and the benefits that society can derive from them will increasingly limit social and economic development. This suggests that how access to and use of ecosystem services are apportioned is a formative process determining the state of social-ecological ecosystems. As Ashton et al. (2008) point out there is compelling evidence that the process of apportionment of benefits in river basins has had a profound determining effect of the current state of regional social-ecological systems and importantly, will be a critical determining factor in sustainability. The revision of South African water law illustrates both how the approach (hierarchical, Nkhata et al. 2010) and the process led to inequitable distribution of benefits, and how the democratic government has adopted a more egalitarian approach as it strives for greater equity. Importantly it also made provision for institutional arrangements (Catchment Management Agencies, Water User Association among others) that create the conditions necessary for interest-based bargaining that can balance equity and efficiency in the use of ecosystem services.

The sustainability of social-ecological systems is also determined by external forces over which stakeholders may have little direct influence. Climate change, for example, will significantly reshape rainfall distribution and with that the capacity of aquatic ecosystems to deliver services. As these change, society will be required to adapt and re-apportion benefits in ways that foster sustainability.

With this understanding benefit sharing is considered to be a key formative process for this research programme.

2.3.2 Bounding the social-ecological system

Aquatic-based social-ecological systems can be conceived over the range of scales from local to global. The implication is that research must develop understanding that can find application at any scale. The community of scientists and the resources we can access to support them are small; to be efficient and effective in knowledge generation requires that research is conducted at social and spatial scales that match resources. For this phase research will focus on one basin (sub-catchment) of an international river in South Africa. What is learned at this scale can then be tested at larger scales.

The Phase 2 Shared River Basins Research Programme will also be informed by and inform research conceptualized and conducted independently (in other locations or systems).

2.3.3 Action research

The term ‘action research’ is subject to different interpretations. Because the goal of the proposed SRBRP is a knowledgeable society, resource users, public infrastructure providers and researches will engage each other in a co-learning process. As the numbers of research users and public infrastructure providers increases exponentially with increase in spatial scale, bounding the system for study at the scale of a sub-catchment basin limits the number of actors to a manageable size and facilitates an action research approach.

2.4 Frameworks

The research will be guided by three frameworks (Millennium Ecosystem Assessment 2005, Anderies et al. 2004 and Walker et al. 2002) that together depict (see Figure 3 below) how we understand the structure and functioning of the river basin SES and frame the questions that research will seek to answer.

1. The Millennium Assessment framework provides the linkage between the social and ecological sub-systems. The ecological sub-system produces services that are the sources of benefits, the allocation of which is a strong formative process determining the structure and function of the social sub-system. Feedbacks defined by the patterns of use of ecosystem services can either reinforce an existing state or can reconfigure the ecological sub-system making it more or less resilient.
2. The Anderies et al. framework structures interrogation of the river basin by enabling identification of “potential vulnerabilities of SESs to disturbances”.
3. The Walker et al. framework (Figure 4) depicts a process that may be followed in the analysis of SESs and details four steps that may be expressed as key questions for the research programme.

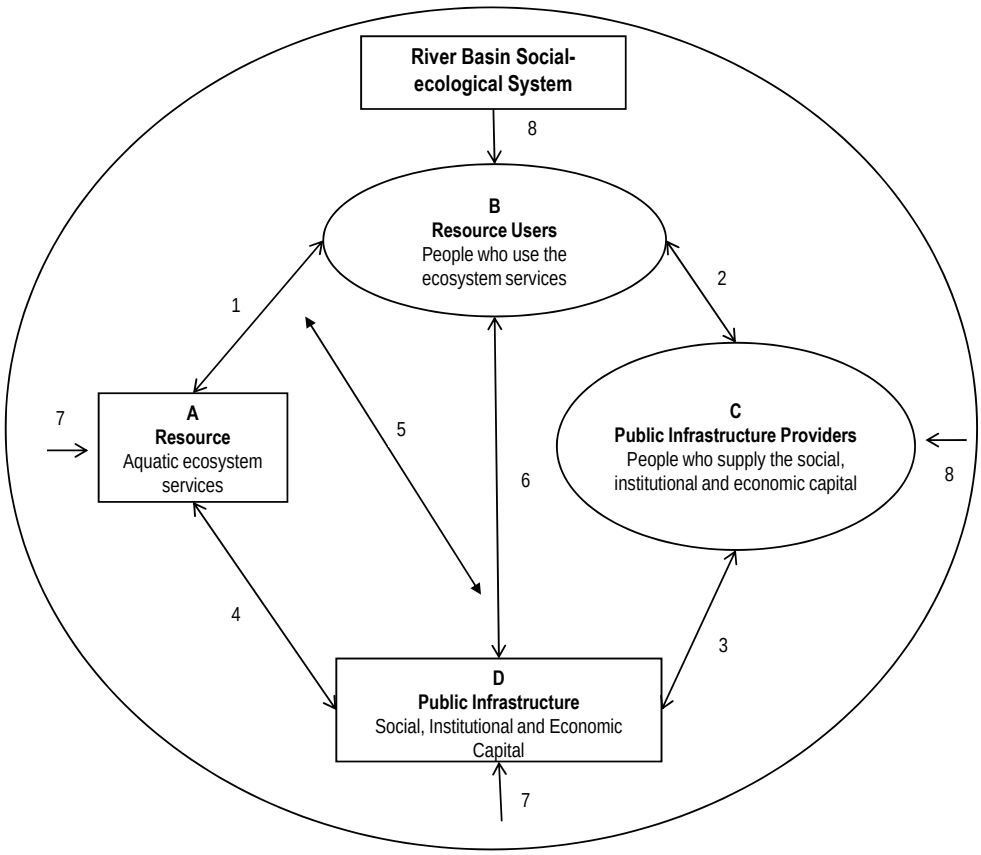


Figure 3. Framework depicting a social-ecological system (Adapted from Anderies et al. 2004). Refer text for more information on the Anderies et al. framework.

Using these combined frameworks, Phase 2 of the Research Programme will enable a structured and integrated approach to:

1. Reviewing research and discovering what contribution it has made to our understanding of and ability to maintain the functionality of shared river basin social-ecological systems
2. Describing the selected shared river basin social-ecological systems (key processes, structures and actors)
3. Identifying the formative processes (particularly benefit sharing) that have resulted in the present state
4. Exploring the drivers of change that pose a risk to resilience in the selected systems
5. Identifying the elements that are needed to renew or re-organize to enable the system to cope with competing demands in the context of a limiting supply of ecosystem services
6. Exploring plausible visions and policies
7. Providing informed systems analysis for learning and decision making.

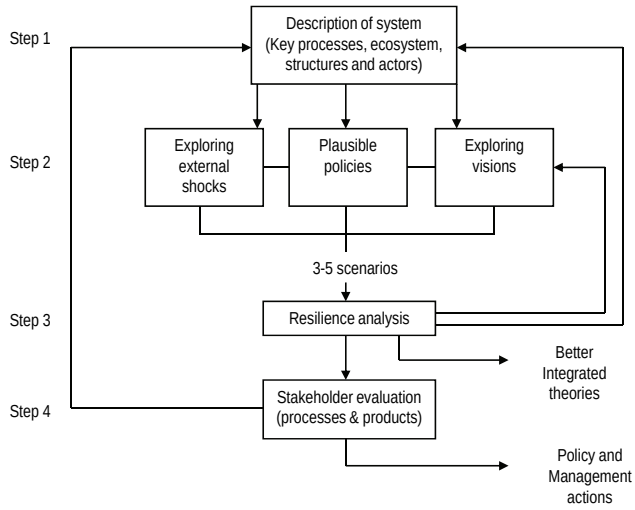


Figure 4. Framework for the analysis of social ecological systems (Walker et al. 2002)

2.5 Key questions

Using the Walker et al framework (Figure 4) we can pose the four key questions that will be addressed in Phase 2:

1. Resilience of what? This is a comprehensive description of the river basin social-ecological system including key natural and social processes, structures and actors. In responding to this question the Programme will develop a protocol for describing and a description of the selected river basin SES. The protocol will be applicable to other basins and over a range of scales. Using a common protocol will facilitate dialogue, and learning across stakeholder scales from local to international.
2. Resilience to what? This involves exploring shocks, developing plausible policies to deal with shocks and developing a vision for the future of the system drawing on experience with Strategic Adaptive Management. The Programme develops an understanding of how benefit sharing in particular and other formative processes influence the structure and functioning of the SES. It will develop plausible policy options (public infrastructure, 'rules of the game') for managing shocks guided by a shared vision for the future of the system. The approach, adapted from experience will be developed as a protocol to guide similar processes in other SES over a range of spatial and social scales.
3. Where does resilience reside? This is a detailed quantitative analysis to determine where the resilience in the system is.
4. This might include the relationships between flow and ecosystem services, between ecosystem services and availability and value of benefits and between apportionment of benefits and effective commitment to and identification with a collective identity that enables collective action for benefit sharing.

5. How does society manage for resilience? This step involves the evaluation of management and policy implications (public infrastructure provisions). The Programme will evaluate the implications of internal and external public infrastructure for reliance. It will provide an approach to analysis that can be applied over range of spatial and social scales. It will suggest actions for enhancing resilience.

2.6 Programme Structure

The research programme will be structured in five research management sub-programmes as shown in Figure 5.

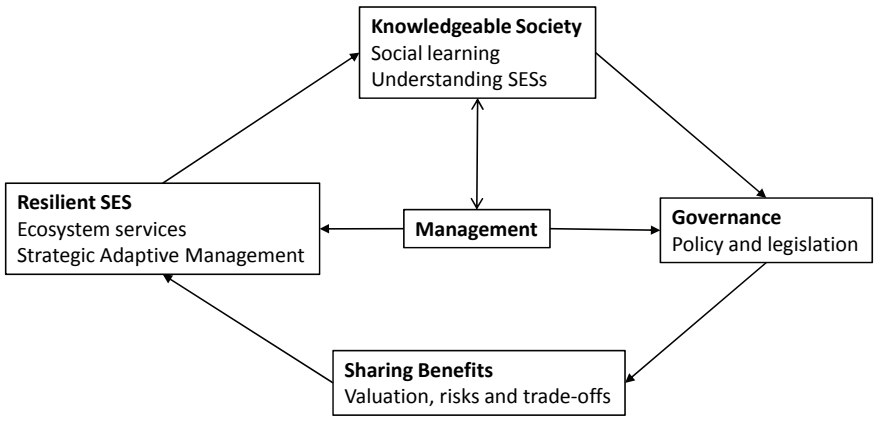


Figure 5. A conceptualization of the organization of the Shared River Basins Research Programme

2.6.1 Sub-programmes

A Knowledgeable Society: Research and engagement designed to inform and promote understanding of benefit sharing in shared river basins

Governance: Research designed to support policy and legislation reform and implementation

Sharing Benefits: Research designed to understand the nature and implications of benefit trade-offs in socially, politically and ecologically complex shared river basins

Resilient SESs: Research designed to enable the implementation of Strategic Adaptive Management in shared river basins

Programme management: Manage the research programme and be accountable for its contribution to:

1. Providing a research environment consistent with the espoused vision, values and intent
2. Developing robust and reliable data and information
3. Developing research competencies and capacity relevant to the concept of resilience in social-ecological systems

4. Developing and enhancing competencies and capacities for bridging between science, management, policy and resource stakeholder domains
5. Developing and enhance implementation competencies and capacity relevant to fostering resilience in shared river basin social-ecological systems and with a focus on mentoring previously marginalized individuals.

3 Management of the Research Programme

3.1 Background

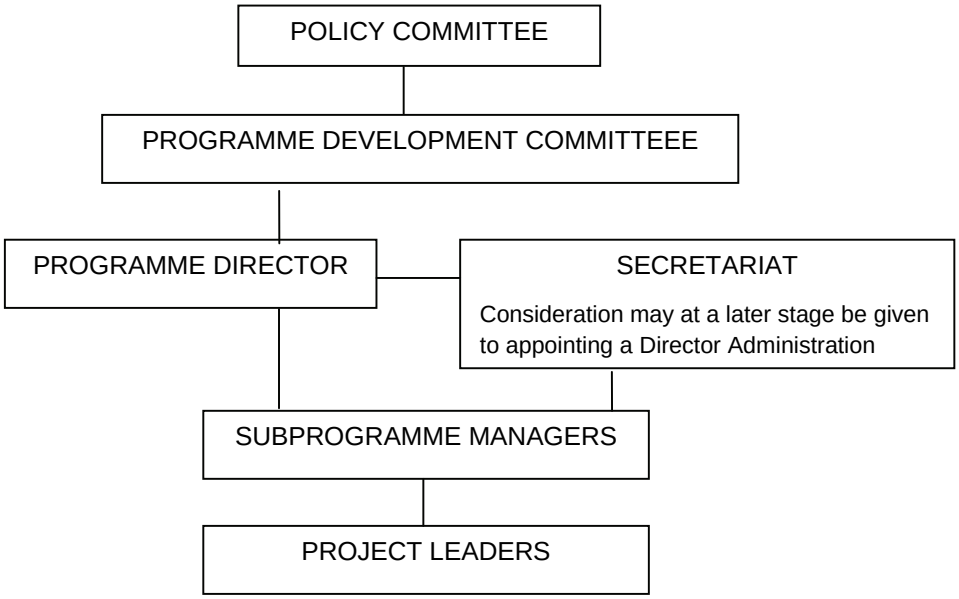
The management structure proposed here is based upon the successful structure of the Kruger National Parks Rivers Research Programme.

Overall, the Programme will be governed by a policy committee, comprising representatives of the knowledge partnership organizations (WRC, SANBI and SANParks for example).

The development of the programme research content will be governed by a programme development committee. This would include middle-management and researchers from the knowledge partnership organizations, but also representatives from other organizations (such as CMAs, Department of Agriculture, Forestry and Fisheries, and others).

The programme will be managed by a **Programme Director** who during the initial stages will be supported by a secretariat. As the programme develops an **Administrative Director** may be appointed and the two directors will jointly fulfill the role of a traditional Managing Director. These will be permanent positions.

The subprogrammes will be defined once the Programme Director and the policy and programme development committees have been constituted. Managers will be appointed for each subprogramme. This structure can be depicted by the following organogram:



3.2 The Policy Committee

3.2.1 Terms of Reference

The Policy Committee provides institutional support for the design and operation of the SRBRP and is accountable for promoting the dissemination, uptake and application of emerging knowledge and understanding; it is responsible for leveraging change in institutional behaviour. Because the Programme will involve cooperation from several organizations it is necessary that high level representatives from key organizations are aware of and may influence the Programme activities. Both knowledge and acceptance of such activities are prerequisites for a successful Programme.

3.2.2 Name.

Policy Committee for the Shared River Basins Research Programme.

3.2.3 Purpose.

The principal purpose of the Policy Committee is to ensure that the SRBRP is embedded within those institutions that collectively are positioned to guide IWRM and create the conditions for an effective knowledge partnership that can leverage change. It provides guidance and promotes the development, implementation and strategic review of the Programme and promotes accountability in institutional, financial and political terms across the spectrum of end-user bodies as well as in the Programme's 'external milieu'.

3.2.4 Objectives.

1. Derive and implement a policy for the Programme.
2. Promote the necessary inter-institutional cooperation for the implementation of a cooperative research programme.
3. Approve the Programme's activities.
4. Approve and recommend the programme budget drawn up jointly by the Programme Director and if applicable, the Administrative Director.
5. Assist with the securing and allocation of funds, manpower resources, etc. from respective organizations.
6. Facilitate information and technology transfer.
7. Promote adoption of research findings by stakeholders.

3.2.5 Membership.

1. The committee will consist of executive representatives from participating organisations.
    a. CMA as appropriate
    b. Water Users
    c. South African National Parks.
    d. Department of Water Affairs
    e. Department of Environmental Affairs.
    f. Provincial government
    g. Local government

h. National Research Foundation
i. Water Research Commission
j. Chairman of the Programme Development Committee
k. The Programme Director (and Administrative Director if appointed) of the Shared River Basin Research Programme report to the Committee but are not members
l. Representatives of other agencies considered appropriate.

2. Members may be co-opted from other organizations as and when the need arises.
3. Representatives will be nominated by their respective organizations.
4. Taking into account the purpose and objectives of this committee, membership should be drawn from senior management.

3.2.6 Chair

1. The Chair will be chosen by members of the Policy Committee.
2. The Chair's functions are as follows:
    a. Chair meetings of the Policy committee
    b. Approve draft agenda before each meeting and
    c. Liaise with the Secretariat, Programme Director (and Administrative Director) and with the Chair of the Programme Development Committee on matters which affect the operation of the Programme.
3. The Chair will act as spokesman for the Committee.

3.2.7 Meetings

1. The Policy Committee will meet at least twice a year.
2. The Policy Committee will annually appoint four members to act as an Executive Committee. The convener will be chosen by members of the Executive Committee.

3.3 Programme Development Committee

3.3.1 Terms of reference

The Programme Development Committee provides institutional support for the design, operation, integration and promotion of the projects conducted under the umbrella of the SRBRP. It draws on knowledgeable and influential personnel who contribute to co-development of knowledge and establishment of the knowledge partnership

3.3.2 Name

Programme Development Committee for the Shared River Basin Research Programme.

3.3.3 Purpose

To ensure the SRBRP leads to development of a knowledge partnership that supports and leverages change in IWRM, and to oversee the management of the 'internal milieu' of the Programme.

3.3.4 Objectives

1. Develop and maintain a research programme plan and recommend its adoption by the Policy Committee
    a. Establish research priorities and recommend their adoption by the Policy Committee
    b. Make recommendations and proposals for funding to the Policy Committee
    c. Promote inter-institutional cooperation with respect to implementation of the Programme
    d. Secure researcher involvement where necessary.
    e. Report regularly to the Policy Committee, researchers and to executives of the participating organizations.
    f. Assist the Programme Director (and Administrative Director) with the steering, management and coordination of the Programme.
    g. Ensure information and technology developed by the Programme is properly managed and disseminated.
    h. Ensure that priorities are observed and important projects are supported in order that the best use is made of limited funds.
    i. Act as a sounding board for assessment and evaluation of research proposals and research findings.
    j. To accept and promote, where appropriate, the implementation of research findings.
    k. Consider and submit an annual report prepared by the Programme Director (and Administrative Director) to the Policy Committee. The annual report is to evaluate progress and to present a work plan and a budget for the following year.

3.3.5 Membership

1. The committee will consist of senior researchers (Subprogramme Managers) and middle-management representatives from participating organizations:
    a. CMA
    b. Water Users
    c. South African National Parks
    d. Department of Water Affairs
    e. Department of Environmental Affairs
    f. Department of Agriculture, Forestry and Fisheries
    g. Provincial government
    h. Local government
    i. Water Research Commission
    j. National Research Foundation
    k. Programme Director (and Administrative Director if appointed)
    l. Representatives of other organisations considered appropriate
    m. Co-opted members, including universities not already involved.
2. Representatives will be officially nominated by their organizations.

3.3.6 Chairman

1. The Chairman will be elected by members of the Programme Development Committee.
2. The Chairman's functions will be as follows:
    a. Chair meetings of the Programme Development Committee
    b. Approve a draft agenda before each meeting in conjunction with the Programme Director (and Administrative Director if appointed) and Secretariat; and
    c. Liaise with the Secretariat, Programme Director (and Administrative Director) and Chairman of the Policy Committee on matters which affect the operation of the Programme
    d. The Chairman will act as spokesman for the Committee.

3.3.7 Meetings

1. The Programme Development Committee will meet as regularly as required in order to fulfill the goals of the Programme but not less than twice a year.
2. The Committee will annually appoint three members to serve as an Executive Committee.

3.4 Terms of reference for the Programme Director

3.4.1 Reporting Relationships.

The Programme Director reports to the Policy and Programme Development committees.

Appointed on 5-year **contracts by the WRC**, but funded through the Policy Committee.

3.4.2 Responsibility

The Programme Director is responsible for ensuring that the Programme is positioned to leverage change by fulfilling its two main goals

1. An informed society and management that is competent to prevent shared river social-ecological systems from moving to undesired states by reinforcing processes that facilitate preferred configurations in the face of external stresses and disturbance; and
2. Adaptive social capacity that can nurture and preserve the elements that enable social-ecological river systems to renew and reorganize as need arises (see Walker et al. 2002).

3.4.3 Accountability

1. The Programme Director is accountable for:
    a. Developing and implementing the strategic plan for the Programme
    b. Coordinating the implementation a subprogramme that addresses the development of competencies in previously disadvantaged sectors (**Corrective Action within the Management subprogramme**)
    c. Supporting programme development in HBUs
    d. Coordinating the work of the subprogrammes and of demands on logistics
    e. Evaluating progress towards meeting end user requirements

f. Streamlining the development, evaluation of project proposals and securing approval by the Programme Development Committee
g. Controlling the quality of the work conducted in the programme
h. Securing investment (human resources, expertise and funds) for the programme
i. Financial control of the programme and management budgets
j. managing the programme secretariat
k. Fostering the public image of the programme through liaison and publicity
l. Reporting to the Programme Development and Policy Committees.

3.4.4 Requirements

The position of Programme Director requires:

1. Acknowledged standing in research
2. A proven ability to develop, implement, manage and evaluate an interdisciplinary, applied research programme
3. An ability to secure facilitate partnerships and secure investment for the Programme
4. A commitment to simultaneously meet the legitimate requirements of researchers and end-users
5. Good leadership and interpersonal skills.

3.4.5 Authority

The Programme Director is authorized to make day-to-day management decisions required to effectively implement the Programme and projects agreed to by the Programme Development Committee. New initiatives require authorization by the Policy and Programme Development Committees.

The Programme Director is authorized to issue public statements concerning the Programme, provided they are consistent with established policy for the Programme.

3.4.6 Work Relationships

The Programme Director is the interface between the Programme and end-users, funders and partner institutions, as well as between subprogramme Managers and programme management. Successful completion of the work of the Programme Director requires collaboration, understanding and support from all participants in the Programme.

3.5 Terms of reference for the subprogramme managers

3.5.1 Reporting Relationships

The subprogramme managers report to the Programme Director.

3.5.2 Responsibility

Subprogramme managers will be responsible for maintaining and enhancing an **Information Management System** which will enable efficient capture, storage, retrieval and dissemination of information to meet the needs of researchers, decision-makers and stakeholders in the programme. They will be responsible for identifying a previously disadvantaged person to

become a management partner and for working closely with and mentoring the appointed partner. They will also be responsible for facilitating effective communications and the transfer of information and technologies to researchers, managers and stakeholders.

3.5.3 Accountability

Subprogramme managers are accountable for:

1. Strategic planning in the subprogramme
2. Implementing the strategic plan
3. Maintaining and enhancing an information management system
4. Providing effective training in the use of the information system
5. Facilitating and coordinating activities within the subprogramme
6. Controlling the quality of work of the subprogramme
7. Evaluating progress in the subprogramme
8. Preparing and managing the budget of the subprogramme
9. Reporting to the Programme Director
10. Enhancing the capacity of Subprogramme-Manager's partner
11. promoting corrective action within the subprogramme.

The products of the subprogramme are:

1. A user-friendly, up-to-date data base and data catalogues
2. An efficient and cost-effective system for managing the data base
3. An efficient and cost-effective information service for researchers, managers and stakeholders
4. A functioning network with other relevant data management systems
5. Protocols, reports and publications promoting use of the systems
6. Trained users
7. Informed researchers, managers and stakeholders

3.5.4 Duties and Activities

The duties and activities of the subprogramme Managers are detailed in the objectives and tasks of the subprogramme.

3.5.5 Requirements

The position of Subprogramme Manager requires:

1. Technical skills and experience of data and information management systems
2. A proven ability to develop, implement and manage complex data and information management systems
3. A commitment to developing the data and information systems
4. A commitment to serving the information and data needs of researchers, managers and stakeholders
5. Good leadership and interpersonal and facilitation skills.

3.5.6 Authority

Once the Sub-programme plan and the strategy for implementation have been accepted by the Management Committee, the subprogramme managers have complete authority for implementing the plan and managing the work of the subprogramme.

4 TIMEFRAME AND FUNDING

4.1 Timeframe

A programmatic approach such as that envisaged here requires a timeframe of at least 5 years to achieve the stated programme vision.

The envisaged timeframe is therefore 1 April 2011 – 31 March 2016.

4.2 Funding strategy

4.2.1 Background and approach

The intention of this document is not to develop a detailed budget for the envisaged programme, but rather to propose a strategy.

The vision for this programme requires significant research investment over a five-year period, amounting to a **total research investment of at least R50 million over a five-year period.**

The proposed investment may start relatively small in Year 1 and escalate annually as the programme matures.

4.2.2 Funding Sources

This would require the proposed knowledge partners (WRC, SANBI and SANParks among others) to invest approximately R3.0 – R3.5 million per year into the research programme.

Additional funding could be attracted from other funding sources (including foreign sources) either at a programme or project level.

4.2.3 Project size

The individual project size will be determined by the scope of each project as designed by the full programme management team.

Section 2.7 above envisages a high level of solicited content in the research projects, combined with an active oversight role by the Programme Director. Because of the importance attached to co-learning and development of the knowledge partnership, frequent review and reflection are essential. It is thus envisaged, that the average project size will be approximately R500k per project, and of 12-18 month duration with consideration for extension.

4.2.4 Programme hosting

To be hosted at WRC.

5 RECOMMENDATIONS / IMPLEMENTATION PLAN:

- Presentation to WRC CEO
- Negotiations between WRC, SANBI, SANParks / MOUs / etc.
- Establish Policy Committee
- Appoint Project Director and Admin Director
- Establish Programme Policy and Development Committees
- Develop Strategic Plan (as envisaged in section 2.2)
- Appoint Subprogramme Managers
- Commission Projects
- Constitute steering committees chaired by the persons appointed by the Water Research Commission

6 REFERENCES

Anderies, J.M., Janssen, M.A., Ostrom, E. 2004. A framework to analyse the robustness of social-ecological systems from an institutional perspective. Ecology and Society 9(1):18 [online]URL: http://www.ecologyandsociety.org/vol9/iss1/art18

Aralal, E. 2009. What Explains Collective Action in the Commons? Theory and Evidence from the Philippines. *World Development* 37 (3) 687-697.

Ashton, P. J., Hardwick, D. and Breen, C. 2008. Changes in water availability and demand within South Africa's shared river basins as determinants of regional social and ecological resilience. Chapter 9 in: *Exploring Sustainability Science: a southern African perspective*. Editors: Michael Burns and Alex Weaver. SUNPress. Stellenbosch, South Africa.

Bodhanya, S. 2010.Personal communication with Mark Dent, University of KwaZulu-Natal.

Cash, D.W., Clark, W.C., Alcock, F., Dickson, N.M., Eckley, N., Guston, D.H., Jäger, J. and Mitchell, R.B. 2003. Knowledge systems for sustainable development. *Proceedings of the National Academy of Science* 100: 8086-8091.

Chang, D. 2010. The coming of the empathetic economy. Askentrepreneur.co.za 47, 72-74.

Goleman, D. 2009. Ecological Intelligence: The coming age of radical transparency. Penguin Books.

Granovetter, M.S. 1973. The strength of weak ties. *American Journal of Sociology* 28 (6) 1360-1380.

Granovetter, M. 1985. Economic Action and Social Structure: The Problem of Embeddedness *American Journal of Sociology* 91 (3) 481-510.

Gynwali, D.R. and Madhavan, R. (2001). Cooperative networks and competitive dynamics: a structural embeddedness perspective. *Academy of management Review* 26 (3) 431-445.

Hardy, C., Phillips, N. and Lawrence T.B. 2003. Resources, Knowledge and Influence: The Organizational Effects of Interorganizational Collaboration. *Journal of Management Studies* 40:2 March 2003, 0022-2380.

Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: current state and trends, Volume 1. Edited by R. Hassan, R. Scholes and N. Ash. World Resources Institute. Island Press, Washington.

MA (Millennium Ecosystem Assessment). 2007. Overview of the Millennium Ecosystem Assessment. http://www.millenniumassessment.org/en/About.aspx 16 May 2007

Mitchell, S. 2007. The Shared Rivers Initiative. Water Research Commission, Pretoria

Nkhata, B.A., Mosimane, A. W, Breen, C. M. and Hay, D. G. 2010. A theoretical framework for understanding benefit sharing arrangements with particular reference to the water sector. Water Research Commission draft report. Water Research Commission, Pretoria.

Ostrom, E., and Ahn, T.K. editors. 2003. *Foundations of social capital.* Edward Elgar Publishers, Cheltenham, UK.

Palmer, C.G. 2010. Concept document: *Akili Complexity and Integration Programme within* Human and Social Dynamics in Development Grand Challenge. National Research Foundation, Pretoria.

Phillips, D., Daoudy, M., McCaffrey, S., Ojendal, J. and Turton, A. 2006. Transboundary Water Cooperation as a Tool for Conflict Prevention and Broader Benefit Sharing. *Global Development Studies No. 4*. Ministry of Foreign Affairs, Sweden.

Pollard, S. and Cousins, T. 2007. Towards integrating community-based governance of water resources with the statutory frameworks for Integrated Water Resources Management: A review of community-based governance of freshwater resources in four southern African countries to inform governance arrangements of communal wetlands. WRC Report No. K8614. Water Research Commission, Pretoria.

Pollard, S. and Cousins, T. (2008). Community-Based Governance of Freshwater Resources in Southern Africa. Water Research Commission Report TT 328/08, Water Research Commission, Pretoria.

Pollard, S. and du Toit, D. (2010). Towards the sustainability of freshwater systems in South Africa: An exploration of the factors that enable and constrain meeting the ecological Reserve within the context of Integrated Water Resources Management in the Catchments of the lowveld. Draft Final Report. The Shared Rivers Initiative Phase 1 WRC K5/1711. Water Research Commission, Pretoria.

Prime Africa Consultants 2010. Socio-economic study in support of the ecological Reserve in the Crocodile West basin. Client confidential report to Golder Associates.

Roux, D. J., Stirzaker, R. J., Breen, C. M., Lefroy, E. C. and Cresswell, H. P. 2010. Framework for participative reflection on the accomplishment of transdisciplinary research programs. *Environmental Science and Policy* doi:10.1016/j.envsci.2010.08.002

Uzzi, B. 1997. Social Structure and Competition in Interim Networks: The Paradox of Embeddedness. *Administrative Science Quarterly* 42:35-67.

Van Kerkhoff, L. and Lebel, L. 2006. Linking action and knowledge for sustainable development. *Annual Review of Environmental Resources* 31: 445-477

Walker, B., Carpenter, C., Anderies, J., Abel, N., Cumming, G., Janssen, M., Lebel, L., Norberg, J., Peterson, G.D. and Pritchard, R. (2002) Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Conservation Ecology* 6(1):14.

Water Research Commission 2010a. Water Research Commission Project KSA2: 8/964 The review, re-conceptualization and re-design of the Shared Rivers Initiative, Deliverable 1: Report on situation analysis regarding what was planned versus what was achieved during Phase 1 of the SRI, with recommendations on how to close gaps. Water Research Commission, Pretoria.

Water Research Commission 2010b Water Research Commission Project KSA2: 8/964 The review, re-conceptualization and re-design of the Shared Rivers Initiative, Deliverable 2: A conceptual framework that provides the philosophical foundation for a shared rivers initiative programme as envisaged in Deliverable 1.Water Research Commission, Pretoria.