Communities on the Pongola River floodplain have been deprived of their rights to water resources (Hennie Kok)

Embedding Property Rights Theory in Cooperative Approaches to the Management of Aquatic Ecosystem Services in South Africa

Report to the
Water Research Commission

by

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Executive summary

1. Background and Introduction

In South Africa, with a growing appreciation of water scarcity, we have seen a shift away from the notion of ownership to rights of use. This shift marks explicit acknowledgement that water and the associated ecosystems need to be understood and managed as common pool resources. As our understanding of the links between ecosystems and society has developed we are encouraged to view ecosystems as providers of services from which we can derive benefits. Society's interest in aquatic ecosystems is thus focused on how the benefits of access to and use of services should be apportioned, a process that requires trade-offs and collective decision making. The need to allocate rights to benefit from ecosystem services that are highly variable in time and space stresses the central importance of understanding the concept of property rights in the context of common pool resources and embedding this in dialogue addressing the sharing of benefits.

A scan of the international literature indicated that well-developed and specifically detailed property rights regimes might contribute significantly to the equitable and efficient governance of common pool resources.

With this in mind, this report:

1. Explores the salient attributes of property rights regimes, particularly common property regimes that sustain cooperative approaches to management over long periods of time.
2. Identifies property rights knowledge gaps in the management of water resources in South Africa.
3. Analyses national policy and legislation with a view to assess the extent to which property rights theory and understanding have been integrated.
4. Develops a collective understanding of how property rights regimes, particularly common property theory, influences the management of aquatic ecosystem services in South Africa.
5. Services the WRC knowledge hub and those who benefit from it, by contextualizing property rights within the water sector.

2. The concept of property rights

A **property right** is an enforceable authority that permits an actor to make specific decisions and carry out actions in a particular social arena. Practically, a right cannot exist without recognition and acquiescence by others in the form of relationships involving the individual rights-holder. For every property right, sets of **rules** exist that authorise or require particular actions in exercising that right. Rules are the prescriptions that forbid, permit or demand some specific actions or outcomes as well as the sanctions related to failures in compliance. Property rights and their rules are exercised through **institutions**. Institutions refer to enduring regularities of human actions structured by rules, norms or shared strategies. They provide the normative framework that guides the decisions and actions of social actors. The operationalization of institutions in the real world results in what is called a regime, a body of fundamental rules that can be established at different levels of human interactions (global, regional, national and local).

Property rights are viewed as **bundles of rights** (Table 1) to use or transfer resources, including benefits. These bundles of rights can be added or subtracted, shared or divided in different ways resulting in changes in the amount of benefits, and associated costs, flowing from the property. Defining them thus allows for a better understanding of how different allocation systems for those rights affect the incentives structures of individuals or collectives.

Table 1: Bundles of Rights Associated with Positions (sourced from Ostrom and Schlager, 1996, P. 133)

Bundle of Rights	Owner	Proprietor	Claimant	Authorised user	Authorised entrant
Access	X	X	X	X	X
Withdrawal	X	X	X	X	
Management	X	X	X		
Exclusion	X	X			
Alienation	X				

Property rights regimes can be one of four types: private, public, common or open-access. We can distinguish these based on the ability to control access and management of the property as shown in Table 2.

Table 2: Types of property rights

	OWNER	EXAMPLE	ACCESS	MANAGEMENT
Private	Private	Freehold land	By owner	By owner
Common	Group	Common land	By joint owners	By joint owners
Public	State	National Park	State	State
Open Access	No-one	Open ocean fishery	Uncontrolled	None

We are able identify seven important principles for the establishment of effective property rights regimes for the governance of aquatic ecosystem services. These relate to boundaries, benefit and costs, collective-choice arrangements, monitoring, sanctions, conflict resolution and self-organization (Table 3).

Table 3: Design principles for effective property rights regimes for aquatic ecosystems (Sourced from Anderies et al., 2004)

Key Aspect	Principle
1. Boundaries	Clearly define the boundaries of an aquatic ecosystem as well as the individuals or households who have rights to benefits
2. Benefits and Costs	Ensure there is proportional equivalence between the benefits and costs associated with particular aquatic ecosystem services. Associated Rules specifying the amount of resource products that a user is allocated are related to local conditions and to rules requiring labor, materials, and/or money inputs.
3. Collective-Choice Arrangements	Ensure that most individuals affected by harvesting and protection rules are included in the group that makes changes to the rules.
4. Monitoring	Make certain that the monitors who actively audit biophysical conditions and user behavior are accountable to the users or are the users themselves.
5. Graduated Sanctions	Make sure that the users who disobey rules receive graduated sanctions.
6. Conflict-Resolution Mechanisms	Ensure access to low-cost, local arenas for users and managers to resolve conflict among users or between users and the managers.
7. Minimal Recognition of Rights to Organise	External governmental authorities should not contest the rights of users to devise their own institutions and that users have secure tenure

3. A global perspective of property rights regimes

There exists a considerable body of literature on property rights regimes related to natural resources and water resources in particular. Distilling this knowledge we can determine key salient attributes of common property regimes:

1. Property rights regimes govern who can do what with resources, who makes decisions, where decisions are made, and how these decisions are made. They also determine who gets what, when, and where. Property rights regimes can either be formal or informal but include both rights to access as well as rights to exclude others from access.
2. Clearly defined and secure property rights are regarded as a vital means of building up society for the common good and by which people cooperate to achieve that common good.
3. Clearly defined property rights provide the means for social coordination and ordered rule in the delivery of aquatic ecosystem services.
4. Secure property rights provide incentives to invest in the sustainability of the aquatic ecosystem services.

4. Developing a case for common property theory

Throughout the world humans are voluntarily and/or involuntarily establishing cooperative approaches. As a consequence, cooperative approaches to the governance of aquatic ecosystem services are increasingly being promoted as a means of addressing problems associated with the governance of aquatic ecosystem services.

Until recently cooperative approaches have given emphasis to two types of property rights regimes: private and public. The two regimes are representative of most cooperative approaches in the literature on aquatic ecosystem services. However, there cannot just be two ways of governing aquatic ecosystem services. What we need is an integrative science of cooperative approaches embedded in common property theory. Adopting common property theory can assist our understanding of the structural and behavioural aspects of cooperative approaches to the governance of aquatic ecosystem services.

A wide variety of research on common-pool resources has demonstrated that common property theory provides a useful perspective for examining social exchanges among cooperating actors. Arising out of this research we identified the importance of institutions and institutional development when embedding common property rights theory in cooperative approaches to the governance of aquatic ecosystem services. Institutions matter in the designing of cooperative approaches, particularly their dynamics, their ability to adapt and their resilience.

A broad-based approach to research that considers institutional design and performance is required in order to formulate reliable models of successful cooperative approaches in developing countries. Ultimately, successful cooperative approaches require an understanding of the behavioural responses by individuals and groups to the institutional boundaries that mediate interactions among actors.

5. Lessons for South Africa

What are the key messages that will inform the direction this research will take in South Africa?

- There is a flawed understanding of what is meant by property rights has caused the contribution of property rights to cooperative management to be overlooked.
- It is quite apparent that, despite its obvious importance to South Africa, the subject of property rights is poorly understood. A key component of our work going forward will be to better inform our key constituents.
- Even at the international level, property rights regimes as governance mechanisms are poorly understood. Where they have been applied it has usually been at the reduced level of complexity of a single ecosystem service. We need to fully appreciate their governance relevance in the context of complex social-ecological systems containing bundles of ecosystem services.
- Water resources in South Africa are primarily common-pool resources and that common property regimes are appropriate governance mechanisms for common-pool resource. We need to pursue this argument to its logical conclusion.

- Clearly defined property rights usually result in improved resilience of a social-ecological system. If our overall goal is to achieve the equitable and sustainable sharing of ecosystem benefits from aquatic resources, this is only possible within the context of a clearly defined property rights regime. In South Africa it is not about whether we apply them as mechanisms of governance but how we apply them.

6. Water as a property right in South Africa

In South Africa, where water resources are scarce, defining and enforcing property rights to the water resource is crucial to reduce conflict and to support sustainable use of the resource. This is achieved through a combination of formal (top down) and informal (bottom up) institutions.

Water rights in South Africa are entrenched in the Bill of Rights of the South African Constitution. The National Water Act (NWA) interprets these Constitutional rights as giving priority to the right to water for the Reserve, namely the quantity and quality of water required:

a) *to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act, 1997 (Act No 108 of 1997), for people who are now or who will, in the reasonably near future, be- (i) relying upon; (ii) taking water from; or (iii) being supplied from, the relevant water resource*; and
b) *to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource* (DWAF, 1998).

All other water use in South Africa is subject to the requirements of the Water Act, through authorisations. However, all these allocated water use rights can be seen as a usufruct right as they are clearly authorised by law.

In South Africa:

- Water Right = authorised access to water for environment
- Water Property = benefits arising from the authorised access to water for the environment (i.e. ecosystem services)
- Water Property Right = claim to the benefit arising from the authorised access to water for the aquatic ecosystem, i.e. the right to claim the ecosystems services arising from the Reserve
- Water property right regime = management of natural resource with similar characteristics, i.e. management of water resources.

Water property rights are not usually homogeneous “ownership” rights that permit one to do anything with the resource, but rather can be considered as bundles of rights (Table 1) that may be held by different parties. The bundle of rights associated with water property rights is determined by the right to acquire, possess, use, manage, sell, lease, donate or subdivide the property. Thus, defining water property rights in South Africa in terms of bundles allows for a better understanding of how different allocation systems determine water resource management in the country.

While the exact definition of these bundles of rights varies from place to place, there are several common elements in water law in Africa:

- *The state generally claims some kind of ultimate "ownership" rights over water*, with individuals required to request the use or development of water from the state.
- *The notion that anyone is entitled to water for "primary uses," which are usually interpreted as basic domestic needs, as well as household gardens, but may include other productive livelihood needs.*
- *While basic use rights are strong, they are usually quite flexible.*
- *Control rights of management and exclusion are often held by the local chiefs, groups, or individuals who developed the resource.*
- *Most state, customary, and religious law does not grant alienation rights (to sell, give away, or otherwise transfer one's rights to someone else).*

7. Institutional structures required for IWRM and an equitable water property rights

As competition for scarce water resources grows in South Africa, strengthened governance institutions for coordinating use and resolving conflicts are needed. Formalising and recognising water property rights is unlikely to make a significant difference unless these are accompanied by legitimate rules which are enforced by a robust water institution. Three aspects that require attention:

- Redesigning or aligning the water institution
- Redesigning governance
- Regulating transfers.

The framework that regulates water consists of four key elements:

1. **water policy**, which sets the high level objectives, aims and approaches;
2. **water legislation** which translates the policy into legal requirements and obligations;
3. **water instruments** for implementing the legislation; and
4. **Water organisations** that create the policy and the legislation; and develop and use the instruments.

In addition, a water institution is grouped into two functional segments; the water **institutional environment** and the water **institutional arrangements**. In South Africa this framework is in place, together with a range of supporting instruments.

8. Two case-studies

Two case studies, the Pongola River floodplain and coal mining in the Olifants River Catchment, were analysed using the design principles for effective property rights regimes (Table 3).

In the Pongola case study:

- Boundaries – prior to the upstream dam being built those who had rights of access and the benefits they could access were well-defined through a customary rights regime administered by the traditional authority. Central government control of flood releases introduced stakeholders acting from outside of the system known by the people of the Pongola Floodplain; the government changed the boundaries of the biophysical resource and of those who had access to that resource.
- Benefits and costs – prior to the dam for the people of the floodplain, benefits matched costs and returns mostly exceeded investments. Post-dam, the balance became distorted. Unnatural patterns of flow increased risk such that investment in agriculture, for example, may not have yielded expected benefits either because crops were flooded or because the floods did not arrive.
- Collective choice – prior to the damming of the river communal decision making involving the users took place. Post-dam decision making relating to flow was carried out by central government authorities largely without consultation, and who were for the most part, inaccessible to people of the floodplain.
- Monitoring – prior to the dam local users understood and monitored the biophysical conditions of the floodplain and the way rights were exercised. They adapted their resource-use behaviour based on what they encountered. Post-dam while locals continued monitoring they encountered unfamiliar flow conditions consequent on monitoring and decision making by central government that did not acknowledge accountability to the people living downstream.
- Sanctions – Prior to the dam rights to resources were granted, recognised and respected. Where resource users broke the rules they were penalised accordingly. Post-dam with critical decision making occurring outside of the customary system it became increasingly difficult to exercise authority at the local scale. As the 'rules of the game' changed the power to sanction users weakened. Conflict resolution – prior to the dam these were handled locally by the traditional authority that was easily accessed and operated at very low cost. Post-dam conflict resolution often involved government officials, some from as far afield as from Pretoria, making conflict resolution difficult and costly for those living downstream particularly as they were also not well enough informed to influence decision making. Those who had influence encouraged government to release flows that met their needs rather than those that might be more equitable.
- Rights to organise – prior to the dam rights to organise at a local level were recognised and encouraged. Post-dam while these rights were still recognised, rights were being negotiated outside of the traditional authority. The resultant legal pluralism caused uncertainty at best and opportunity for exploitation at worst.

In the Olifants example abstraction of water, the destruction of wetlands and water pollution through mining activity is compromising the rights of downstream users, primarily rural people, to the benefits that would normally accrue. The boundaries of the system have not been agreed and because there is no register of who has what rights, either formal or informal, we are not aware of

who gains what benefit and who carries what costs and for how long. Under these conditions people's rights are invariably infringed and commonly the least influential are most affected.

9. The present water institutional structure: strengths and challenges in South Africa

Using the same design principles of an effective property rights regime we reviewed the current water institution in South Africa. Summarising the key findings:

- It is not the water law or policy that requires adaptation and change to ensure equitable, efficient and sustainable allocation of water use, but rather the manner in which these polices and laws are interpreted in the implementation.
- The water allocation process in the country would thus benefit from integrating ecosystem service thinking, analysis and approaches into the process.
- There is an urgent need for DWA and the CMAs to identify all the possible benefits provided by aquatic ecosystem services within water management areas, and to apply the economic value of these in the water allocation and authorisation decision-making process in South Africa. This is particularly important in catchments where livelihoods of poor individuals are directly dependent on these aquatic ecosystem services.
- Since Schedule 1 water uses and users are directly and implicitly related to the ecosystem service provided by the water resource, the right to this common-pool resource needs to be considered before allocation of water resource to the General Authorisation and WUL users. Most important is that the water property rights of these users need to be considered in water allocation decisions. These Schedule 1 uses need to not only consider the direct use (benefit) of the common-pool resource but also other ecosystem services such as watering of livestock; food production as part of survival strategies; survival strategies during disasters, i.e. wetland use during drought, etc. Thus, to ensure equitable allocation of this common-pool resource, Schedule 1 water uses also need to be acknowledge and recognised in the water allocation process, including the aquatic ecosystem services which these Schedule 1 users benefit from.
- Identifying and quantifying all the possible services provided by aquatic ecosystem services within water management areas, and making decision on water authorisation and allocation based on these, can assist with the mitigation of direct and indirect impacts linked to a WUL.
- While recognition of the aquatic ecosystem services from which water users benefit in the water authorisation and allocation procedure in South Africa can help identify trade-offs, this process needs to be supported by a process of negotiating these trade-offs. The WUAs in South Africa are the ideal organisation at which these trade-offs can be negotiated. Water authorisation and allocation must be placed in the broader decision-making context of a collaborative approach to imposing water management decisions.
- Once water property rights have been recognised and included in the water allocation and authorisation process in South Africa, monitoring and evaluation (M&E) is required to detect and correct violations, provide evidence to support enforcement actions and evaluate program progress by establishing compliance status.

10. Recommendations for the South Africa water institution

Based on this report, the requirements for a robust institution to enforcement compliance to the water property rights regime in South Africa will require addressing the following gaps:

- The water institution in South Arica is presently failing due, in part, to poorly defined and applied water property rights regime;
- Water property rights are poorly defined in the water institutional environment and thus within the water institution as a whole. For the present property rights regime to function efficiently, water property rights need to be included in policy, legislation and regulations.
- As both case studies demonstrated, a common property rights regime needs to be considered and recognised at a local level, which will support the national public property rights regime. Implementation of a local level common property rights regime, through the strengthening of the WUA role in the water institution, will devolve the decision-making to the users effective by the rules.
- The present understanding of the South African water institution does not necessary reflect international experience. This water institution needs to be reviewed within present international trends and developments in water institutions and water property rights regimes.
- Transparency in decision-making and accountability in the South African water institution is weak. This could be strengthened through improvement in the property rights regimes in the country, especially through the introduction of standardise water instruments in a consistent manner.

Based on this analysis of water property rights issues within the South Africa water institution we suggest that:

- Property rights, as they are currently understood and administered, are not sufficiently comprehensive to achieve the intentions of environmental justice as required by policy and legislation.
- Because Water User Associations operate at the interface between the formal institutions of government and the informal institutions established by users, they offer the best prospect for both elucidating how more comprehensive property rights regimes could emerge and for testing implementation.
- It would be prudent to adopt an action research approach to gaining further insight into how to property rights should be applied to better enable attainment of environmental justice.

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Acronyms

CMA	Catchment Management Agency
DEA	Department of Environmental Affairs (formerly DEAT)
DEAT	Department of Environmental Affairs and Tourism
DWA	Department of Water Affairs (Formerly DWAF)
DWAF	Department of Water Affairs and Forestry
GWP	Global Water Partnership
IWRM	Integrated Water Resource Management
KNP	Kruger National Park
MEA	Millennium Ecosystem Assessment
NEMA	National Environmental Management Act
NWA	National Water Act
NWRMS	National Water Resource Management Strategy
RDM	Resource Directed Measures
RWQO	Resource Water Quality Objectives
SAWQG	South African Water Quality Guidelines
WDCS	Waste Discharge Charge System
WUA	Water User Association
WUL	Water Use License

1. Background and Introduction

Background

With the advent of democracy in South Africa and a growing appreciation of water scarcity we have seen a shift away from the notion of ownership to rights of use. This shift marks explicit acknowledgement that water and the associated ecosystems need to be understood and managed as common pool resources. As our understanding of the links between ecosystems and society has developed we are encouraged to view ecosystems as providers of services from which we can derive benefits. Society's interest in aquatic ecosystems is thus focused on how the benefits of access to and use of services should be apportioned, a process that requires trade-offs and collective decision making. The need to allocate rights to benefit from ecosystem services that are highly variable in time and space stresses the central importance of understanding the concept of property rights in the context of common pool resources and embedding this in dialogue addressing the sharing of benefits.

Collective use of aquatic ecosystem services is usually susceptible to externalities that make difficult their governance and management in a sustainable, efficient and equitable manner (Ostrom, 1999). In South Africa, for example, a country which shares six river basins with neighbouring countries and has already allocated much of its national water resource, the allocation of benefits from catchment and trans-boundary water resources is always viewed as a source of social tension between users at various political and spatial scales. This is usually attributed to the fact that use of water by one riparian user essentially subtracts the benefits available to others. More often than not, cooperative strategies are promoted as a tool for addressing problems associated with the allocation of benefits from aquatic common-pool resources (Phillips et al., 2006).

Cooperative approaches to the management of aquatic ecosystem services involve different actors working together across community, national and regional scales to create more benefits (and their more efficient and equitable distribution) than could be produced in unilateral settings (Jagerskog and Zeitoun, 2009). Over the past two decades, these approaches have received increasing attention from governments, donors and non-governmental entities. These individuals and organizations want to understand how cooperative arrangements work and how they can be supported, improved and reoriented to advance water security and benefit sharing. While a number of researchers such as Phillips et al. (2006) and Jagerskog and Zeitoun (2009) have responded to the need for improved understanding of cooperative approaches to the management of aquatic ecosystems, it is still largely unclear whether this research is assisting us advance knowledge about how to create the necessary conditions for cooperative behaviours in the allocation of benefits from aquatic ecosystem services. Despite a few notable exceptions, this research has exhibited major deficiencies insofar as common property theory is concerned. Although improved management of aquatic ecosystems may result from enhanced cooperation, there are often greater incentives for users not to cooperate in the allocation of benefits derived from finite aquatic ecosystem services. This is compounded by the biophysical properties of common-pool aquatic ecosystem services (e.g. water as a flux) as well as the unwillingness of actors operating at multiple political and spatial scales to learn how to learn

together in addressing problems associated with the allocation of benefits from common-pool aquatic ecosystem services (Turton, 2008). In many respects, these problems can be defined as classic collective action problems, which are a purview of common property theory.

Notwithstanding a growing appreciation of the importance of common property theory in analysing collective action problems, research on cooperative approaches has not given explicit attention to this expanding body of knowledge. If knowledge about cooperative approaches to the management of aquatic ecosystem services is to remain contextually relevant and scientifically reliable, there is need to embed common property theory in related principles and practices.

This report:

6. Explores the salient attributes of property rights regimes, particularly common property regimes that sustain cooperative approaches to management over long periods of time (Sections 2-5)
7. Identifies property rights knowledge gaps in the management of water resources in South Africa (Sections 6-10)
8. Analyses national policy and legislation with a view to assess the extent to which property rights theory and understanding have been integrated (Sections 6-10)
9. Develops a collective understanding of how property rights regimes, particularly common property theory, influences the management of aquatic ecosystem services in South Africa (Sections 6-10)
10. Services the WRC knowledge hub and those who benefit from it, by contextualizing property rights within the water sector (This report and Appendices 1-4)

Introduction

The persistent presence of water characterises aquatic ecosystems and defines the nature of the benefits we can derive from them. There are many types of aquatic ecosystem such as wetlands, rivers and lakes, but all deliver multiple ecosystem services in proportions that are unique and that vary over time. While many of the benefits and beneficiaries of aquatic ecosystem services are readily apparent, there are also many that go largely unrecognised and are thus not acknowledged. Because every use has implications for the supply of ecosystem services it is evident that progress toward sustainable use requires that we are able to manage the relationships between the supply of and demand for ecosystem services. In South Africa, this relationship is well acknowledged and established in the national approach to governance through recognition of water uses. For example, provisions are made to licence the use of water for irrigation, or to discharge effluent into a watercourse, or to use a river for recreation. Each of these activities is related to an ecosystem benefit. In the Millennium Ecosystem Assessment (MEA) approach, water is categorised as a provisioning service, effluent discharge makes use of a regulating service and recreation would be regarded as a cultural service. However there are also examples of use of ecosystem services for which governance is less clear, particularly in communal areas. An example might be grazing on a floodplain which may be subject to regulation by traditional authorities. What emerges is a realisation of a partial and perhaps even inconsistent approach to governance of access to and use of aquatic ecosystem services.

Property rights can be viewed as an important governance mechanism for addressing problems associated with the sustainability of aquatic ecosystems services (Pomeroy et al., 1999). They govern who can do what, when and how with aquatic ecosystem services. For example, withdrawing water from a stream, fishing from a river, grazing cattle on a floodplain, using a river as a means of transport, enjoying the scenery of a water body, and dumping waste into a river are all expressions of the exercise of property rights to aquatic ecosystem services. Property rights influence the choices available to users of aquatic ecosystem services and the extent to which the impacts of use on third parties have to be taken into account. They provide the means to contain the use of ecosystem services within the limits of the capacity of ecosystems to deliver chosen services. Property rights are thus a key driver of ecosystem changes and a major determinant of human reactions to those changes.

Property rights, as an instrument of governance, regulate and facilitate access to and use of aquatic ecosystem services. They can be conceived as a key governance mechanism for achieving societal goals such as environmental justice, peace and economic development. For example, it has been shown in Australia that reforms in water property rights can result in important improvements in how water is used, with net gains for society as a whole. By making water property rights arrangements more flexible Australian society has been able to assign higher value uses to irrigation water at the margin, thereby making the opportunity costs of use more transparent (Sheehan, 2003).

While the influences of property rights on the governance of aquatic ecosystem services are well documented at the global scale (Tuyen and Brzeski, 1998; Pomeroy et al., 1999; Meinzen-Dick, 2000), the situation in South Africa is somewhat different. Not much is known from a South African perspective about how property rights regimes influence governance outcomes, particularly in settings that require actors with different understandings, expectations and needs to work together. The challenge is to improve understanding of how property rights influence the governance practices related to aquatic ecosystem services at multiple scales in a country that has been experiencing on-going socio-political and economic transformation. Property rights that relate to aquatic ecosystem services, particularly those for which the supply and demand may change rapidly and unpredictably (such as in river systems), require both a longitudinal understanding (history is important), a precautionary approach (the future is not knowable) and a responsive (adaptive) and inclusive system of governance. Without such an understanding of the range and complexity of property rights, efforts to address the sustainability problems related to aquatic ecosystem services may be futile.

2. The concept of property rights

The classic story of the Maine lobster fishery

Different people define and understand property rights and their influences differently. To help us better understand property rights and their influences, we draw on the classic story about property rights and lobster fishing in the state of Maine in the United States of America as narrated by Schlager and Ostrom (1992).

Prior to 1920, the lobster grounds off the coast of Maine were owned by the local lobstermen. The coast was separated into zones which allowed lobstermen from each harbour to only fish from grounds that were associated with particular harbours. Permissions to enter and fish from particular grounds were sought from and made by the lobstermen themselves, who could also determine how the grounds were used and what fishing technologies were employed. The lobstermen carried out the enforcement of rights to access and use. Enforcement was usually accompanied by sanctions tailored for specific violations. For example, they destroyed fishing gear to deter and exclude anyone who violated group rules. Such destruction involved the cutting of large wooden traps which are set on the ocean floor in order to catch lobsters. The period in which lobstermen owned the grounds and were able to enforce rights was generally associated with stable and sustainable outcomes.

After 1920, the situation in Maine began to change, particularly in the northern areas. The state of Maine took over ownership of the lobster grounds and new fishing technologies began to emerge. The de facto system of rights transformed into de jure system. The beginning of government ownership saw the introduction of a licensing system and the breakdown of the informal zoning system. Lobstermen also began to install motors on their boats. The introduction of motors had a great impact on the lobster fishery by increasing the range and extent in which fishing was conducted. Prior to 1920, fishing was only conducted during summer times in the bays, which were preferred by the lobsters for their warm waters. With the introduction of motor boats, lobstermen could go beyond the bays and gain access to open water grounds which were previously inaccessible. The changes in the systems of rights and technological capabilities brought about a period associated with greater uncertainty and unsustainable outcomes. Without the zoning system, the prevailing rights made it virtually impossible to 'self-regulate'. However, it is instructive to note that, following the decline of the fishery, property rights systems have been revised to a situation similar to that of pre-1920. With this, certainty and sustainability have returned.

The major thrust of this story is that the nature and context of the claims and obligations of different actors to the benefits of an aquatic ecosystem matter in determining the outcomes of governance and sustainability. The story illustrates that there are many combinations of rights to benefit from and control the flow of aquatic ecosystem services. By examining the institutions and actors that governed the Maine lobster fishery Schlager and Ostrom (1992) were able, through their narrative, to illustrate the importance of explicitly defining and categorizing a range of rights. This narrative helps in presenting the main concepts and definitions which are central to this report. It also informs us about the importance of recognising and accounting for scale, the influence of demand, the relevance of history and the need for a precautionary approach.

We can conclude here that the attributes of the lobster fishery, while sustainably used, included: enforceable authority over rights of use, rules that authorised and regulated use, and an institutional arrangement necessary to regulate use. A weakening of the institutional arrangement led to overfishing.

Core Concepts and Definitions

Property right: To begin, a property right is an enforceable authority that permits an actor to make specific decisions and carry out actions in a particular social arena. In short, it is a claim to a benefit (Bromley, 1991). Property is defined as 'a benefit (or income) stream', while a right refers to particular actions that are authorised. Practically, a right cannot exist without recognition and acquiescence by others in the form of relationships involving the individual rights-holder.

Rules: For every property right, sets of rules exist that authorise or require particular actions in exercising that right. Rules are the prescriptions that forbid, permit or demand some specific actions or outcomes as well as the sanctions related to failures in compliance (Imperial, 2005). They represent an implicit or explicit attempt by society to achieve order or predictability. However, it is important to acknowledge that since rules can never be self-formulating or self-enforcing, they are subject to problems of ambiguity, misunderstandings and varied interpretations, more especially that they are essentially crafted in human language. Thus, the stability of the rule-ordered relationships that define property rights is contingent upon the establishment of shared meanings of the related rules.

Institutions: The definition of 'property rights' as used in this report does not focus on the aquatic ecosystem services themselves, but on the institutions that are in place to regulate and facilitate access to and use of the services. Institutions refer to enduring regularities of human actions structured by rules, norms or shared strategies (Ostrom, 2005). They provide the normative framework that guides the decisions and actions of social actors. The operationalization of institutions in the real world results in what is called a regime, a body of fundamental rules that can be established at different levels of human interactions (global, regional, national and local).

Bundles of rights: While the principles are valid in their own right, it is important to note that property rights regimes can further be recognised as being dynamic, changing with societal expectations and the context in which they are applied (Kabii and Horwitz, 2006). The dynamic nature of property rights is based on their features, which entail a bundle of discrete divisible rights including the right to acquire, possess, use, manage, sell, lease, donate or subdivide what constitutes the property (Honoré, 1961; Farrier, 1995). In this context, property rights are viewed as bundles of rights to use or transfer resources, including benefits. These bundles of rights can be added or subtracted, shared or divided in different ways resulting in changes in the amount of benefits, and associated costs, flowing from the property (Kabii & Horwitz, 2006; Yandle, 2007). Thus, defining property rights in terms of bundles allows for a better understanding of how different allocation systems for those rights affect the incentives structures of individuals or collectives.

Table 2.1: Bundles of Rights Associated with Positions (sourced from Ostrom and Schlager, 1996, P. 133)

Bundle of Rights	Owner	Proprietor	Claimant	Authorised user	Authorised entrant
Access	X	X	X	X	X
Withdrawal	X	X	X	X	
Management	X	X	X		
Exclusion	X	X			
Alienation	X				

Table 2.1 depicts the conceptual links between bundles of rights and the associated positions. The bundles of rights range from access and withdrawal through management and exclusion to alienation rights. While access rights refer to authorizations related to entry into a defined physical property, withdrawal rights denote the rights to extract benefits from a resource. The rights to regulate internal use patterns and bring about changes through improvements are known as management rights. Exclusion rights influence decisions regarding who can have access rights, and how those rights may be transferred. The rights to sell or lease out management and exclusion rights are referred to alienation rights. In terms of the associated positions, it is possible for an owner to hold all the above rights. Except for alienation rights, the proprietor holds all the rights. The claimant and authorised user hold access, withdrawal and management rights, but not exclusion and alienation rights. The authorised entrant only enjoys access rights.

Types of property rights regimes: Property rights regimes can be one of four types: private, public, common or open-access. We can distinguish these based on the ability to control access and management of the property as shown in Table 2.2. Two characteristics are usually used to distinguish among the four types of property regimes: exclusion and subtractability. Both of these two attributes can range from low to high. An ecosystem service is said to be excludable when individuals can be prevented from using it. An example would be where a person is denied a licence to discharge effluent (making use of a regulatory service) or abstract water (a provisioning service). Often, public goods are non-excludable as well, but not necessarily. A classic example of a pure public good is national security: it is impossible to exclude individuals of a country from benefiting from national security, and the consumption benefits of each individual do not depend on the consumption benefits of others. Water quality may be an interesting case here: when public goods or services are non-excludable, they are unlikely to be adequately supplied by the marketplace. No firm can earn money if consumption does not depend on purchasing the good or service. The socially efficient level of production, in this case, would be far greater (and at a far lower price) than a private firm would find profitable. As a result, public goods are traditionally provided by the State and financed with tax money. Civil society has a key role to play to hold government agencies accountable for the provision of such goods and services.

Table 2.2: Types of property rights

	OWNER	EXAMPLE	ACCESS	MANAGEMENT
Private	Private	Freehold land	By owner	By owner
Common	Group	Common land	By joint owners	By joint owners
Public	State	National Park	State	State
Open Access	No-one	Open ocean fishery	Uncontrolled	None

Subtractability refers to the extent to which one individual's use subtracts from the availability of a good or service for consumption by others. It denotes the degree to which one person's consumption of a good or service prevents another from consuming it. For example, one person's use of water prevents others from using it, while a person's enjoyment of outdoor recreation usually prevents no one else from enjoying it. Freshwater fishing opportunity may be regarded as a public service that does possess this characteristic. It may have low Subtractability, provided that demand for fishing is limited. Beyond a certain point, however, congestion begins to impose a cost on users and the non-subtractability characteristic no longer applies.

Design principles for effective property rights regimes

We are able identify seven important principles for the establishment of effective property rights regimes for the governance of aquatic ecosystem services (see Anderies et al., 2004). These relate to boundaries, benefit and costs, collective-choice arrangements, monitoring, sanctions, conflict resolution and self-organization (Table 2.3). These principles were initially developed by Ostrom (1990) as design principles for common-pool resource institutions. They were based on extensive field work and extensive reviews of case-study literature.

Table 2.3: Design principles for effective property rights regimes for aquatic ecosystems (Sourced from Anderies et al., 2004)

Key Aspect	Principle
1. Boundaries	Clearly define the boundaries of an aquatic ecosystem as well as the individuals or households who have rights to benefits
2. Benefits and Costs	Ensure there is proportional equivalence between the benefits and costs associated with particular aquatic ecosystem services. Associated Rules specifying the amount of resource products that a user is allocated are related to local conditions and to rules requiring labor, materials, and/or money inputs.
3. Collective-Choice Arrangements	Ensure that most individuals affected by harvesting and protection rules are included in the group that makes changes to the rules.
4. Monitoring	Make certain that the monitors who actively audit biophysical conditions and user behavior are accountable to the users or are the users themselves.
5. Graduated Sanctions	Make sure that the users who disobey rules receive graduated sanctions.
6. Conflict-Resolution Mechanisms	Ensure access to low-cost, local arenas for users and managers to resolve conflict among users or between users and the managers.
7. Minimal Recognition of Rights to Organise	External governmental authorities should not contest the rights of users to devise their own institutions and that users have secure tenure

3. A global perspective of property rights regimes

Introduction

There exists a considerable body of literature on property rights regimes related to natural resources in general and aquatic ecosystems in particular. Although changes in land property rights regimes are more familiar, studied, and debated, related changes in water property rights regimes have received less attention. Water has several properties that suggest that water property rights cannot be determined in exactly the same manner as property rights to land and other resources. Notably, water is mobile and most water use depends on flow. This chapter reviews these analytical linkages in the existing literature, with a view to establishing the salient attributes of property rights regimes in the governance of aquatic ecosystem services. We argue that property rights regimes play a significant role in the governance and maintenance of aquatic ecosystem services. The incentives, rules and responsibilities attached to the rights are vital to sustainable allocation of the benefits of aquatic ecosystem services. Different property rights regimes influence governance and sustainability outcomes differently. These differentials affect the kinds of uses of aquatic ecosystem services people engage in. While there has been increased support for efforts in managing the collective use of and access to aquatic ecosystems services, little research has been published on the effects of varying property rights regimes on governance and sustainability outcomes.

A brief overview of literature

The challenges and opportunities associated with property rights regimes in the governance of aquatic ecosystem services are well documented. Researchers have presented different conceptual frameworks and case studies to highlight these challenges and opportunities. To begin, Oakerson (1992) presents a conceptual framework for collecting and analysing information about aquatic ecosystem services. His framework outlines four types of attributes used to describe aquatic ecosystem services, each of which is related to the others: physical attributes of the service and the technology used to harvest it; decision-making arrangements (organizations and rules) that govern relationships between users; resulting patterns of interaction among decision-makers; and the associated outcomes or consequences. Oakerson (1992) states that his framework is “a bare-bones representation of the commons” which should not be taken as a complete model that includes all variables. However, he contends that the framework he presents is still considered a classic, relatively useful tool, but it has been considerably adapted and elaborated by others since it first appeared.

Ostrom (1992) attempts to develop a general theory of common pool resource management by blending her views with those of Oakerson on how institutional arrangements affect the motivations and behaviours of individuals with important variables identified by other researchers. She makes an effort to refine the part of the Oakerson framework that deals with the technical and physical attributes of the aquatic ecosystem services by offering a definition of "common-pool resources" and contrasting them with other types of services. Her central argument focuses on how "the

tragedy of the commons" is avoided and the conditions under which resource users or "appropriators" are likely to act in a coordinated, rather than an independent, fashion. The argument is supported by a discussion of the conditions which may foster the destruction or degradation of the commons by appropriator organizations. Over and above, Ostrom's contribution establishes a list of key conditions for the survival and efficient performance of organizations managing common-pool resources, and provides a typology of policies that donors and governments need to adopt to be consistent with the evolving understanding of common property regimes. However, it is important to note that much of Ostrom's earlier work related to a single 'resource' (e.g. a bundle of rights for a fishery) rather than a bundle of rights for a bundle of resources (ecosystem services).

Ireson (1995) describes the traditional system by which lowland Lao villages manage water for paddy rice irrigation, and relates this system to selected models of common property management. He begins by briefly summarizing the shortcomings of conventional theoretical approaches to the study of the commons, arguing for an approach which is more sensitive to the effects of social context on decision-making for resource management. He criticises Hardin`s "tragedy of the commons" approach for assuming that "individuals act selfishly, that there is no communication among resource users, and that no social norms mediate their actions" (Ireson, 1995: 543). A more useful model of analysis, he argues, is one that views individual behaviour as being motivated not only by self-interest but by the degree of assurance a person has that others will cooperate. But neither of his nor other similar models, according to Ireson, consider the impact of the wider social context on the decision to cooperate with or take advantage of one`s neighbours. In the case of Lao villagers, "an individual`s willingness to cooperate in village irrigation systems must be understood in the context of household interdependence, and strong norms of mutual support within the village" (Ireson, 1995: 541). The author discusses both successful and unsuccessful Lao irrigation systems and compares these to the management of other local resources, in order to define some of the limits to effective common property management schemes.

Berkes (1996) discusses how different social systems and natural resource systems interact under different property regimes. She makes an attempt to define the four basic property regimes and summarises the issues surrounding Hardin's "tragedy of the commons" thesis. She provides an account of the classical and recent views of the link between natural and social systems, arguing that such a relationship is, in fact, made up of a three-way linkage between: natural capital; cultural capital; and human-made capital. To support her argument, she uses a number of empirical cases to evaluate the four types of property rights regimes in terms of their ecological sustainability, concluding that there is no clear-cut verdict on which is best, except that open-access regimes are unsustainable in the long run. She concludes that any solutions to resource degradation must include a diversity of property rights regimes and institutions that can be adapted to particular circumstances.

Beck (1998) presents a case study of poor people's use of and access to common property resources (CPRs) in three villages of West Bengal. His article has a dual purpose: "to show the enormous importance of common pool resources to the poor in West Bengal, and to show how some of these resources are presently one axis of class conflict, and why class conflict over common pool resources is likely to increase in the future" (Beck, 1998: 3). The author argues that while access to common pool resources is crucial for the survival of the rural poor, particularly for women, access is declining

due to commercialization, scarcity and restricted access. He yields a discussion of common pool resources use by the poor in nineteenth century Britain as a reference point for understanding class conflict in contemporary India, and goes on to analyse similar use in West Bengal and conflicts arising over access to these resources. His key contribution involves outlining a typology of common pool resources use in West Bengal and discusses some implications for policy making and future research.

Elsewhere, Tuyen and Brzeski (1998) present preliminary research findings from a project which examined the management of aquatic resources under various kinds of tenure regimes in a densely-populated lagoon system of Vietnam. The issues covered include the nature of the resources, the technologies used to exploit these, related behaviour of fishers, arrangements for property rights associated with different exploitation and management strategies, and the effectiveness of informal and formal rules within particular management schemes. This paper provides readers with a good example to show how complicated property rights and tenure systems can be in a 'real world' setting. While the rest of this report focuses on the principles and theories of common property, researchers will usually find there are no 'pure' types of tenure, and local situations are highly dynamic. Readers could consider the specific issues identified by Truong and Brzeski in the context of the general characteristics of effective common property systems and institutions at the local level, such as those discussed by Ostrom (1992) as well as Pomeroy et al. (1999) below.

Pomeroy et al. (1999) discuss the results of their research aimed at discovering the general principles and conditions which facilitate fisheries co-management in Asia. The authors use Ostrom's key conditions for successful common pool resource management as a foundation for their research, assessing their relevance in the context of this project and discussing the new conditions and principles they have identified through the course of their research. A major contribution of this study is a discussion of policy implications for fisheries co-management in Asia and worldwide.

Ostrom (1999) contended that the social sciences had, over the preceding five decades, unyieldingly advocated for two broad policy prescriptions for how to avoid the "tragedies of the commons" in developing countries. The first prescription supported the privatization of as much of an economy and its resource base as possible. The second prescription recommended the strengthening of the bureaucratic structures of central government, essentially entailing the assumption of ownership by national governments of key natural resources. The underpinnings of the two prescriptions emanate from an article titled "The Tragedy of the Commons" written three decades earlier (Hardin, 1968). Hardin argued through this article that the eventual fate of all resources held 'in common' is over-exploitation because access is unrestricted and there is no incentive among individuals towards resource protection. The essence and substance of the underlying principles in Hardin's article have reverberated across the full range of natural resource sectors, including aquatic ecosystem services.

However, critics now assert that Hardin's thesis does not properly distinguish the type of property regime susceptible to such a process, arguing that it applies not to 'common property', but to 'open-access' regimes. Common property is now generally defined as a system where "the resource is held by an identifiable community of users who can exclude others and regulate use" (Berkes et al., 1989). Recent research has shown that, under such arrangements, local people can manage common resources in an effective, sustainable manner. Open-access, on the other hand, is characterised by an "absence of well-defined property rights" (Berkes et al., 1989) which can lead to

people ‘free riding’ and over-exploiting a resource. Unfortunately, governments in particular have been slow to recognise this distinction, condemning all forms of communal resource use and moving to privatise or limit access to the commons.

Salient attributes of property rights regimes

From the foregoing, a number of salient attributes of property rights regimes can be identified. Firstly, it is evident that property rights regimes govern who can do what with resources, who makes decisions, where decisions are made, and how these decisions are made. They also determine who gets what, when, and where. Property rights regimes can either be formal or informal but include both rights to access as well as rights to exclude others from access. In other words, they denote the claims and responsibilities of different actors, be they individuals or collectives, to the benefits of a resource. As Schlager and Ostrom (1992) observe, the rights of access, withdrawal, management, exclusion and alienation can be separately assigned to different entities (Table 2.1). The assigned set of claims and responsibilities influence the incentives structure of the rights holder. Thus, in sum, property rights regimes embody “the claims, entitlements and related obligations among people regarding the use and disposition of a scarce resource” (Furubotn and Pejovich, 1972).

Secondly, clearly defined and secure property rights are regarded as a vital means of building up society for the common good and by which people cooperate to achieve that common good. It has frequently been observed that aquatic ecosystem services become depleted in the absence of clearly defined and secure property rights that are enforceable. It is also usually argued that the relative importance of property rights diminishes in tandem with the availability of aquatic ecosystem services. In situations where the services are plentiful, there is often little need to establish property rights and users usually do not even bother about who else might be sharing the same river, lake, or aquifer. As human populations and associated demands for aquatic ecosystem services grow and diversify, relative scarcity increases and creates a conducive environment for competitive rather than cooperative behaviours required for the governance of common-pool resources. In that regard, social coordination, orderliness and incentives become all the more fundamental and influential.

Thirdly, clearly defined property rights provide the means for social coordination and ordered rule in the delivery of aquatic ecosystem services. They are needed to provide direction and to guide the energies of society members towards the common good. They provide the means for negotiating, constructing and ultimately defining the common good which the state must then secure. They also provide the means of resolving trade-offs in order to establish the common good. Clearly defined property rights are used by society to guide the relationships among users, managers and policymakers as they go about articulating their interests, meeting their social obligations, and mediating their differences. In this way, they evince the nature and substance of the interactions amongst social actors in the delivery of aquatic ecosystem services.

Fourthly, secure property rights (note that this does not imply that rights are granted in perpetuity) provide incentives to invest in the sustainability of the aquatic ecosystem services (see Schlager and Ostrom, 1992). They are needed to encourage users to invest in the maintenance of the services in

the long term. This understanding takes into account the transactional costs of enforcement, conflict resolution, negotiations, policing and litigation. Security of tenure is also important insofar as the sharing of the benefits derived from aquatic ecosystem services is concerned, particularly in terms of equity in the allocation of rights to benefit from the services in proportion to the investments that users make. This insight is instructive as the manner in which rights are allocated more often than not influences decisions about whether people are included in or excluded from the benefits derived from aquatic ecosystem services. Property rights can thus be conceived to influence the choices that are available to policymakers and people's ability to obtain associated benefits.

4. Developing a case for common property theory

Introduction

Throughout the world, humans are voluntarily and/or involuntarily establishing cooperative approaches. The need for social actors to work together to enhance the capacity of aquatic ecosystems to sustain the supply of ecosystem services and cope with intermittent shocks has continued to receive enthusiastic policy and scholarly attention. As a consequence, cooperative approaches to the governance of aquatic ecosystem services are increasingly being promoted as a means of addressing problems associated with the governance of aquatic ecosystem services. The fact that cooperation is happening directs research to understand the nature of this phenomenon.

This section develops the case for common property theory as a basis for collective approaches to the governance of aquatic ecosystem services. Despite a growing appreciation of the importance of common property theory in other sectors, it has surprisingly received less scholarly attention in the field of aquatic ecosystem services. Most studies have not given explicit attention to the relevance of common property theory to the governance of aquatic ecosystem services. Yet, most of the benefits derived from aquatic ecosystem services in developing countries are regarded as common property. We specifically view property to which a collective or community of people may rightfully claim access and use constitutes as public or common property.

In situations where access to ecosystems services, particularly those from aquatic ecosystems that are so spatially inter-connected, becomes more contested, there is a move to central government control on behalf of the people. Such situations entail the emergence of a common property philosophy that structures governance over the use of ecosystem services. However, the complexity that attends both the allocation of rights to ecosystem services and the enforcement of those rights over the range of scales at which they are accessed must inevitably require the devolution of governance within the context of common property. If this is so, then, the challenge is to determine how this devolution can be made and made effective (see Pejan et al., 2012). More importantly, such situations raise significant questions that are pertinent in developing a case for common property theory in the South Africa context. For example, what might be some of the attributes of an institutional arrangement that exhibits a devolutionary philosophy? Are catchment management agencies (CMAs) one spatial step down in such an arrangement? Are Water User Associations another step down the scale? Does river classification offer opportunities to define spatial and social units for devolved governance? If this is the case, then can we develop social and ecological attributes for such an institutional arrangement? It must be spatially distinguishable. One would argue that these questions have much to do with developing a collective identity that enables cooperative approaches (see AWARD, 2012).

Cooperative Approaches to the Governance of Aquatic Ecosystem Services

Over the past two decades, cooperative approaches to the governance of aquatic ecosystem services have received increasing attention from governments, donors and non-governmental entities. These individuals and organizations want to understand how cooperative arrangements work and how they can be supported, improved and reoriented to advance water security and benefit sharing. It is understood that cooperative approaches are difficult to manage due to multiple interests among multiple parties. The inherent conflicts of interest associated with multi-party schemes thus justify a strong concern for understanding cooperative approaches. While a number of researchers such as Phillips et al. (2006) and Jagerskog and Zeitoun (2009) have responded to the need for improved understanding of cooperative approaches in the management of aquatic ecosystems, it is still largely unclear whether this research is assisting us advance knowledge about how to create the necessary conditions for cooperative behaviours in the allocation of benefits from aquatic ecosystem services.

Cooperative approaches involve different actors working together across community, national and regional scales to create more benefits than could be produced in unilateral settings (Jagerskog and Zeitoun, 2009). The benefits advanced for cooperative approaches include reduced transactional costs (Wood and Gray, 1991), greater social-ecological resilience (Walker et al., 2002), enhanced performance (Imperial, 2004), and improved governance (Imperial, 2005). Following Bardach (2001) and Hardy and Phillips (1998), however, we do not view cooperative approaches as a 'fix-all' strategy for all social-ecological problems. Their significance and appropriateness will depend on a range of contextual, preferential, and contingency factors (Wondolleck and Yaffee, 2000; Imperial, 2005). Accordingly, actors operating in particular aquatic social-ecological systems may opt for any of the several strategies of engagement, such as tolerance, avoidance, compliance, contention, and contestation (Hall, 1995; Huxham, 1996; Hardy and Phillips, 1998; Cousins, 2002).

We specifically view cooperative approaches as the implementation of governance systems for aquatic ecosystem services at multiple levels of human organization. As earlier pointed out, we do not claim that such approaches are a panacea for all social-ecological challenges faced by governance systems for aquatic ecosystem services. Yet, we are of the view that the extent to which governance systems are effectively implemented will result in particular common interests being advanced or hindered through cooperative approaches. Cooperative approaches to the governance of aquatic ecosystem services are founded on complex long-term social exchanges that involve multiple interest groups with divergent expectations and experiences. These exchanges are usually characterised by behavioural processes in which interest groups influence each other's behaviours over a period of time in order to advance shared goals. Ostrom (1998) contends that the nature of such exchanges is critical in determining the success or failure of most human processes such as cooperative approaches. Perhaps not surprisingly, evidence and logic suggest that most cooperative approaches have not been taking sufficient account of the nature and substance of the long-term exchanges. Particularly, cooperative approaches have neither been taking sufficient account of the degree of social integration among participants, nor have they been drawing adequate attention to the nature of social differentiation among them.

Building successful cooperative approaches to the governance of aquatic ecosystem services is always a lengthy and complex journey. Although there may be several examples of successful cooperative approaches, there are also many examples of failed approaches across countries and time. Embracing cooperative approaches is no simple task for any social actor, not least because of the perceived costs of relinquishing autonomy, however small that might be. But why do social actors engage cooperative approaches? The obvious answer on the face of it is that cooperative approaches are by definition good and are therefore the right course of action. It is usually assumed that cooperative approaches generate desirable benefits (Imperial, 2004). The concomitant cooperative processes are seen as a means of achieving goals that would be difficult for individual social actors to attain.This is asserted time and again as a first principle in countless international meetings and proclamations. Yet the reality is more nuanced.

Although improved governance of aquatic ecosystems may result from enhanced cooperation, there are often greater incentives for participants not to cooperate in the allocation of benefits derived from finite aquatic ecosystem services. This is because individual users of services usually have strong private incentives to act in ways that are detrimental to the group as a whole. This is compounded by the biophysical properties of common-pool aquatic ecosystem services (e.g. water as a flux) as well as the unwillingness of actors operating at multiple political and spatial scales to learn how to learn together in addressing problems associated with the sharing of benefits from common-pool water resources. Examples of non-cooperation are well-documented (Brockhaus and Botoni, 2009; Kosmus and Cordero, 2009; Suneetha and Pisupati, 2009; Nkhata and Breen, 2010). In many respects, these problems can be defined as classic collective action problems, which are a purview of common property theory. Notwithstanding a growing appreciation of the importance of common property theory in analysing collective action problems, research on cooperative approaches has not given explicit attention to this expanding body of knowledge. If knowledge about cooperative approaches is to remain contextually relevant and scientifically reliable, there is need to embed common property theory in related principles and practices.

Engaging common property theory

For a long time, cooperative approaches to the governance of aquatic ecosystems services have been giving emphasis to two types of property rights regimes: private and public. The two regimes are representative of most cooperative approaches in the literature on aquatic ecosystem services. We acknowledge that these property rights regimes have contributed significantly to water policy research by way of improving understanding of the social structure and processes responsible for the generation of aquatic ecosystem services used and enjoyed by humans. However, we are of the view that there cannot just be two ways of governing aquatic ecosystem services. What we need is an integrative science of cooperative approaches embedded in common property theory.

Based on the foregoing, it is indicative that there is need for more than just two property rights regimes to provide a basis for cooperative approaches. The two property rights regimes are limited policy prescriptions both in their form and function. Most of what is termed ‘cooperation’ in these two policy prescriptions comprises idealistic recommendations which rarely take into account real-world complexity. It is also suggestive that these narrow perspectives of cooperation have mostly

been based on technical considerations. In large part, this is because the conventional approach to cooperation centres on such activities as centralised technical decision-making.

While these activities provide information that is useful for making trade-offs among competing demands for aquatic ecosystem services, a narrow description of cooperation results in property rights and governance being effectively compartmentalised into isolated components. Specifically, property rights and governance are reduced to a technical allocation of human values and associated benefits, with relatively little attention being given to the implications of broader social issues and concerns. The emphasis on framing cooperation from technical perspectives, without examining how collective processes impinge on governance, thus renders the two property rights regimes inadequate as frameworks. Importantly, the dominance of the two property rights regimes does little to encourage understanding and potentially reframing of the 'property rights problem' in developing countries.

Cooperative approaches enable participants to actualise benefits derived from complex social exchanges. The issue of 'who benefits' involves consideration of the property rights of participants. As earlier indicated, property rights are viewed in terms of the nature of relationships between participants (Bromley, 1991). Property to which a community of people may rightfully claim access and use constitutes a common property. Because there are usually rules governing how members of the community access and use the common property, cooperative approaches would thus be conceived to encompass a diverse set of rules and other aspects of access to and use of aquatic ecosystem services. Thus, if we understand property rights to refer to an individual's capacity to call upon the collective to stand behind his or her claim to a benefit stream (Bromley, 1991) then, cooperative approaches essentially describe relationships among people. Conceptualizing cooperative approaches from the perspective of property rights and relationships supports the contention of Ostrom (1990) that social homogeneity is important in the governance of ecosystem services.

Research on cooperative approaches to the governance of aquatic ecosystems services has exhibited major deficiencies insofar as common property theory is concerned. Adopting common property theory can assist our understanding of the structural and behavioural aspects of cooperative approaches to the governance of aquatic ecosystem services. The manner in which humans regulate and facilitate access to these services is of fundamental significance to the success of cooperative approaches. We believe that successful cooperation renders the governance of aquatic ecosystem services to effectively cope with timely and appropriate responses to societal demands. A common property perspective would thus offer better heuristics for understanding the effects of cooperative approaches. Of fundamental significance to this report, a common property perspective would facilitate understanding of how to better manage human behavior in the governance of aquatic ecosystem services. Not only can such a perspective facilitate the integration of common property theory into cooperative approaches, but also it can help us better understand the human processes required for successful cooperation.

A wide variety of research on common-pool resources has demonstrated that common property theory provides a useful perspective for examining social exchanges among cooperating actors. Over two decades ago, Elinor Ostrom (1990) challenged conventional understanding that common property is poorly managed and should be completely privatised or regulated by central authorities.

It is now generally acknowledged that conditions do exist under which cooperation is feasible. According to Ostrom (1999), it has also been shown when users of aquatic ecosystem services are given more voice in the design of institutions for governing the services, it is feasible to manage sustainably use of common-pool resources. Institutions, which are commonly referred to as the sets of rules that govern human interaction, play a crucial role to that effect. The main purpose of institutions is to facilitate exchanges. These insights are important not only to the study of common property, but also to the study of water property rights in general. In this way, we suggest that the need to understand the dynamics underlying common property systems has great implications for the efforts aimed at understanding and improving cooperative approaches to the governance of aquatic ecosystem services in developing countries.

Factors to consider when embedding common property rights theory

It is envisaged that common property issues will continue to form part of the core research agenda on the governance of access to and use of aquatic ecosystem services in developing countries. This is especially the case given that most natural resources in developing countries are regarded as common property (Wallace, 2007). As demands for access to and use of aquatic ecosystem services become more diverse and grow, relative scarcity will increasingly foster competitive rather than cooperative behaviours necessary for sustainable allocation of benefits, particularly from common property resources. In such complex contexts, governing access and use is not simply a matter of setting a utility function and selecting the alternative leading to the preferred set of consequences. On the contrary, it requires a systemic framing of key determinant factors which define the effectiveness, efficiency, equity and sustainability of delivering aquatic ecosystem services. Knowledge about cooperative approaches to the governance of these services must be scientifically reliable and evolve to remain contextually relevant. Based on the foregoing, we were able to identify a number of related thematic areas as being representative of the key factors to consider when embedding common property rights theory in cooperative approaches to the governance of aquatic ecosystem services.

Particularly, research on cooperative approaches needs to take lessons from common property studies. An important lesson from common property studies is that institutions matter in the designing of cooperative approaches. As indicated earlier, institutions refer to the prescriptions that people use to organise all forms of repetitive and structured human interactions (Ostrom, 2005). These prescriptions may include different sets of shared norms, rules, and organizational mechanisms for regulating access to and use of ecosystem services. While some of these prescriptions are formal, others can be perceived to be informal by participants in particular benefit sharing arrangements. These prescriptions can also exist at local, national, regional and global levels. As such, particular prescriptions have to be examined within their context. This perspective lies in distinct contrast to the perspective offer by the two property rights regimes (private and public) discussed above. This is partly because the technically biased approach behind the two regimes is inconsistent with the understanding that different prescriptions can have different impacts in different contexts. Depending on context, some prescriptions can lead to highly inefficient, inequitable and dysfunctional cooperative approaches. Still others may enhance the fairness,

efficiency and sustainability of cooperative mechanisms. Thus, if researchers concentrate on studying the two types of property rights regimes they would not be able to expose other effective cooperative mechanisms which in the past enabled indigenous local users to sustain natural resources over time.

Research on cooperative approaches needs to address the dynamics of institutions in the context of temporal and spatial changes. Particularly, it needs to investigate how enduring institutions are determined by the nature of rules as well as the processes of rule-making and enforcement. Enduring in this context does not simply imply that there is some idealised or steady state of a system but rather that the institutions for cooperation are resilient. For example, security of tenure is central to the resilience of cooperative schemes as it denotes the capacity of a participant to call upon the collective to stand behind his or her claim to a benefit stream (Bromley, 1991). Resilient institutions for cooperative approaches are able to adapt to continually changing circumstances, thereby sustaining the structure and function of a governance system. In other words, resilience confers an ability to maintain desirable institutions despite fluctuations in structure and function (Anderies et al., 2004). It is therefore surprising that, whilst it is well established that institutions matter in the design and implementation of cooperative approaches, the unwillingness to adequately incorporate property rights that relate to ecosystem services limits the usefulness of such institutions. This is compounded by the fact that there has been a general inclination to not understand property rights as a governance system. As a result, property rights are poorly understood in the context of governance.

We argue that a broad-based approach to research that considers institutional design and performance is required in order to formulate reliable models of successful cooperative approaches in developing countries. While complimenting the two property rights regimes, such an approach needs to take into account the enduring regularities of cooperative action defined by rules, norms and strategies which are constituted through common property systems. We note here that in many instances cooperative action is affected by the nature and design of the institutions in society that engender and shape these regularities. For example, it has been shown that most institutions involved in cooperative approaches in the governance of aquatic ecosystem services are imbued with boundary problems that defy cooperative actions. The institutional boundaries around cooperative approaches usually channel communication in ways that encourage fragmentation in the distribution of knowledge (see the report of du Toit et al). In such instances, the multi-scale nature of cooperative approaches hinders the ability of participants to contextualise knowledge at scales required for effective delivery of the services. Since institutional boundaries also hinder the way in which governments communicate with local communities, this makes it difficult for society to frame property rights problems and solutions in integrated ways. Ultimately, successful cooperative approaches require an understanding of the behavioural responses by individuals and groups to the institutional boundaries that mediate interactions among actors.

5. Lessons for South Africa

What are the key messages that will inform the direction this research will take in South Africa?

- The first is that flawed understanding of what is meant by property rights has caused the contribution of property rights to cooperative management to be overlooked.

- The second is not derived directly from this report but rather, from engaging with senior water resource policy makers, practitioners and researchers in discussions on property rights. It is quite apparent that, despite its obvious importance, the subject of property rights is poorly understood. To quote an influential researcher and former policy-maker: “In South Africa there are no such things as property rights, only rights of use.” A key component of our work going forward will be to better inform our key constituents.

- Third, it is apparent that, even at the international level, property rights regimes as governance mechanisms are poorly understood. Where they have been applied it has usually been at the reduced level of complexity of a single ecosystem service (e.g. fish resource). We need to fully appreciate their governance relevance in the context of complex social-ecological systems containing bundles of ecosystem services.

- Fourth, there is a clear argument that water resources in South Africa are primarily common-pool resources and that common property regimes are appropriate governance mechanisms for common-pool resource. We need to pursue this argument to its logical conclusion.

- Finally, our assessment reveals that clearly defined property rights usually result in improved resilience of a social-ecological system. Actually, we take this further and contend that, if our overall goal is to achieve the equitable and sustainable sharing of ecosystem benefits from aquatic resources, this is only possible within the context of a clearly defined property rights regime. In South Africa it is not about whether we apply them as mechanisms of governance but how we apply them.

6. Water as a property right in South Africa

Introduction

Property law in South Africa regulates the *rights of people in or over certain objects or things* (Mostert et al., 2010). Property rights are social relationships established between an entity (owner) and other entities (non-owners) with respect to a resource or item (Speelman et al., 2010b). In many cases these relationships are not merely between the owner and non-owner but often include an authority system (usually the state) which is responsible for defining and enforcing these rights (Bromley, 1992). The Constitution of South Africa has a property protection clause, stipulating that *no one may be deprived of property except in terms of law of general application, and no law may permit arbitrary deprivation of property* (South Africa, 1996; Section (25) (1)). This section of the Constitution also indicates that *property is not limited to land* (Section (25) (4) (b)).

There are usually two ways a user can legitimately access the benefits of a particular resource: (1) through the acquisition of property rights or (2) through specific policy that allows the use of goods and/or services of a resource at a given time (Gerber et al., 2009). According to Bromley (1992) **propert**y *is a benefit (or income) stream, and a* ***property right*** *is a claim to a benefit stream that some higher body – usually the state – will agree to protect through the assignment of duty to others who may covet, or somehow interfere with, the benefit stream*. Management of property rights of natural resources with similar characteristics is referred to as a **property rights regime or system** (Gerber et al., 2009).

There is general agreement in the literature that poorly defined property rights can seriously prejudice efficient use of natural resources (Speelman et al., 2010a). When property rights are poorly defined, decisions incur higher transaction cost (information search, negotiation, monitoring) which influence the value people assign to the resource (Speelman et al., 2010a). In the case where only the users recognise the value of the resource the incentives to manage the resource sustainably will be confined to this user group (Speelman et al., 2010c). Improvements in the property rights system should reduce transaction costs and thus increase the value of the resource to all users (Herrera et al., 2004; Frija et al., 2008; Speelman et al., 2010c).

In general, the importance of the definition and enforcement of property rights also increase as a resource becomes scarcer (Soltau, 1999). As the scarcity of the resource increases, so competition increases. Property rights can clarify expectations and thereby reduce conflict and interaction between users over a resource (Bruns et al., 2005). In South Africa where water resources are scarce, defining and enforcing property rights to the water resource is crucial to reduce conflict and to support sustainable use of the resource. This is achieved through a combination of formal (top down) and informal (bottom up) institutions.

The South African National Water Act (NWA) (Act No. 36 of 1998) sets the context for property rights in management of access to and use of water resources. The Act incorporates the principles of Integrated Water Resource Management (IWRM) that encompass equity, efficiency and sustainability. According to the GWP (2000), IWRM can be defined as:

a process which promotes the co-ordinated 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.

The Act recognises that the water resource in the country belongs to the public (*res publica*), with national government entrusted to ensure that these resources are protected, used, developed, conserved, managed and controlled according to IWRM principles and criteria. Water resources in South Africa can therefore be considered as common pool resources. Characteristics of a common pool resource are that: (1) it is costly to exclude individuals from benefitting either through physical barriers or legal instruments and (2) the benefits obtained by one individual subtract from the benefits available to others (Ostrom and Hess, 2007). The range of property rights regimes that can be used to regulate the use of common pool resources is large, including open access without rules (i.e. no regulation of use); or as in the case of South Africa's water resource, management by a government; or private property or common property regimes.

Water rights in South Africa

Water rights in South Africa are entrenched in the Bill of Rights of the South African Constitution. The National Water Act (NWA) interprets these Constitutional rights as giving priority to the right to water for the Reserve, namely the quantity and quality of water required:

c) *to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act, 1997 (Act No 108 of 1997), for people who are now or who will, in the reasonably near future, be- (i) relying upon; (ii) taking water from; or (iii) being supplied from, the relevant water resource*; and
d) *to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource* (DWAF, 1998).

There are thus only two recognised water rights in South Africa. While water *rights* referred to above relate to particular actions that are authorised, a water *property right* would be defined as 'a claim to a benefit (or income) stream' arising from the right.

Water property rights in South Africa

All other water use in South Africa is subject to the requirements of the Water Act, through authorisations. However, all these allocated water use rights can be seen as a usufruct[1] right as they are clearly authorised by law. These water use rights provide authorised water use for the act of taking and storing water; impeding or diverting flow of water; discharging wastewater; stream flow reduction activities (e.g. afforestation) or controlled activity (e.g. irrigation with wastewater; modification of atmospheric precipitation; power generation; and intentional recharging of an

[1] Usufruct is a right of enjoyment enabling a holder to derive profit or benefit from property that either is titled to another person or which is held in common ownership, as long as the property is not damaged or destroyed.

aquifer) (DWAF, 1998). These allocated usufruct water rights can be considered as a water property right as the authorization gives the user the right to claim the benefits arising for the water resource (e.g. crop production; wastewater discharge; afforestation; power generation) (Liu, Yang and Wang, 2001 in Bruns et al., 2005).

For example, in South Africa:

- Water Right = authorised access to water for environment
- Water Property = benefits arising from the authorised access to water for the environment (i.e. ecosystem services)
- Water Property Right = claim to the benefit arising from the authorised access to water for the aquatic ecosystem, i.e. the right to claim the ecosystems services arising from the Reserve.
- Water property right regime = management of natural resource with similar characteristics, i.e. management of water resources

The well-being of present and future generations depends on access to and the availability of ecosystem services which underpin water property rights (Figure 6.1) (Lankford et al., 2011). The Millennium Ecosystem Assessment (MA, 2005) has crystallised thinking on the concept of ecosystem services and has re-defined the concept of ecosystem services in a way that is useful; namely, ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling (MA, 2005). A water property right can thus be defined as a claim to the ecosystem services (benefits) provided by aquatic ecosystems.

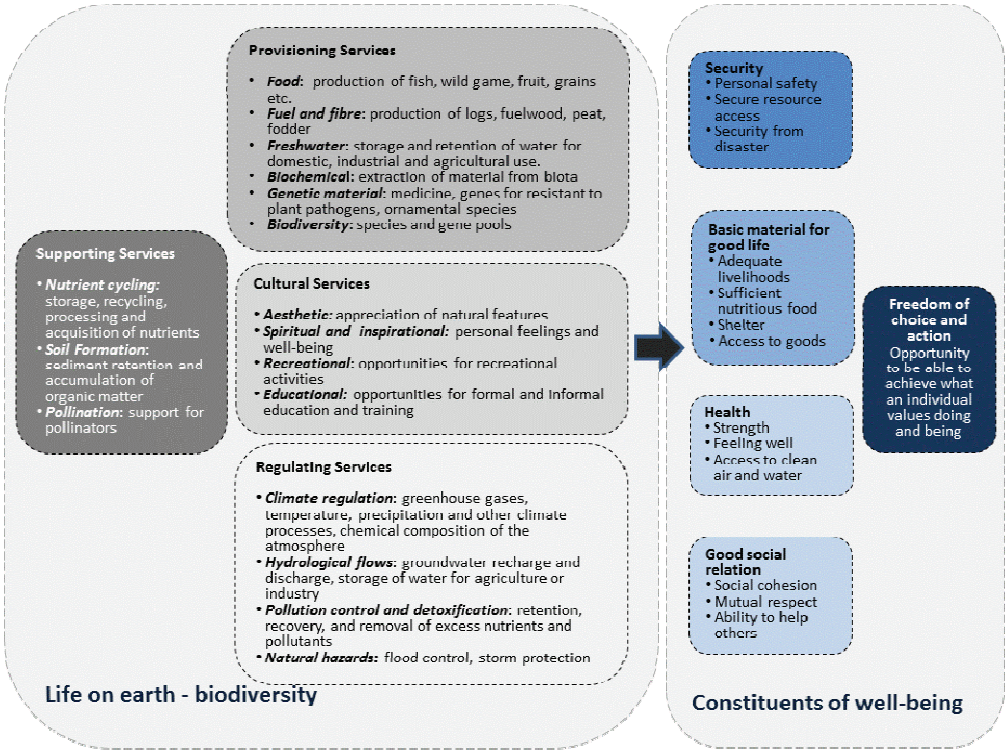


Figure 6.1: Ecosystem Services provided by or derived from inland water systems (taken from MA, 2005)

In order to achieve social and economic development goals, water ecosystem users and managers will commonly have to make trade-offs between the available services (MA, 2005), particularly as the demand for resources has begun to outstrip their supply. Decisions regarding trade-offs are complicated by the perceived value of ecosystem services by different stakeholder groups and their diverse and sometimes conflicting needs/expectations over time and space (Lankford et al., 2011). Furthermore, policy makers commonly ignore supporting and regulatory services, as they are difficult to quantify and monitor.

Water property rights are not usually homogeneous “ownership” rights that permit one to do anything with the resource, but rather can be considered as bundles of rights (Table 2.1) that may be held by different parties (Meinzen-Dick and Nkonya, 2005). The bundle of rights associated with water property rights is determined by the right to acquire, possess, use, manage, sell, lease, donate or subdivide the property. Thus, defining water property rights in South Africa in terms of bundles allows for a better understanding of how different allocation systems determine water resource management in the country.

Applying Table 2.1 to the South African water property rights regime, the ‘owner’ of water in the country, according to the NWA, is the public (DWAF, 1998). However, this ‘ownership’ does not come with the bundles of rights associated with the owner in Table 2.1 but rather, the South African government holds these ‘owner’ rights on behalf of the South Africa public. Government thus dictates access, withdrawal, management, exclusion and alienation to the benefits (ecosystem services) which are claimed from aquatic ecosystems in South Africa. The authorised users of water in South Africa hold access, withdrawal and management rights, but not exclusion and alienation rights.

According to Meinzen-Dick and Nkonya (2005) while the exact definition of these bundles of rights varies from place to place, there are several common elements in water law in Africa:

- *The state generally claims some kind of ultimate "ownership" rights over water*, with individuals required to request the use or development of water from the state.
- *The notion that anyone is entitled to water for "primary uses," which are usually interpreted as basic domestic needs, as well as household gardens, but may include other productive livelihood needs.*
- *While basic use rights are strong, they are usually quite flexible.*
- *Control rights of management and exclusion are often held by the local chiefs, groups, or individuals who developed the resource.*
- *Most state, customary, and religious law does not grant alienation rights (to sell, give away, or otherwise transfer one's rights to someone else)*

One of the key challenges of water management is to be able to balance water allocations and uses between water users and sectors (Korsgaard and Schou, 2010). Often certain sectors or water users have relatively well developed methods for quantifying and justifying their water needs but this is not the case for ecosystems—the silent water user (Korsgaard and Schou, 2010). There is therefore an urgent need to identify all the possible services provided by aquatic ecosystems (Figure 3.1), particularly in developing countries such as South Africa where the livelihoods of rural people commonly depend directly on these ecosystem services. Many of these people are poor and have few alternatives should the aquatic ecosystems deteriorate. To ensure equitable and sustainable use of water and the associated ecosystem services requires that the poor have secure water rights supported by effective governance.

Thus the value placed on water is not only dependent on *demand* for the service but also being able to *access* the benefits and the ability to ensure *delivery* of the service. Access to benefits is determined by property rights, which refer not only to private individual rights, but are defined more broadly as "the capacity to call upon the collective to stand behind one's claim to a benefit stream" (Bromley, 1991 in Gregorio et al., 2008). According to the MEA (2005) one of the key challenges of water governance[2] is the establishment of the appropriate forms of water property rights and responsibilities. These water property rights however, only exist if there are institutions to enforce the property rights regime that protect the rights holder against others interested in using the same "benefit stream" (Gerber et al., 2009).

[2] Governance is about effectively implementing socially acceptable allocation and regulation and is thus intensely political. Governance is a more inclusive concept than government per se; it embraces the relationship between a society and its government. Governance generally involves mediating behaviour via values, norms, and, where possible, through laws. The concept of governance of course encompasses laws, regulations, and institutions but it also relates to government policies and actions, to domestic activities, and to networks of influence, including international market forces, the private sector and civil society. These in turn are affected by the political systems within which they function (Rogers and Hall, 2003).

Water property rights regimes for common pool resource management in South Africa

Bromley and other scholars make the distinction between four classical types of property rights regimes: no property, common property, state property and private property (Bromley et al., 1992; Ostrom, 2002). South Africa's water resources are common pool resources, with the government regulating access to and use of the resource. Hence, open access (no effective property rights regime), common property and private property regimes for management of this resource are not applicable under the NWA.

According to Bromley (1992), state property regimes are characterised by the control over use of a resource resting with the state. Access to and beneficial use of the resource is only allowed at the forbearance of the state. Shifts from state property to other types, or vice versa, are possible. For instance, the 1998 nationalization of South Africa's water resource with the introduction of the National Water Act converted a common and private property. State property regimes are characterised by the separation of management of the resource from access and beneficial use. That is 'ownership' of the common pool resource resides with the South African citizens; management and regulation (control) rests with government, while access and beneficial use resides with a subset of the citizenry.

No matter which water property rights regime is applied in the management of water property rights, property rights theory identifies seven important principles for the establishment of a robust governance institution to manage aquatic ecosystems. The seven principles relate to boundaries, rules for benefits and costs sharing (operational-choices), collective-choice arrangements, monitoring, sanctions, conflict resolution and self-organization (Table 2.3). The principles were initially developed by Ostrom (2000) as design principles for common pool resource management institutions and were based on extensive fieldwork and extensive reviews of case-study literature.

7. Institutional structures required for IWRM and an equitable water property rights

As competition for scarce water resources grows in South Africa, strengthened governance institutions for coordinating use and resolving conflicts are needed (Bruns et al., 2005; Speelman et al., 2010b). Usually, conflicts and ambiguity in resource use arise when property rights or the allocation processes create mismatches (Yandle, 2007; Amacher et al., 2009). Formalising and recognising water property rights is unlikely to make a significant difference unless these are accompanied by legitimate rules which are enforced by a robust water institution (Bruns et al., 2005).

Given the institutional dependence of formal water property rights, Bruns et al. (2005) distinguishes three aspects that require attention:

- *Redesigning or aligning the water institution* —establishing rules and other institutional arrangements to clarify rights and provide recourse for settling disputes;
- *Redesigning governance*— which includes the forming of inclusive forums to negotiate water agreements and rules;
- *Regulating transfers*—implementing routine mechanisms for temporary and permanent transfers, including relevant safeguards.

This does not imply that every water rights reform will or must deal with all three aspects. However, attempts to institute water transferability without well-defined rights are unlikely to succeed, while defining water rights without a governance structure is likely to prove fruitless. (Bruns et al., 2005). Bruns et al. (2005) suggests that *institutional design for water rights reform will be more effective if it takes account of how transfers and rights depend on more basic governance institutions, and suitably sequences emphasis on redesigning governance, resolving tenure, and regulating transfers*.

An institution is defined in the literature as the "*framework within which human interaction takes place*" (North, 1990; Bandaragoda, 2000). The institution has the purpose of constraining socially undesirable behaviours such as on-going water pollution, and promoting and facilitating desirable actions such as interventions to protect a water resource.

The term institution is often confused or used interchangeably with the term organisation (Bandaragoda, 2000). Generally, an organisation is a management structure, such as the Departments of Water Affairs, Water Boards or a Water Tribunal. An institution is however, "an organised, established procedure" which determines the "rules of the game" which shapes and stabilises actions within the water sector, sets the rules and incentives and defines the information and compulsions that guide the outcomes of the sector (Bandaragoda, 2000). A water organisation is thus one of the components, which make up the water institution.

According to Schreiner et al. (2011a), the framework that regulates water should consist of four key elements:

1. **water policy**, which sets the high level objectives, aims and approaches;

2. **water legislation** which translates the policy into legal requirements and obligations;

3. **water instruments** for implementing the legislation; and

4. **Water organisations** that create the policy and the legislation; and develop and use the instruments.

In addition, according to a number of authors, a water institution is grouped into two functional segments; the water **institutional environment** and the water **institutional arrangements** (Davis and North, 1970; North and Thomas, 1973; Saleth and Dinar, 2004).

In examining the requirements of a water institution to enforce compliance with the public property rights regime in South Africa, we make use of a combination of the Schreiner et al. (2011a) regulatory framework requirements and the two functional segments to review the water institution in South Africa. We thus review the water property rights issues in South Africa using the institutional components of (1) the institutional environment and (2) the institutional arrangement. The Schreiner et al. (2011a) categories of water policy and legislation fall within our institutional environmental segment and categories of instruments and organisation under our institutional arrangement segment.

Thus the **water institutional environment** in this report is the set of fundamental political, social, and legal rules that establish the basis for water institution, including:

1. **Policies:** water policies can be considered as a "Statement of Intent" or a "Commitment" which describe the principles or rules that guide water decisions.

2. **The law and regulations** where the laws will provide the overall framework of the water institution and the regulations provide the more detailed guidance (rules or governmental orders) designed to control or govern behaviour of the water institution (Elledge et al., 2002). Law can be differentiated as:

    a. *Statute laws* are written laws passed by legislature and government of a country and those which have been accepted by the society (i.e. the National Water Act);

    b. *Common laws:* evolve with new decisions made by judges in courts.

While the water institutional environment described above covers the rules of the water 'game', the **water institutional arrangements** are the governance structures that evolved from and interact with the water institutional environment (Saleth and Dinar, 2004). **Water *institutional arrangements*** thus provide a structure within which stakeholders – individually or collectively – cooperate or compete (Saleth and Dinar, 2004) and include:

1. **Instruments** which are the instruments used to implement the water legislation, including:

    a) *Strategies and operational plans and procedures***:** a *strategy* is a plan of action designed to achieve a vision, it translates policies into interventions (i.e. the 'what' is intended by the water institution) (Scott et al., 2003). *Operational plans and procedures* are, on the other hand, the plans and procedures to be followed by strategic interventions, i.e. the ('how') actions to be followed in order to achieve water objective:

b) *Funding and finance:* the water institution has mechanisms in place to source adequate funding and for the preparation and implementation of a financial plan and budget for the organisation.

c) *Accountability, transparency and incentive mechanisms:* the water institutions are able to account rationally for their actions through documenting how resources are used and have the ability to reconstruct the series of organizational decisions, rules, and actions associated with a set of outputs or outcomes. Water institutions with high accountability are more likely to persist.

d) *Incentives and disincentives:* the water institution has mechanisms to motivate positive behaviours (i.e. tax incentives) and discourage negative behaviours (i.e. fines for unsafe disposal, emission charges, and user charges).

e) *Information, research and technological capabilities:* access to and sharing of information, research and technologies are important components of a water institution.

2. **Formal organisations**: North (1990:73) defines organizations as "purposive entities designed by their creators to maximise wealth, income, or other objectives defined by the opportunities afforded by the institutional structure of the society." (Bandaragoda, 2000). The performance of a water organisation is determined by seven pre-identified organisational performance categories, including (Cullivan et al., 1998):

    a) *Autonomy/independence*: effective autonomy of the water organisation is characterised by the power to make independent decisions that affect its financial, political, and legal ability to perform (Scott et al., 2003).

    b) *Leadership*: the organisation has the ability to inspire others to understand and commit to the water institution's mission, and work toward its fulfilment.

    c) *Management and administration*: effective water management, characterised by teamwork, cooperation and good communication, is evident in the water organisation's capacity to effectively and efficiently utilise its available resources (human and other).

    d) *Consumer orientation*: effective water organisation has workable means wherein consumers can interact with them. These may include creative and cost-effective means of arbitration through interacting with consumers by providing outlets or 'hotlines' when there are crises, clearly identified places where disputes about bills or service can be arbitrated, etc.

    e) *Technical capability*: the organisation has the requisite competence to conduct the technical work required to carry out the responsibilities of the organisation.

    f) *Developing and maintaining staff*: effective water institutions develop and maintain their personnel and direct activities toward recruiting staff, providing skills to do the jobs and grow professionally, and providing adequate job satisfaction and wages and benefits to retain competent personnel.

g) *Interactions with key external institutions*: the organisation has the capacity to influence positively and strategically those institutions that affect its financial, political, and legal ability to perform.

These institutional components and insights from the practical case studies discussed in the next section are used later in the report to assess the state of the water institution which manages water rights and water property rights in South Africa.

8. Two South African case studies

We used the seven design principles for enduring sustainable resource management institutions as the analytical framework to analyse water property rights in two case studies in South Africa. These principles are outlined in Section 2, Table 2.3.

The Pongola River floodplain

The purpose of this case study is to provide insights into the central role of water property rights regimes in mediating the relationship between ecosystem services and human benefits. We draw on the Pongola River floodplain to illustrate how property rights regimes influence the nature of governance, which can be categorised into either vertical, horizontal or unstructured forms. Vertical governance relates to a governance form that is characterised by various levels of power, whereas horizontal governance concerns a category of governance among individuals and groups at the same level with equal power (Schedler, 1994; O'Donell, 1999; Collomb et al., 2010). The case study illustrates that there are many combinations of rights to benefit from and control the flow of aquatic ecosystem services, in our case flood releases. By examining the institutions and actors that have governed the Pongola River floodplain we are able to illustrate the importance of explicitly defining and categorizing a range of rights.

The Pongola River has a catchment of 7000 km^2 at the eastern extent of South Africa (Figure 8.1). It is located on the coastal plain immediately upstream of Mozambique. The river descends steeply from its source at 2200 metres above mean sea level and passes through a narrow gorge between the Lebombo and Ubombo mountains where the Pongolapoort Dam is now situated. Below the dam-wall the river meanders across a gently sloping floodplain with numerous pans that are dependent upon periodic flooding by the river. The floodplain extends for approximately 50 km in length, varying in width between 0.8 and 4.8 km to the confluence of the Pongola and Usutu Rivers, on the border with Mozambique. The landscape comprising the river, floodplain lakes and temporarily flooded areas was a catalyst for human settlement as it offered access to diverse ecosystem services that sustained livelihoods. For thousands of years the Thonga people, who made the floodplain their home, have had rights to benefit from the flooding regime (to cultivate the enriched soils that were exposed once floodwaters had receded, to harvest fish, to gather reeds and to use other floodplain resources.)

The idea of damming the Pongola River was first considered in 1931 but was shelved in favour of an upstream diversion for irrigation. The matter was again raised in 1947 when the Irrigation Commission was instructed by the Minister of Lands and Irrigation to investigate the Pongola River Storage Project. Momentum started to build up when the Department of Water Affairs observed that 'the Pongolapoort/Makatini Flats project is the only irrigation scheme in the Union which can provide, at reasonable cost, the additional sugar production capacity required.' [1] (Quoted in Turton et al, p.359.)[3] In 1960 the Minister announced that the project would be prioritised with about

[3] Quoted in Turton et al, p.359.

70 000 morgen available for production of sugar cane on the Makatini Flats. Mention was also made of 11-12 000 morgen of Crown land under the canal on which Africans were living and might benefit. (House of Assembly Debates, 1961, Vol. 108 p. 5914ff.)[4] Construction started in 1963 and the dam was completed 10 years later. The envisaged irrigation scheme has not yet been realised. (The above material was personal communication from Deborah Lavin at lavindeb@btinternet.com.)

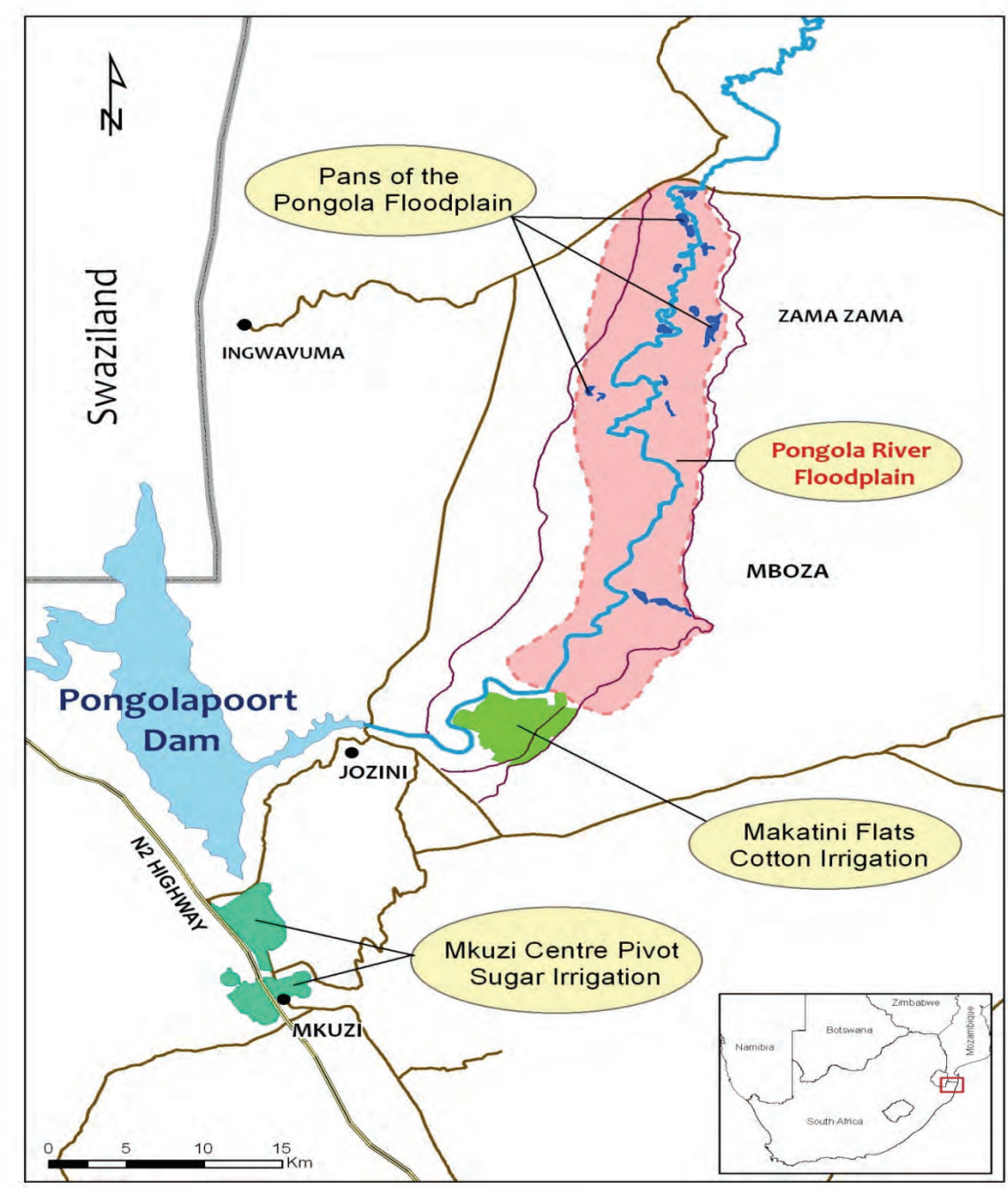


Figure 8.1: The Pongola River floodplain and surrounds

[4] House of Assembly Debates, 1961, Vol. 108 p. 5914ff.

Analysis of the evolution of the Pongola property rights regime is divided into three main eras: pre-impoundment, post-impoundment phase 1, and post-impoundment phase 2. We now discuss each of the eras in turn.

Pre-impoundment era: The pre-impoundment era dates from the pre-colonial period (1650s) to impoundment period (1963), when construction of the dam started. The primary purpose of the dam was to control floods and provide an assured supply of water for a single use (irrigation to approximately 40,000 ha of land adjacent to the floodplain). Prior to the building of the Pongolapoort Dam, the natural flooding regime governed many of the characteristics of the floodplain (floodplain pans, diverse ecosystems and the patterns of land use of the communities living adjacent to the floodplain) as well as the property rights regime. Local communities were highly dependent on the flooding and subsistence agriculture remained an important use of the floodplain. The rights to exploit the flood benefits were controlled on behalf of the traditional authorities, by the local iZinduna (Headmen) (Heeg and Breen, 1982). The Pongola region formed part of the former KwaZulu homeland and the land surrounding the floodplain area was governed through communal tenure. Given that the flow of the Pongolo River was not regulated during this era, the natural variations in river flow determined patterns of floodplain productivity and use: the summer floods replenished water in the floodplain lakes and stimulated fish migration for breeding allowing them to be captured in mono-baskets set in the inlets to the lakes. As waters receded small fish could be captured by young women using cloth seine nets. With lower water levels new growth became available for grazing livestock, reeds could be harvested for construction and when water levels in the lakes were low enough, the chief or local iNduna (Headman) would arrange for isifonya fishing. This was a major social occasion when residents would congregate and moving in a line across the lake, they would drive fish into shallow water where they could be captured with thrust baskets (Heeg and Breen, 1994). People and the floodplain were intricately linked in a complex and dynamic social-ecological system centred on the common pool resource.

Post-impoundment phase 1 era: The post-impoundment phase 1 era dates from 1973, when the construction was completed, to around 1986 when the first local management committees were established. During this era, the Department of Water Affairs (DWA) (formerly the Department of Water Affairs and Forestry) operated the dam without consulting stakeholders. Governance was based on an unstructured process of flood releases whose timing proved to be sporadic and entirely unpredictable. With this lack of certainty about flood releases, conflicts developed between agriculturists, grazers and fishermen who no longer knew how to protect their access to respective resources. There was no clear regime of flood releases and the imperfect system that did exist did not take into account the emerging interests of those who used the floodplain to support their livelihoods. The unstructured scenario was evidenced through the flood releases that 'proved to be fairly sporadic particularly towards the end of this era (1984-1986) (see Table 8.1). The timing was entirely unpredictable' (van Vuuren, 2009). This era pointed to the fact that just as river environments are dynamic, so too are social systems; just as the effects of disturbances are propagated through ecosystems, so too are disturbances propagated through social systems. The evidence suggests that it is commonly not the immediate effect that holds greatest consequence because, as disturbances are propagated, so they may be magnified and dispersed with unintended outcomes. However, one might identify the ecological impacts of flow regulation and seek to mitigate them in an equitable fashion. It is clear that potentially far greater impacts emerged during this era from the realization of opportunities, the differentiation of society, the redistribution of

rights and the marginalization of sectors who previously had protection within the communal system.

Table 8.1: Managed flood releases showing variability in timing and volume (Source: Basson, Denys and Beck, 2006: 33)

YEAR	MONTH	Q_{peak}	VOLUME
1984	• February	• 1480	• 1080
1984	• September	• 850	• 224
1985	• March	• 375	• 507
1986	• February	• 415	• 178
1986	• October	• 340	• 132

Post-impoundment phase 2 era: With growing discontent amongst the local community, a small number of articulate persons of some standing tried to mobilise popular support in order to establish some local bodies that would take a more proactive approach in improving matters. This begun the establishment of a number of water committees on the floodplain with representation from a range of water users such as stockowners, women and traditional healers. These committees were supported by local development initiatives and NGOs who championed the process; and in some cases, money was raised from foreign aid organizations to support the committees. However, these committees were active only from 1986 to 1996. The late 1990s coincided with international donors channelled their funding to the new government rather than to NGOs. At the same time, the era saw the emergence of a power group of flood irrigation farmers on the floodplain and cotton farmers, resulting in unproductive power struggles within the community and the water committees. These related mainly to the timing of flood releases from the dam with farmers preferring flood releases in early summer and others, such as cattle farmers, fishers and conservationists wanting releases in late summer (Poultney and Bruwer, 2002). The information in Box 1 provides evidence of the self-interest and influence of the agriculturists in relation to other people who held traditional rights to benefit from the floodplain ecosystem.

BOX 1: CONTINUING CONFLICTS

With the habitat loss and changes as manifested in reduced grazing areas on the floodplain, the situation could be reached during the next drought that the communal floodplain land will not be able to cater in the grazing requirements, resulting in **conflict between floodplain inhabitants and non-floodplain inhabitants.** A politically inspired **move to destabilise** the Combined Phongolo Floodplain Water Committees was executed by a group who referred to themselves as Powadeta, a group who started farming cotton on the floodplain.

The **conflict** and the resultant alteration in flood releases had its origin during March 1997. The negotiated October 1996 release was coupled to a negotiated and agreed March 1997 release to benefit the ecology. When it became time to make the March 1997 release, there was **pressure from cotton farmers** who did not want a release as they had started farming cotton in the floodplain. These farmers were politically inspired and demanded that they would only tolerate one flood per year and this should happen during September each year. The conservation authorities on the other hand **put severe pressure on the Department of Water Affairs and Forestry** and to stick to the negotiated release of March 1997. The Combined Phongolo Floodplain Water Committees **were intimidated** by the politically motivated minority and were reluctant to speak up for **fear of retribution**. Top management in the Department of Water Affairs and Forestry were reluctant to sanction a decision to have the March 1997 release as artificial releases put the onus on the department to accept **liability for damages** so caused. Having been warned about the pending claims by the cotton farmers, the Department had no option but to not make an artificial release. This turned out to be a serious mistake, as it **created a precedent** that repeated itself on a number of subsequent occasions, even after the promulgation of the National Water Act in 1998 that allocated the right of environmental water to aquatic ecosystems.

Despite all these negotiations the cotton farmers again **held the other floodplain users to ransom** by again renaging on a negotiated release during March 1999 that was coupled to the October 1998 release.
A release of 800 m3/s was negotiated with the communities for October 1999. No coupled release was negotiated for February/March 2000. **The conservation agencies were unhappy about this situation and feel that the Department of Water Affairs and Forestry are not looking after the floodplain ecology properly.**

Table 8.2 subjects the Pongola case study to analysis using the seven principles of effective property rights regimes.

Table 8.2: Each era in the Pongola case study is subjected to analysis using the seven design principles of effective property rights regimes

KEY ATTRIBUTE	Pre-impoundment era	Post-impoundment era Phase 1	Post-impoundment era Phase 2
1. Boundaries	The floodplain during this era had clearly defined boundaries under traditional authorities and the individuals or households who had rights to claim flood benefits were clearly identifiable through the same local authorities. The rights to access benefits were held collectively and administered under communal tenure (Heeg and Breen, 1994; Jaganyi et al., 2008; Lankford et al., 2010). Rights to benefits were thus shared and could be revised to adjust as need arose (see Yandle, 2007).	The introduction of government control saw the breakdown of traditional boundaries and the de facto system of rights to flood benefits transformed into a de jure system.	While the introduction of water committees began the process of reconstructing some form of boundaries, this was however not enough, as individuals or households who had rights to flood benefits were not clearly identifiable.
2. Benefits and Costs	There was a relatively proportional equivalence between the benefits and costs (inputs/risks) associated with the flooding; access to the flood benefits was determined by the communal tenure system (operational-	The relationship between the benefits and costs associated with the flood releases become entirely distorted; the amount of benefits allocated were largely disproportional to the inputs/risks (among agriculturists, grazers and fishermen; on-floodplains vs. off-	The relationship between the benefits and costs associated with access to flood releases continued to be distorted; the amount of benefits allocated were still largely disproportional, with certain groupings getting unfair shares.

KEY ATTRIBUTE	Pre-impoundment era	Post-impoundment era Phase 1	Post-impoundment era Phase 2
	level rights).	floodplains users).	
3. Collective-Choice Arrange-ments	The local user groups who were affected by communal tenure rules were included in the decision processes of the traditional authorities (collective-level rights). The multiple livelihood strategies drawing on resources on and off the floodplain were governed by rules, norms and values that were shaped by experience and knowledge of how the system was structured and functioned.	The local user groups who were affected by flood release rules were no longer included in the decision processes, which were largely dominated by government.	The local water committees did not ensure that the local user groups who were affected by flood release rules were included in the decision processes, still largely dominated by government. The evidence suggests that a system developed during this era in which rights to use of land for cultivation on the floodplain dominated over rights to the use of other resources. Whilst sustainability was evidenced in the ability to reduce and manage certain risks, this was only amongst those who were part of the newly demonstrated memberships, and more particularly those who pursued crop production. It can thus be argued that the decisions emanating from the Water Committees led to greatly reduced risk for floodplain cropping which in the absence of effective governance led to considerable expansion of cultivation on the floodplain that was increasingly ecologically, socially and economically unsustainable. This understanding directs that we question the future of flood irrigation for subsistence agriculture. It also shows very clearly a collapse of governance.

KEY ATTRIBUTE	Pre-impoundment era	Post-impoundment era Phase 1	Post-impoundment era Phase 2
4. Monitoring	Prior to construction of the dam the people living along the floodplain were subject to traditional authority and were largely isolated from the influences of central government and the mainstream economy. The users of ecosystem services were involved in monitoring the biophysical conditions of the floodplain as well as user behaviour and were accountable to themselves as users (operational-level).	The local users of ecosystem services were never involved in monitoring the biophysical conditions of the floodplain as well as user behaviour as government was largely accountable to itself.	While local monitoring had improved to some extent, the monitoring of biophysical conditions of the floodplain as well as user behaviour continued to be largely government driven.
5. Graduated Sanctions	Sustainability was dependent upon the social processes and relationships through which rights were granted, recognised and respected. Appropriate sanctions were effected by traditional authorities.	There was no explicit system for effecting appropriate sanctions to law breakers.	The local water committees were weak to facilitate a system for effecting appropriate sanctions to law breakers.
6. Conflict-Resolution Mecha-nisms	Ensure access to low-cost, local arenas for users and managers to resolve conflict among users or between users and the managers	The governance system in place did not provide for effective access to local low-cost conflict resolution mechanisms.	The local water committees did not provide for effective access to local low-cost conflict resolution mechanisms.
7. Minimal Recogni-tion of Rights to	The traditional authorities ensured access to local low-cost conflict resolution mechanisms. The	The government of the day never recognised the rights of users to devise their own rules to secure tenure, a	The local water committees never provided for the recognition of the rights of users to devise their own rules to

KEY ATTRIBUTE	Pre-impoundment era	Post-impoundment era Phase 1	Post-impoundment era Phase 2
Organize	communal tenure system recognized the rights of users to devise their own rules to secure tenure. Stakeholders held overlapping use and decision-making rights that were established and adjusted through the social relationships among those holding property rights (see Meinzen-Dick & di Gregorio, 2004).	situation that encouraged an open access regime.	secure tenure.

We conclude that the pre-impoundment era is characterised by common property right regimes which evolved to regulate who, when, where and how the range of ecosystem services could be accessed (Heeg and Breen, 1994; Jaganyi et al., 2008; Lankford et al., 2010). This era was strongly associated with strong governance **(horizontal**) and sustainable outcomes that were underpinned by an effective common property rights regime.

We concluded that the post-impoundment phase 1 era was strongly associated with weak governance **(unstructured)** and unsustainable outcomes that were underpinned by an ineffective property rights regime.

We concluded that the post-impoundment phase 2 era was strongly associated with weak governance **(vertical)** and unsustainable outcomes that were still underpinned by an ineffective property rights regime.

It is important to note that currently the property rights arrangements for the coordination of flood releases from the Pongolapoort Dam are centred on a Water Users' Association (WUA) called the Imfunda Yopongola WUA. There is a strong expectation of democratic representation through the WUA as the intention is to have various stakeholder groups democratically nominate their representatives. However, there remain serious challenges in realising the full potential of the WUA. The immediate challenge relates to the need to harmonise the expectations of the WUA and the Department of Water Affairs (DWA) concerning the new formalised status of the WUA and its responsibility to raise fees from its constituents. Continuing hopes on the part of the WUA to receive funds from the state for operations have constrained its working and prevented it from assuming a broader role in floodplain governance.

This case study has illustrated that a property rights perspective provides a better way of understanding relations between ecosystem services and human benefits. This is especially the case in contexts in which collective use of ecosystem services is susceptible to externalities that make governance difficult. The case study demonstrates that although common property rights regimes for the management of water of a small homogenous group can function for long periods of time, these regimes:

- Are not immune to disturbance from outside systems such as new technologies (i.e. new water law or construction of dams); new job opportunities (i.e. jobs from the introduction of large-scale cotton farming) and new media of exchange (i.e. change from bartering with labour, tools and material in farming to payment for assistance)
- Are likely to persist when the actors in the regime are at roughly the same operational and collective-choice levels but that this robust property rights regime may not necessarily withstand challenges from outside the boundaries of the system
- May cease to function when heterogeneity is introduced into the water property rights system. Introduction of commercial farming upstream from the Pongola community resulted in upstream users having a greater claim to the water resource, at the expense of the water property rights (ecosystem services) which were enjoyed by the local downstream water users

Coal mining and wetlands in the Olifants water management area

The Olifants Water Management Area (WMA[5]) is one of the largest WMAs in South Africa and is spread across the three provinces of Gauteng, Mpumalanga and Limpopo (Figure 8.2). The Olifants River is the major water resource in the WMA and originates near Bethal in the highveld of Mpumalanga. The river initially flows northwards before curving in an easterly direction through the Kruger National Park (KNP) and into Mozambique where it joins the Limpopo River before discharging into the Indian Ocean. The WMA is one of the most economically important catchments in South Africa. Economic activity is highly diverse and is characterised by mining, agriculture, and tourism. The economy of the WMA is largely driven by the mining sector, with large coal deposits found in the eMalahleni and Middelburg areas and large platinum group metal (PGM) deposits found in the Steelpoort and Phalaborwa areas.

[5]According to the National Water Act (1998), a WMA is an area established as a management unit in the national water resource strategy within which a catchment management agency will conduct the protection, use, development, conservation, management and control of water resources. 19 WMAs have been identified nationally.

Figure 8.2: The Olifants Water Management Area (Sourced from Golder Associates)

Within the WMA, wetlands form an important component of the aquatic resource and are located primarily in the upper Olifants Catchment (bottom of Figure 8.2). According to the National Freshwater Ecosystem Priority Areas (NFEPA) database there are approximately 1 288 km^2 of wetland area in the entire Olifants WMA, of which approximately 66% (856 km^2) is found within the upper Olifants Catchment. By virtue of their position in the landscape and relation to drainage networks, wetlands are often impacted by coal mining activities.

Coal mining, while extremely important to South Africa's energy needs and economy, has resulted in the partial or complete destruction of several wetlands within the upper part of the WMA. On a global scale, the destruction of wetlands has led to a host of water related issues, which have direct impacts on human wellbeing (MA, 2005). Within the upper Olifants Catchment, the picture is no different, with the deleterious impacts of coal mining resulting in the decreased capacity of wetlands to deliver ecosystem services essential for human well-being.

Wetlands are highly productive ecosystems that are ecologically complex and provide a variety of goods and services that are of value to society (Table 8.3). The Millennium Ecosystem Assessment (2005) identifies a diversity of ecosystem services that may be delivered by wetlands, such as food (notably fish) and fibre that may, in some communities, be essential for human well-being and, poverty alleviation. Wetlands in Southern Africa have also been shown to contribute to the livelihoods of rural communities by providing valuable grazing land, cultivation area, building materials and medicinal goods (Turpie, 2000; Masiyandima et al., 2004; McCartney and van Koppen, 2004; Masiyandima et al., 2005).

Table 8.3: List of ecosystem services affected by mining operations in the Olifants Water Management Area

Ecosystem Service Category Affected	Scale of Impact	Consequence
Provisioning Services	Local scale	Loss of grazing, reed collection, food, etc.
Cultural Services	Local scale	Loss of access to culturally important sites
Regulating Services	Olifants WMA scale	
Water Purification		Decreased water quality
Hydrological Regimes		Timing and magnitude of river flow affected and hydrological recharge impacted

Regulating and supporting services of wetlands sustain other vital ecosystem services that deliver many benefits to people (MA, 2005). Of particular importance in the Olifants WMA are the water provisioning and detoxification regulating services delivered by wetlands (Table 8.3) as these determine the wellbeing of people residing downstream.

As noted above, wetlands can provide a host of ecosystem services to society and this is particularly so in the upper Olifants Catchment because of the high wetland cover in the catchment. There is a broad spectrum of water users throughout the catchment, who are economically, socially and culturally dependent on both the quantity and quality of water that they abstract directly from the Olifants River. The impacts of coal mining affect these users at different scales from the local wetland scale to the larger area of the Olifants WMA scale.

During the coal mining process entire wetlands are often completely destroyed. In such cases, destruction results in the loss of all ecosystem services delivered by the wetland of which the loss of the provisioning and cultural services is the most noticeable. In southern African socio-ecological systems, beneficiaries of these services commonly include rural communities, which rely on these services, particularly during times of economic hardship such as drought. An example often used to illustrate this direct dependence is the provisioning service of grazing. However, this scenario is unlikely to occur in the upper Olifants Catchment as mining companies have excluded users of these services from accessing mining properties and former landowners have been compensated.

At the scale of the Olifants WMA however, the destruction of wetlands has significant impact on the pattern of river flow, the quantity and quality of the water that is used by various downstream economic sectors. These ecosystem services are referred to as the regulating services. For the purposes of this case study, the water purification service is used to illustrate how wetland degradation affects downstream users of ecosystem services.

Several drivers of pollution have been identified in the WMA. Among these is loss of wetland functioning that results in a decreased ability of the Olifants system to adequately purify or detoxify water. The downstream users affected by poor water quality are both numerous and varied including:

- The agricultural sector which is reliant on clean water for food production;
- The mining and industrial sectors which require water quality of a particular standard;
- The KNP which requires a certain water quality for ecological functioning; and
- Communities living alongside the Olifants River, which require water for basic human needs (drinking, personal hygiene, agriculture, livestock watering, etc.).

Table 8.4 subjects the Olifants case study to analysis using the seven principles of effective property rights regimes.

Table 8.4: The Olifants case study is subjected to analysis using the seven design principles of effective property rights regimes

KEY ATTRIBUTE	Mining (single wetland)	Mining (Olifants Water Management Area)
1. Boundaries	The boundary would be limited to a single wetland and the area owned by the mining company. Since the mining company would have a water use authorisation they effectively have a 'private' property rights to the wetlands and are able to solely claim the benefit arising for said wetland.	Coal mining activities in the Olifants WMA are essentially limited to the upper Olifants Catchment that happens to be where most wetlands in the WMA are situated. However, since there are downstream water users in both the middle and lower Olifants Catchment, the claims to wetland water property rights extend to these users. However, the present water use authorisation does not necessarily recognise, let alone enforce these claims to water property right (ecosystem services).
2. Benefits and Costs	Benefits of wetland utilisation would accrue to the mining companies. Any benefits that would have accrued to previous landowners would be lost, but would have been compensated by the sale of the land.	Downstream water users bear the costs of decreased water quality (water property right/ ecosystem service) because of the decreased capacity of the wetland's ability to purify water. The beneficiaries of the water property right are the coal mining companies who have claim to the benefit from utilising the wetland. Cost and benefits are thus disconnected.
3. Collective-Choice arrangements	A water use license (WUL) would be granted to the mining company by the Department of Water Affairs (DWA). The rules guiding conservation and sustainable use of the resource are determined by	Resource Water Quality Objectives (RWQO) will be set for each WMA in the near future. The RWQOs should take into consideration the water requirements of all water users in the WMA. The establishment of Catchment Management Agencies (CMA) should provide all water users with a platform for determining RWQOs. In this situation, the local water users,

KEY ATTRIBUTE	Mining (single wetland)	Mining (Olifants Water Management Area)
	the public property rights regimes of the country.	including downstream users, should be included in the rules governing water quality (water property rights) in the CMA.
4. Monitoring	In the public property regime in South Africa, monitoring of water quality is the responsibility of the state. The establishment of CMAs should allow a more decentralised approach to water quality monitoring.	In the public property regime in South Africa, monitoring of water quality is the responsibility of the state. The establishment of CMAs should allow a more decentralised approach to water quality monitoring.
5. Graduated Sanctions	Enforcement for contravening the conditions of the WUL for a single wetland in a public water property rights regime is the responsibility of the state. Enforcement is often costly and resource intensive.	Enforcement for contravening the conditions of the WUL for a single wetland in a public water property rights regime is the responsibility of the state. Enforcement is often costly and resource intensive. The destruction of wetlands leads to decreased water quality. However, changes in water quality in the downstream areas may be a function of several drivers. The implementation of the RWQO as well as the Waste Discharge Charge System should provide downstream users with a certain level of recourse. Linking upstream wetland property rights to the destruction of downstream water user's property rights will be difficult, expensive and resource intensive as downstream wetland property rights are not explicit and often not even recognised in the public water property rights regime.
6. Conflict-Resolution Mechanisms	Issues of access to ecosystem services (such as grazing, tourism and cultural services) produced by wetlands are determined by the owner of the land which in this case is the mining companies. The mining company thus has exclusion rights and can easily, through social and physical infrastructure,	Implementation of CMAs and other water interest groups should provide downstream water users with a platform in which to raise the grievances regarding water quality, thus upstream wetland property rights. There may still be significant detachment between the water users and the CMA in this water property rights regime.

KEY ATTRIBUTE	Mining (single wetland)	Mining (Olifants Water Management Area)
	exclude individuals from claims to benefits from wetland property rights.	
7. Minimal Recognition of Rights to Organise	Public water rights regimes in South Africa do recognise the role of CMAs and WUA in local level water resource management. However, these organisations are not immune to interference from state.	Public water rights regimes in South Africa do recognise the role of CMAs and WUA in local level water resource management. However, this water property rights regime does not recognise the right of local users to form their own water management organisations that are protected from interference by the state. .

While the right of access to water for basic human needs and the environment is entrenched in the Constitution of South Africa and the National Water Act (1998), the statutory mechanisms in place to ensure water quality are currently insufficient to deal with the compromised water quality. The South African Water Quality Guidelines (SAWQG) delineates water quality thresholds for different economic sectors, but monitoring and enforcement remains an issue. The yet to be implemented Resource Water Quality Objectives (RWQO) will set in-stream water quality guidelines and the requirements of all users will be taken into consideration. The establishment of Catchment Management Agencies (CMA) should allow for a decentralised and therefore more inclusive approach to water quality management.

According to Bromley (1992) a water property right would be defined as 'a claim to a benefit (or income) stream' arising from the right. Loss of the benefits associated with water quality is ultimately revealed in the increase in production costs of the associated product, i.e. an increase in food prices due to increased water treatment cost. At present downstream water users in the Olifants WMA have limited recourse for poor water quality. The proposed introduction of the Waste Discharge Charge System (WDCS[6]) will provide downstream water users with a mechanism which should, in the long term, improve water quality.

The case study demonstrates that public water property right regimes:

- Do not always recognise the water property rights of all water users equally. For example, some water property rights (mining) have precedence over other water property rights (downstream water quality from wetlands). This is the case where an authorised water use allocation takes preference over the wetland property rights enjoyed by poor, rural downstream users and the KNP ecosystems.
- Can make monitoring and enforcement of water property rights difficult, costly and resource intensive as it usually involves national government.

[6] The WDCS aims to reduce the impacts that water users have on water resources in order to address the problem of excessive pollution on water systems. The objectives of the WDCS include efficient resource utilization, sustainable water use and development, discouraged pollution, internalization of environmental costs and cost recovery from activities polluting water sources. The principles on which the WDCS is based are the polluter pays principle (PPP), reduction of pollution at source principle and the precautionary principle.

- Should include clear processes and procedures for graduated sanction to facilitate enforce compliance to water authorisations. Graduated sanctions of non-license offences are however difficult to realise as currently it is almost impossible to sanction one individual for another individual's loss of water property rights.

9. The present water institutional structure: strengths and challenges in South Africa

As the case studies in Section 8 demonstrate, property rights influence the claims that users can make on the benefits of the ecosystem services arising from water systems. Macintosh and Denniss (2004) noted however, that the *creation of more certain property rights in water will not necessarily deliver an effective system of property rights, or an efficient market in the resources and processes that are essential to the health of the environment or inland water dependent ecosystems.* The critical linkages between institutional components (e.g. between property-rights system and conflict-resolution capabilities or between water technology and information application, and enforcement and monitoring capabilities of water administrations) is perhaps more critical. Therefore, international policy prescriptions have moved from 'getting the prices right' to 'getting the property rights right,' to focussing on 'getting institutions right' (Williamson, 1994; Sileth and Dinar, 2004).

Below we use the seven principles of an effective property rights regime to review the current water institution enforcing compliance to the public property rights regime in South Africa. This water institution in South Africa is the sum of the national, provincial and local water institutional environment and institutional arrangements.

Water Institutional Environment

The water institutional environment is defined by water-related (1) policy and (2) laws. Of the seven principles required for an enduring resource management institution, the boundaries principle (principle 1) is addressed by the water institutional environment. If the boundaries of water property rights are not clearly defined by the management institution or are costly to enforce, resource users, according to Anderies et al. (2004), will be incentivised to overharvest or shirk maintenance requirements of the resource. The institution enforcing the water property rights regime in South Africa thus needs to be able to monitor and enforced these water property rights to ensure they are abided by and acknowledge by all resource users in the country.

Policy defining the South African Water Institution

A water policy should provide the "Statement of Intent" or "Commitment" to water and should describe the principles or rules that guide water decisions.

With the new democracy in South Africa, the water sector was reformed, commencing in 1995 with the Water Law Review process (DWAF, 1995, 1997). The core objective of the water law review process was to develop a framework to ensure that water use rights could be transferred from one user to another, to address national interest and support the broad transformation goals of government (de Coning and Sherwell, 2004).

Prior to this water sector reform, water rights were linked to property rights. A landowner was thus the owner of all water arising on or beneath the surface of their land. This ownership rights entitled them to use the water, within the limits of the law, as they wished, and to grant water servitudes to non-owners where appropriate. Hence water could be owned privately and was managed through a private property regime.

In addition, as demonstrated in the Pongola case study, water use and ecosystem services on communal land were managed through a common property rights regime. This common property rights regime was similar to private property right regime in that it was possible to exclude others from use and decision-making. This was demonstrated by the case study that showed that water property rights in the pre-impoundment era were limited to individuals subsisting on the floodplain.

Present water resource policy in South Africa stems from the Constitution and from the White Paper on a National Water Policy for South Africa (DWAF, 1997). This new water dispensation, introduced in 1997 and 1998, did away with private control of water in favour of state management. Water resource management thus changed from one of private and common property right regimes to one of a public property rights regime. This public property rights regime is demonstrated by the Olifants case study. The boundaries of the resource system and the individuals that have usufruct water use rights are underpinned by the Constitution of the country and by the 28 principles for public water property rights regime in South Africa (see Appendix 1 for the principles which relate to water property rights in South Africa).

Ecosystem services from aquatic ecosystem do not only fall under the ambit of water policy in South Africa, but also under the environmental policies that govern conservation and sustainable use of natural resources. Resource use and management in South Africa stem from the White Paper of Environmental Management (DEAT, 1997). The White Paper recognised environmental property right as the quantity, quality and reliability of water required to maintain ecological functions, so that the human use of water does not individually or cumulatively compromise the long term sustainability of aquatic and associated ecosystems. The other water property rights principles introduced by the White Paper relate to some of the instruments of the public property rights regime in South Africa, namely (1) the application of risk averse and cautious approaches in situations of limited knowledge (precautionary principles) and (2) those responsible for environmental damage must pay the repair costs both to the environment and human health, and the costs of preventive measures to reduce or prevent further pollution and environmental damage (polluter pays principle) (DEAT, 1997).

Water Law defining the South Africa Water Institution

Laws provide the overall framework of the water institution. According to Meinzen-Dick (2009) the *starting point for analysis of property rights is to identify the legal frameworks that apply*. The essence of any property rights regime, be it a common, private or public regime, is the authority system that can assure that the expectations of rights holders are met (Bromley, 1992). The ability of an authority to enforce the compliance of rights holders is a necessary condition for a viable property rights regime. Common, private and state property rights regimes would become ‘open

access' systems if the authority system were not in place (Bromley, 1992). It is thus, not the property rights regime that ensures compliance and "wise" use of water resource in South Africa, but rather the authority system that governs the property rights regime.

In the era prior to the current NWA, private water property rights regimes of landowners were enforced by the property landowner using the coercive (legal) power of the state to assure compliance and to prevent intrusion by non-owners. As the Pongola case study shows, common property rights regime were also in place and compliance within these regimes was assured by the traditional authority. System boundaries and water use rules were determined and managed by the authority. However, two problems of authority arose before the introduction of the NWA. First, in the Post-impoundment Phase 1 there was a breakdown in compliance with user rules (when, who and how much ecosystem services may be used) due to the increase competition for decreasing ecosystem services resulting from changes in the flooding regime of the river. Secondly, in the Post-impounded Phase 2 of the case study the state disregarded the interests of these downstream water users that were very dependent upon common pool resources.

Compliance with the present public property rights regime in South Africa, through graduated sanction, is applied by statutory and common law.

Statutory Law

These are laws passed by legislature and government of a country and those, which have been accepted by the society. In South Africa, the public water rights regime is governed by the state. The National Water Act (1998) legitimises *National Government's overall responsibility for and authority over the nation's water resources and their use, including the equitable allocation of water for beneficial use, the redistribution of water, and international water matters* (DWAF, 1998). The Act contains rules regarding the manner in which water resource (surface and ground water) should be protected, used, developed, conserved, managed and controlled in an integrated manner (de la Harpe and Potter, undated). Water is allocated only as use rights by making provision for authorisations of water use through:

- Schedule 1 use: use of relatively small quantity of water, primarily for domestic purposes;
- General authorisations: allows limited water use of larger volumes with some potential for negative impacts on the water resource;
- Water use licenses (WUL): control all other water uses. Any water use that exceeds a Schedule 1 use, or that exceeds the limits imposed under general authorisations, must be authorised by a licence. Rights under a licence may not constitute property at law, but rather merely a person right. Hence, in South Africa the rights under a water licence may merely make 'an act lawful which without it would be unlawful'.

The WUL in South Africa have the following characteristics (DWAF, 2004):

- They are specific to the user to whom they are issued and to a particular property or area.

- They are specific to the use or uses for which they are issued.
- They are valid for a specified time period, which may not exceed 40 years.
- A range of conditions can be attached to the license (conditions can refer for example to the volumes and timing of abstractions, the volume that may be stored, etc.).
- They must be reviewed by the responsible authority at least every five years.

Water use licenses in South Africa provide clear boundaries to the water property rights, which these users have claim to. However, the difficulty in a public property rights regime is to clarify water property rights of Schedule 1 users as demonstrated by the Pongola case study, of General Authorisation users and of 'secondary users' as demonstrated by the Olifants case study.

Meinzen-Dick (2009) refers to secondary rights as all aquatic ecosystem services to which a water user has claim. Unless these secondary property rights, held by various claimants, are taken into account, public property rights regimes may be undermined and these water users may lose the right to claim the benefits, i.e. firewood, fish, medicinal plants or grazing from aquatic ecosystems. If these secondary property rights are not recognised, livelihoods, especially for people living on the margins of survival, can be eroded (Meinzen-Dick, 2009). As demonstrated by the Olifants case study, the South Africa National Water Act is perhaps not as adept at dealing with local variations in secondary ecosystem services property right claims of water users. Because these secondary rights are often used for subsistence by the poor they are often undervalued, and hence overlooked when gains from land market development are cited (Meinzen-Dick, 2009). A water licence to some extent does address these water property rights through explicit consideration of beneficial use that it defines as "…conferring a benefit on the whole population, not just the user". Beneficial use is taken into account when licences are reviewed (Nieuwoudt, 2000) although there appears to be little transparency around what this means in practice. It is however, extremely complex to enforce secondary water property rights in South Africa, even those recognised by Schedule 1 and General Authorisation. Secondary rights to ecosystem services such as grazing in wetlands; health benefits from clean water, and tourism based on water resources are less explicitly defined in the Act. This makes it particularly difficult to control, manage and enforce these property rights.

The water licensing component of compliance with the public property right regime in the country also has its own difficulties, including (Speelman et al., 2010a):

1. Duration: represent the period of the rights. In terms of duration, water license in South Africa have a specified duration of maximum 40 years. However, this license has to be evaluated at least every five years, at which time the conditions attached to licenses may change. This five-yearly revision has been shown to clearly influence investment decisions of farmers (Nieuwoudt and Armitage, 2004; Backeberg, 2006; Speelman et al., 2010b). Since the conditions attached to licenses may change at each review (for instance the volumes and timing of abstractions, the volume that may be stored, etc.), Nieuwoudt and Armitage (2004) found that farmers had the impression that their licenses were insecure.
2. Exclusivity: describes the extent to which others can be prevented from accessing the item/ resource or enjoying the benefits that flow from it. This element of property right specification is most difficult to fully assign (Dragun *et al*., 1986 in Pagan and Crase, 2005) due to the common pool resource attributes of water resources and many of the non-extractive uses of water resource (e.g. uncongested recreational uses, riverine aesthetics, non-consumptive riverine

ecological processes) are public goods. It would be unrealistic to place restriction, through water licensing, on the use of water for these purposes or to charge people for water used in supplying these services (i.e. specification of private rights is inefficient). Consequently, while the National Water Act is fairly effective in specifying water rights for extractive and discharge water users (to ensure that all benefits and costs of their water use accrues to them), it is less clear in specifying water property rights in a way that will not undermine non-extractive public good uses of water.

3. Flexibility: defines the extent to which the right permits an alteration to the pattern of use transferability: encapsulates the ease with which a right may be passed to others. In South African National Water Act, provisions are made regarding transferability of rights of use. It is stated that permanent transfers, constituting trade in water licenses, will be subject to all requirements for license applications. This means that the CMA has to approve every transfer (Speelman et al., 2010c). Legislation is however, not very clear about the timing of the introduction of trade in water licenses (Perret, 2002; Backeberg, 2006).

Common Law

Common law evolves with new decisions made by judges in courts. The South African courts and the Water Tribunal[7] play a primary role in the regulation of the public water rights regime in the country (Schreiner et al., 2011a). It is through these institutions that water users and affected parties have legal recourse to take action against water decisions and activities of the public sector (Schreiner et al., 2011a).

Aretino *et al.* (2001) suggests that two broad choices could be made when dealing with market failure concerning water rights and ecosystem services (water property rights), namely; the beneficiary pays principle and polluter (or impacter) pays principle (in Macintosh and Denniss, 2004). The beneficiary pays principle suggests that the individual that benefits from a certain action should pay for the costs of undertaking it (Macintosh and Denniss, 2004). This can occur through two options:

- User pays principle: suggests that everybody who obtains a direct benefit from an action should pay some of the costs of the action
- Beneficiary compensates or community pays principle: anybody who obtains an indirect benefit from an action should contribute to the costs of an action.

The National Water Act introduces this concept in the public property rights regime through the 'user pays' principles, i.e. water pricing. In contrast, the polluter pays principle suggests that a person taking an action should be required to pay the full costs associated with the action, including the costs of environmental degradation (Macintosh and Denniss, 2004). This principle is introduced

[7] The Water Tribunal, stemming from the National Water Act, hears appeals against certain decisions made by a responsible authority, catchment management agency or water management institution under this Act. The Tribunal is an independent body, whose members are appointed through an independent selection process, and which may conduct hearings throughout the Republic. A person may appeal to a High Court against a decision of the Tribunal on a question of law (DWAF, 1998).

to the public water property rights regime in South Africa through both the National Water Act and the National Environmental Management Act (DWAF, 1998; DEAT, 1998). This principle recognises this environmental right (including water right) through delineating a consequence to ignoring the right. Interestingly, NEMA does not confine the polluter pays principle to contravention of environmental right but also to the *adverse health effects* arising from the pollution or from the damage to the environment. The Act therefore recognises the property right associated with the environmental right, reflected through the claim to the health benefits from unpolluted water/environment. However, the Act does not clearly recognise other environmental (water) property rights (ecosystem services) such as stock watering, grazing land; tourism which may be lost/damaged as a result of damage to the environment or directly from the pollutant. The Olifants case study clearly demonstrates the consequence of not recognising secondary property rights and not implementing a legislated and policy-related gradation sanction instrument to enforce public property rights regimes in South Africa.

The issue of liability pertaining to pollution of or harm to the environment is a critical area in law as environmental liability is not adequately addressed in terms of South African law (Nabileyo, 2009). One of the difficulties of customary law is that the burden of proof of loss/damage to these water property rights would be on the plaintiff. The EU has developed an environmental liability White Paper which has taken the slightly different stance on this issue with the burden of proof concerning fault or causation in favour of the plaintiff (i.e. the defendant needs to establish the fact concerning the causal link (or absence of it) between an activity carried out by the defendant and the damage) (EU, 2004). The public water property rights regime would benefit from a similar environmental liability policy.

Regulations

These are rules and administrative codes issued by governmental agencies at all levels. The water services sector of the water institution has a number of regulations, which provide the rules, and administrative codes of the public water property rights regime. Schreiner et al. (2011a) distinguish between the formal regulation of government, and the more informal regulations applied by the media, community groups, and consumer watchdogs. Informal regulatory mechanisms have the power to regulate human behaviours and link the formal regulatory system to the informal system.

Guasch and Hahn's (1997) common classification scheme for formal regulation consists of three components: economic, social and process regulation. Economic water regulations would be those that place restrictions on water prices, water quantity, water access and water exclusion conditions. Social water regulation would include a range of other sector regulation, such as environment, public health and safety, which have an impact on the water sector. Finally, water process regulation relates to government management of the water sector.

Formal regulations of water property rights in South Africa are particularly deficient, and those, which are in place, seems to fall within the category of economic water regulation. Regulations are available for the:

- Taking and storage of water (DWA, 2012)
- Use of water for recreational purposes (DWAF, 2006)
- Use of water for mining (DWAF, 1999) and
- Establishment of a water resource classification system (DWA, 2010)

Water process regulations which guide water property rights regime issues such as licensing process, polluter pays principles, compliance enforcement protocols are not readily available (if in place), resulting in these processes being perceived as opaque. This may contribute to the lack of recognition of secondary water property rights in these processes.

Water Institutional Arrangement in South Africa

The South African Water institutional arrangements are discussed at a national, provincial and local level based on the key components, which make up an institutional arrangement:

1. Instruments including:
    a. strategies and operational plans and procedures;
    b. funding and finance;
    c. accountability and transparency;
    d. incentives; and
    e. information, research and technology.
2. Formal Organisation

Instruments of the Water Institution

This component of the water institution speaks directly to the proportional equivalence between benefits and cost (Principle 2); collective-choice arrangements (Principle 3); monitoring (Principle 4) and graduated sanction (Principle 5) required for robust institutions to enforce compliance to the public water property rights regime in South Africa. Many of the water instruments applicable in the public water property rights regime relate to providing the rules which govern the regime, i.e. implementation rules to meet policy, legislation and regulatory requirements.

South Africa has a National Water Resource Management Strategy (NWRMS) (DWAF, 2004), which introduces the plan and instruments for water management in South Africa. These water management instruments include:

- Recognizing the water property rights of the aquatic ecosystems through the introduction of the water resource protection instruments of Resource-Directed Measures (RDM) and Source-Directed Controls. RDM focus on protecting the quality (i.e. water quantity and quality; riparian habitats and aquatic biota) of the water resource, while Source-Directed Controls place constraints on the use (i.e. water use activities) of

water resources to achieve the desired level of protection. Balancing the protection and use of water property requires the collective application of resource-directed measures and source-directed controls in respect of water quantity and quality, as well as the biological and physical dimensions of the resource. However, due to the gap in policy and legislation, these instruments do not explicitly require consideration of all water property rights and specifically those of secondary property rights (i.e. water quality of downstream users, etc.). These instruments are particularly relevant in the Olifants case study, as the NWRMS recognises the many of the ecosystem benefits that are claimed from wetlands and acknowledges the need to protect wetlands. For these instruments to be effective in the water property rights regime of the country, the secondary property rights should be included as a consideration when introducing these water resource protection instruments.

- The NWRMS also expands on water use rights and thus the allocation of water property rights in South Africa. However, as both case studies show, the balancing of water requirements against water availability often does not consider the individual's water requirements against the collective resource availability. The water requirements of a single user (a mine) or a specific sector (commercial agriculture) are met without considering the cumulative effects on the resource. In cases like these the water property rights regimes may fail the 'other' users of the water property such as the local communities in the one case and the downstream users in the other.

Another key strategy in the water institution of South Africa is the Waste Discharge Strategy (WDS) which, through a pricing strategy, promotes the preservation of resource quality via a polluter pays principle for waste discharge (DWAF, 2007). This waste discharge pricing system has not yet been implemented and it appears unlikely that it will occur in the short-term. This instrument recognises water quality property rights of users of the common pool resources and provides sanction for individuals who interfere with these rights. However, it is still unclear which water property rights will be recognised by this strategy when implemented. According to Schreiner et al., (2011b), implementation of the waste discharge charging system could possibly require considerable human resource commitment from the DWA, which may detract from other key priorities. This instrument could go a long way to addressing some of the issue in the Olifants case study, where recognition of downstream water quality property rights of users may result in sanction of upstream mining activities.

Funding and revenue instruments within the water institution r*elate to adequate mechanisms in place to source adequate funding.* The NWA and NWRMS introduce the water pricing instruments for management of the public water property rights regime in South Africa. The Minister is responsible to establish a pricing strategy for any water use described in section 21 of the Act. These water use charges include (1) funding of water resource management, water resource protection and water conservation (2) funding of water resource development and use of waterworks and (3) achieving the equitable and efficient allocation of water through economic incentives to encourage more efficient use of water, water conservation and a shift from lower to higher value uses. Relating these back to the design principles of a robust institution to govern water resource, this instrument related to principle 2 (proportion equivalence between benefits and cost) where the rules related to the actual cost of the claim to water property use are articulated by

these pricing instruments. However, the costs of water use property rights does not necessarily address the full cost associated with water resource use, i.e. environmental cost of loss of water property rights.

The accountability and transparency instruments of the water institution in South Africa can be related to decision-making, monitoring and conflict resolution mechanism (Principles 3; 4 and 6 of the design principles). A number of reports have indicated the high level of corruption in the provision of water infrastructure and in water flows, and therefore in who has a claim to water property (OECD, 2008; Schreiner et al., 2011b). This includes corruption pertaining to the regulation of water use and the authorisation of and enforcement of water entitlements. The strongest weapon against corruption is institutional transparency to ensure collective decision-making and the ability to hold the water institutions accountable for water property rights decision.

Transparency and accountability demands that a number of elements should be present in the institutional domain, including access to information and bodies to which the water resources regulator(s) must account. In the current South African institution, accountability for water resource decision is to the Tribunal, the courts and to Parliament. However, Schreiner et al. (2011b) indicate that due to the significant information asymmetry in the water institution, related to direct and secondary property rights, it is questionable to what extent this accountability is exercised effectively.

Formal organisations

Formal water organisations in South Africa are those entities designed to maximise wealth, income, or other objectives of the water institution. Schreiner et al. (2009) highlights that there is some confusion in South Africa related to organizational arrangements of the water institution in relation to DWA, CMAs and WUAs.

The intent of the South Africa water institution is to devolve decision-making responsibility to the lowest level of management. This supports Principle 6 which requires a robust water institution, namely users and officials having a rapid, low-cost arena to resolve conflicts at a local level. The NWA makes provision to delegate water resource management to a regional or catchment level. Catchment Management Agencies (CMAs) are responsible for water resource planning at the catchment level and most water resources management activities in these areas, such as the licensing of water use and discharges, monitoring abstractions and discharges, collecting abstraction and discharge fees, monitoring water quality, and overseeing land-use activities as this affects water management (DWAF, 1998). Both the case studies demonstrate the need for decision-making and water property rights regimes to operate at the lowest management level possible. If property rights decisions are made at these levels, conflicts can be cost-effectively, efficiently and transparently addressed. The most effective manner in which to manage the public property water rights regime in South Africa would be at the WUA level. Unfortunately, WUAs operate at a restricted localised level and are not statutorily linked to the water institution in South Africa (Uys, 2006). They are ad hoc associations which promote individual water users' interests, and whose

representative participation in water resources management is restricted to local levels and acting for its members at the CMA.

Schreiner et al. (2011b) also indicated that the issue of independence of water organizations within the water institution is much debated. A strong water institution requires some independence in decision making in South Africa. This would relate to the concept of an 'independent regulator'; the degree of independence of state agencies and the separation of player and referee organization (Schreiner et al., 2011b). This concept also links to the design principle 3 of collective-choice arrangement where individuals with water property rights have some opportunity in defining the rules which govern the water property rights regime in the area. Technical regulation of water in South Africa is a function of government, thus the independence of the regulatory organization is limited. Independence is not only an issue for the regulator in South Africa as some functions are delegated to the CMAs. Delegated functions do not occur without establishing some degree of independence for that body.

Schreiner et al. (2009) also indicate that the technical capability required for a robust water institution is sorely lacking in South Africa.

Finally, research has shown that there is serious frustration with the lack of customer focus of the water sector. Nemeroff (2005) characterises this tendency as follows:

When government has not met expectations, citizens have responded by blaming it and demanding that it perform better. Government officials in many cases have responded to this by disengaging from citizen groups or shifting blame, leading to increased frustration among citizens who have felt even more out of touch with government. The result is a self-reinforcing cycle that leads to poorer delivery, because officials are even less willing to communicate with the public or co-operate with each other. In addition, it has increased frustration within a public that sees long-standing problems going unsolved. Finally it has led to disregard for the law, and in some cases violent protests by people rebelling against a system they do not feel respects them.

This failure of government and other sectors to recognise community water property rights to the floodplains in the Pongola case study clearly illustrate this problem with the community becoming increasing frustrated and discontent with the water property rights regime in the post-impoundment phases. There is little clarity of the processes and procedures to follow when one is discontent with water property rights issues. Even legal recourse can be complicated and confusing, and currently is only an option for well-resourced industries and commercial farmers.

Water Allocation and property rights in South Africa

Water use authorisation and allocation, if applied correctly, is a form of acknowledging water property rights as well as an instrument for regulating use. Water property rights in South Africa are the rights of users of water resources in the country to claim the benefit arising from aquatic ecosystem services provided by water resources. Hence, to assign these water property rights, the South African water allocation and authorisation process needs to recognise these aquatic ecosystem services in the decision-making process.

Section 22 of the NWA defines the permissible water uses which include:

Schedule 1 water use: This is, according the Water Act, the allocation of small quantities of water for use for domestic purposes (including rainwater harvesting, non-commercial gardening, livestock watering and discharging wastewater into a system which is authorised to undertake the purification, treatment or disposal of waste or water containing waste); for use in emergency situations and for recreational purposes (DWA, 2004). Users must have lawful access to the resource in order to exercise the Schedule 1 entitlement. Although the Water Act does not specify numerical limits for allocation of water for Schedule 1 uses, these water uses are subject to any restrictions or prohibitions imposed by other relevant laws, ordinances, bylaws and regulations. The National Water Resource Strategy states that *requirements for water for small-scale uses in rural areas will be quantified during compulsory licensing, and the Department will investigate ways of making secure and cost effective supplies of water available without placing unnecessary administrative burdens on the users* (DWAF, 2004).

General Authorisation (GA) water use: General Authorisation water uses according the Water Act is the conditionally authorised allocation of larger (than Schedule 1 use) volumes of water for a specific type of water use or category of water user (DWAF, 2004). In some water resource situations these users may be required to register their water use with the management authority. However, this is not the norm and even when General Authorisations registration is required by the water authority some GA water uses may be exempt from the registration process. General Authorisations thus do not need a licence and will generally not require registration with the water authority. Limits are placed, through Gazette Regulations, on water use which qualifies for GA, based generally on the nature of the use and the capacity of the resource to accommodate the use without significant degradation (DWAF, 2004). General authorisations apply for a limited time period (usually 3-5 years) and may be reviewed and amended during this time (DWAF, 2004).

The NWA recognises 11 water uses, (Section of Water Act shown in brackets) which are allocated water using General Authorisation (or water licenses) including:

- The taking (21a) and storage (21b) of water from a water resource (Draft Regulation: 288 of 2012).
- Impeding or diverting the flow of water in a watercourse (c) and altering the bed, banks, course or characteristics of a watercourse (i) (Regulations: Gov Gazette No. 32805 of 2009).
- Engaging in a controlled activity (21e) such as irrigation of any land with waste or water containing waste generated by any industrial activity or by a waterworks
- The discharge of waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit, and the disposing in any manner, of water that contains waste from, or which has been heated in, any industrial or power generation process.
- Disposing of waste in a manner that may detrimentally impact a water resource.
- Altering the bed, banks, course or characteristics of a watercourse.
- Removing, discharging or disposing of water found underground.
- Commercial afforestation activities as a stream flow reduction activity
- Recreational use (Draft Regulations: Gov. Gazette No. 29413 of 2006).

According to a draft of the second National Water Resource Strategy DWA will *make greater use of General Authorisations to reduce the burden of license applications on the Department. In order to support the processing of licence applications (DWA, 2012)*

Licensed Water Use (WUL): Any water use that is detailed is a recognised water use in Section 21 of the NWA and which exceeds the GA regulations (see bullets above) must apply for a WUL. Licences give existing and prospective water users authorisation to use water, or to access water resources for beneficial purposes. Licences will be applied for individually by new users, by existing users who wish to increase or change their use and by existing users who wish to continue their use in terms of an existing limited-duration authorisation (DWAF, 2004). A person who wishes to use water must apply to a responsibility authority, either the DWA or a CMA. A detailed procedure for individual licence applications has been established, which begins with discussions with the applicant about the proposed use and culminates in a decision to issue a licence or to refuse the application.

The process of compulsory licensing comprises:

- Verification of existing water use.
- Determination of water resource availability.
- Classification of the water resource.
- Setting of resource quality objectives.
- Determination of the Reserve.
- Development of components of the catchment management strategy.
- Calling for and evaluation of licence applications.
- Preparation of water allocation schedules and undertaking public consultation on them.
- Announcing water use allocations in the *Government Gazette.*
- Issuing licences.

There is currently a backlog of WUL which DWA aims to clear by 2016 and will put in place streamlined processes to ensure that licence applications are dealt with in a reasonable time. According to the draft of the second National Water Resource Strategy*over the next 3 years, DWA will delegate water use licensing to at least four CMAs as they are progressively established and develop capacity.*

Recommendations

The NWA requires that water in South Africa be *protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons and in accordance with its constitutional mandate* for the benefit of all persons (South Africa, 1998). The allocation of water by government, on behalf of the public of South Africa, is underpinned by this principle.

It is not the water law or policy that requires adaptation and change to ensure equitable, efficient and sustainable allocation of water use, but rather the manner in which these polices and laws are interpreted in the implementation.

An important challenge of IWRM in South Africa is to balance water allocation between water users. Decision of who is authorised, through GA or WUL, to use or access water is determined by:

- the need to redress the results of past racial and gender discrimination;
- efficient and beneficial use of water in the public interest;
- the socioeconomic impact

a) Water Use Authorisation and Benefit Realisation

Many of the decision on allocations in the country are focussed on the efficient and beneficial use of the water. Much of this beneficial use is determined by the economic benefit of the water, i.e. use of the water to produce crops and for industrial production. Decisions on water allocation to these economic and/or politically powerful users are based on a well-developed system of WUL application, where users quantify and justify their water needs.

However, this is not the case for the beneficiaries of the ecosystem services derived from aquatic ecosystem, particularly in the case of Schedule 1 and GA water users. In the rural areas of the country, the livelihoods of people often depend directly on the provision of aquatic ecosystem services (Korsgaard and Schou, 2010). In addition, the ecosystem service from which all South Africans benefit are often not recognised in the water allocation process in the country. The water allocation process in the country would thus benefit from integrating ecosystem service thinking, analysis and approaches into the process.

The current water classification procedure is a positive and proactive move towards this integration of ecosystem service thinking into the water resource management procedure. The water authorisation decision-making process needs to move to a similar process of decision-making which recognises the suite of aquatic ecosystem services from which individuals benefit:

1. If the aquatic ecosystem services provided to these users are recognised, quantified and planned for in the water allocation process, the water property rights of these users will be recognised.
2. If the impacts, both direct and indirect, of authorised water use on the immediate and downstream aquatic ecosystem services from which individuals benefit are noted and included in the water allocation process, the water allocation and authorisation process will be more equitable (i.e. considering all aquatic ecosystem services derived by beneficiaries) and will not only focus on productive, economic benefits of water use.

There is an urgent need for DWA and CMAs to identify all the possible benefits provided by aquatic ecosystem services within water management areas, and to apply the economic value of these in the water allocation and authorisation decision-making process in South Africa. This is particularly important in catchments where livelihoods of poor individuals are directly dependent on these aquatic ecosystem services.

b) Water Authorisation and Schedule 1/GA water use

The National Water Act indicates in Section 27 (1) that when considering the issuing a general authorisation or license a water management authority must take into account (a) *existing lawful water uses* which would include the Reserve (ecological and human); (b) *the need to redress the*

results of past racial and gender discrimination; and (c) efficient and beneficial use of water in the public interest.

Since Schedule 1 water uses and users are directly and implicitly related to the ecosystem service provided by the water resource, the right to this common-pool resource needs to be considered before allocation of water resource to the General Authorisation and WUL users. Most important is that the water property rights of these users need to be considered in water allocation decisions. These Schedule 1 uses need to not only consider the direct use (benefit) of the common-pool resource but also other ecosystem services such as watering of livestock; food production as part of survival strategies; survival strategies during disasters, i.e. wetland use during drought, etc. Thus, to ensure equitable allocation of this common-pool resource, Schedule 1 water uses also need to be acknowledge and recognised in the water allocation process, including the aquatic ecosystem services which these Schedule 1 users benefit from.

Recognising aquatic ecosystem services derived by Schedule 1 and GA water users is a good tool for benefit realisation in the water allocation and authorisation process. These water resource benefits need to be influence the water use decision-making process and to be actively managed and monitored.

c) Water Use Authorisation and Mitigation

Identifying and quantifying all the possible services provided by aquatic ecosystem services within water management areas, and making decision on water authorisation and allocation based on these, can assist with the mitigation of direct and indirect impacts linked to a WUL. For example, if a mine is granted a WUL, impacts on the water resource caused by pollution of this water use can be minimised by attaching conditions to the WUL. There is thus scope for DWA and CMA to minimise and mitigate negative impacts of a particular water use on water resources and aquatic ecosystem services derived from these.

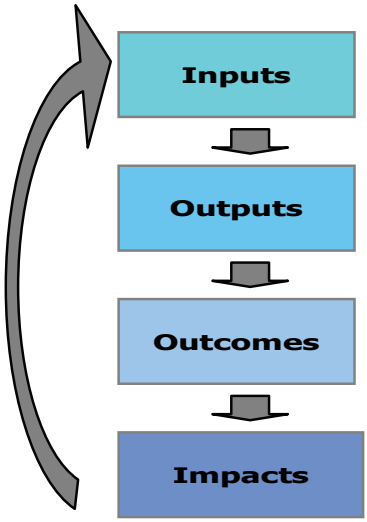
d) Water Use Authorisation and Water User Associations

While recognition of the aquatic ecosystem services from which water users benefit in the water authorisation and allocation procedure in South Africa can help identify trade-offs, this process needs to be supported by a process of negotiating these trade-offs. The WUAs in South Africa are the ideal organisation at which these trade-offs can be negotiated. Water authorisation and allocation must be placed in the broader decision-making context of a collaborative approach to imposing water management decisions.

Representation on a WUA is currently determined by whether an individual has a WUL and the extent of this license. The WUA thus has strong representation of WUL holders, but little to no representation by the aquatic ecosystem service derived by Schedule 1 and other users or by GA water users. These water uses and users need to have equal representation and recognition within WUA as WUL users do. DWA should look at the manner in which these water user groups can be included into WUA to ensure equity within the water allocation and authorisation process and decision-making.

e) Water Use Authorisation and Monitoring and Evaluation

Once water property rights have been recognised and included in the water allocation and authorisation process in South Africa, monitoring and evaluation (M&E) is required. In support of national M&E imperatives, this M&E system should be a p**erformance or result-based M&E** system that focusses on monitoring the progress of the water institution in address the equity, efficiency and sustainability principles of the NWA. Results-based M&E is a powerful management tool that can be used to help decision-makers track progress and demonstrate the impact of a policy, programme, project or plan. Where traditional M&E frameworks are designed to answer the 'did we do it question', the results-based framework is designed to address the "so what if we did it" question of implementing a programme. Results-base monitoring usually makes use of four types of indicators; input, output, outcome and impact indicators (see Figure 9.1).



Input:	indicators are typically resource-related. Indicators show what resource "inputs" the water sector is providing, i.e. financial inputs;
Output:	indicators refer to the 'products' of inputs, i.e. the immediate or short-term results of programme activities. For example, the number of WUL approved, number of CMAs and WUA
Outcomes:	indicators refer to the intended or achieved short-term and medium-term effects of an intervention's outputs, i.e. increasing equity in water allocations;
Impact:	indicators monitor the longer-term or more pervasive results of a policy, programme, project or plan, i.e. increased water property rights; sustainable water use. Impact indicators are generally difficult to measure.

Source: Palmer Development Group (2004)

Figure 9.1 Results-based model of categorising indicators.

Monitoring should not only focus on results, but also on compliance. Compliance M&E is the collecting and analysing of information on the compliance status of the regulated community, i.e. water authorisation and allocation which recognise water property rights. Compliance M&E is one of the most important elements of an enforcement program and is essential to:

- Detect and correct violations.
- Provide evidence to support enforcement actions.
- Evaluate program progress by establishing compliance status.

10. Recommendations for the South Africa water institution

This chapter seeks to summarise the various "gaps" identified in this deliverable and which have been thoroughly illustrated herein. Based on this report, the requirements for a robust institution to enforcement compliance to the water property rights regime in South Africa will require addressing of the following gaps:

- The water institution in South Arica is presently failing due, in part, to poorly defined and applied water property rights regime;
- Water property rights are poorly defined in the water institutional environment and thus within the water institution as a whole. For the present property rights regime to function efficiently, water property rights need to be included in policy, legislation and regulations. This will ensure that an individual's right to claim an aquatic ecosystem service will be clearly defined in the decision-making and enforcement environment (Principle 1 – clearly defined boundaries);
- As both case studies demonstrated, a common property rights regime needs to be considered and recognised at a local level, which will support the national public property rights regime. Implementation of a local level common property rights regime, through the strengthening of the WUA role in the water institution, will devolve the decision-making to the users effective by the rules (Principle 3 – collective-choice arrangements). It will also ensure that decisions made are based on sound local knowledge of the costs and benefits associated with use of a unit of the water resource (Principle 2 – proportional equivalence between benefits and costs). The WUA can also act in a local monitoring role (Principle 4 – monitoring) as this association would be the most knowledgeable of resource in their area. Modifying the present horizontal public property rights regime in South Africa to include a common property rights regime at a local level will ensure both the horizontal and vertical decision-making that was demonstrated by the Pongola case study.
- The present understanding of the South African water institution does not necessary reflect international experience. This water institution needs to be reviewed within present international trends and developments in water institutions and water property rights regimes.
- Transparency in decision-making and accountability in the South African water institution is weak. This could be strengthened through improvement in the property rights regimes in the country, especially through the introduction of standardise water instruments in a consistent manner. As the Olifants case study demonstrated, implementation of graduated sanction instruments in a consistent and transparent manner may go a long way to enforcing non-compliance to the water property rights regime in the country.

Based on this analysis of water property rights issues within the South Africa water institution we suggest that:

- Property rights as currently understood and administered, are not sufficiently comprehensive to achieve the intentions of environmental justice ("linking social justice with concerns about environmental abuse" Soltau, 1999) as required by policy and legislation.
- Because Water User Associations operate at the interface between the formal institutions of government and the informal institutions established by users, they offer the best prospect for both elucidating how more comprehensive property rights regimes could emerge and for testing implementation.
- It would be prudent to adopt an action research approach to gaining further insight into how to property rights should be applied to better enable attainment of environmental justice.

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Appendix 1: Paper submitted to Water SA for publication (Deliverable 4)

Managing property rights regime shifts in the provision of freshwater ecosystem services on the Pongola River floodplain

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Abstract

This paper proposes a property rights perspective for interpreting and managing regime shifts in the provision of freshwater ecosystem services. Shifts of regimes happen when changes in internal processes or when external shocks trigger a completely different system behaviour. Persistence in regimes is a function of the time period over which shifts take place. While regime shifts in ecosystems have been extensively studied in the natural sciences given their perceived importance in influencing the flow of ecosystem services, there has not been a corresponding accumulation of knowledge about regime shifts as they relate to the social dimension of ecosystem services. We draw on the Pongola River floodplain to illustrate the central role of property rights in mediating regime shifts in the provision of freshwater ecosystem services. The case study provides insights into the consequences of failing to recognise, establish and enforce bundles of rights in the management of regime shifts. A major thrust of the case study is that the nature and context of property rights are important in determining the outcomes of regime shifts and ultimately governance.

Keywords: property rights, regime shifts, freshwater ecosystems, governance, common pool resources

Introduction

There are many types of freshwater ecosystems such as wetlands, rivers and lakes which all deliver multiple ecosystem services in proportions that are unique and variable over time and space. Changes in the provision of freshwater ecosystem services are usually attributed to reorganizations in ecosystem structure, functions and feedbacks (Crépin et al., 2012). For example, the persistent presence of freshwater which characterises these ecosystems is often viewed as the key – if not the only – determinant of the nature, substance and quantity of the benefits that people derive from freshwater ecosystem services. This perspective essentially entails that the management of ecological and hydrological elements is decisive in the provision of freshwater ecosystem services. While this might be valid and legitimate to some extent and in some contexts, this perspective overlooks some fundamental aspects of human organization which are responsible for the provision of many nature-based benefits that are used and enjoyed by people. For instance, given that every human use has implications for the supply of freshwater ecosystem services, the perspective ignores the fact that progress towards sustainability largely depends on how effectively relationships among users are governed. Such a misconception usually results in many of the benefits and beneficiaries of freshwater ecosystem services going largely unrecognised and unacknowledged.

Increasingly, there has been a steady build-up of interdisciplinary knowledge about the range of societal arrangements required for delivering ecosystem services. For instance, the works of Ostrom and her colleagues at the Workshop in Political Theory and Policy Analysis have extensively contributed to building knowledge about how different forms of societal arrangements provide the means through which ecosystem services are 'structured' and 'processed' once they enter the social system (Ostrom, 2005). Elsewhere, interdisciplinary scientists such as Costanza (2008) and Fisher and Turner (2008) have been calling for explicit attention to the different forms of arrangements that underpin the sets of shared norms, rules, and organizational mechanisms for regulating access to and use of ecosystem services. Similarly, the literature on ecosystem services has started to seriously and explicitly incorporate analyses of societal arrangements related to the provision of ecosystem services (Farley and Costanza, 2010; Vatn, 2010). Research attention to societal arrangements has grown in tandem with efforts to enhance collective action and devolve natural resource management to local communities. Although there is general agreement that these efforts are relevant and vital to the enhancement of sustainability, little attention has been given to the importance of societal arrangements in understanding and managing the dynamic long-term provision of ecosystem services.

The dynamic long-term provision of ecosystem services is usually characterised by regime shifts in the social systems through which resource users influence each others' behaviours to advance individual and common interests (Nkhata et al., 2012). By regime, we refer to a body of fundamental rules and norms that systematises the social system. These rules and norms provide a normative framework that guides the decisions and actions of social actors. They can be institutionalised at different levels of social interaction (global, regional, national and local) to establish particular regime processes and structures. Thus, a regime denotes the characteristic behaviour of a system which is maintained by mutually reinforced processes or feedbacks. It generally refers to the dominant practices, rules and technologies that provide stability and reinforcement to the prevailing social system. Shifts of regimes happen when changes in internal processes or when external shocks trigger a completely different system behaviour (Crépin et al., 2012). Persistence in regimes is a function of the time period over which shifts take place. In simple terms, therefore, regime shifts imply the changes in the structure and function of a system. While regime shifts in ecosystems have been extensively studied in the natural sciences given their perceived importance in influencing the flow of ecosystem services, there has not been a corresponding accumulation of knowledge about regime shifts as they relate to the social dimension of ecosystem services.

In this paper, we propose a property rights perspective for interpreting and managing regime shifts in the provision of freshwater ecosystem services. Property rights embody the claims, entitlements and obligations people hold regarding the use and disposition of the benefits derived from ecosystem services. For example, withdrawing water from a stream, fishing from a river, grazing cattle on a floodplain, using a river as a means of transport, enjoying the scenery of a water body, and dumping waste into a river are all expressions of the exercise of property rights to freshwater ecosystem services. Thus, a property right denotes an enforceable authority that permits an actor to make specific decisions and carry out actions related to a particular stream of benefits. Accordingly, the institutionalization of property rights results in what is called a property rights regime, a body of fundamental rules and norms.

Given the variability of freshwater ecosystem services, property rights regimes can be conceived to be flexible and fluid, shifting by season and year. Property rights regime shifts

occur in tandem with societal expectations and the context in which the associated rights are applied. Property rights regimes can be one of the four types: private, public, common or open-access (Schlager and Ostrom, 1992). However, it is important to note that property rights regimes exist as bundles of distinct rights including the rights of access, withdrawal, management, exclusion and alienation. Such rights cannot exist without recognition by others in the form of relationships involving the individual rights-holder. As such, defining property rights regimes in terms of their dynamics and multiplicity allows for a better understanding of the dynamic long-term provision of ecosystem services. More specifically, it allows for a better appreciation of regime shifts in the allocations systems for ecosystem services.

We draw on the Pongola River floodplain to illustrate the central role of property rights in mediating regime shifts in the provision of freshwater ecosystem services. The case study provides insights into the consequences of failing to recognise, establish and enforce bundles of rights in the management of regime shifts. A major thrust of the case study is that the nature and context of property rights are important in determining the outcomes of regime shifts and ultimately governance. The case study illustrates that property rights influence the nature of governance, which can be categorised into either vertical or horizontal (or unstructured) forms. Vertical governance relates to a governance form that is characterised by power differentials, whereas horizontal governance concerns a category of governance among individuals and groups at the same level (Schedler, 1999; O'Donell, 1994; Collomb et al., 2010). Actors at the same level hold each other accountable from more or less equal power bases. The case study illustrates that there are many combinations of rights that underpin regime shifts and thus the governance of the flow of freshwater ecosystem services. By examining the institutions and actors that have governed the Pongola River floodplain over the years, we are able to illustrate the importance of explicitly defining and categorizing the range of rights in the provision of freshwater ecosystem services.

Managing regime shifts on the Pongola River floodplain

The Pongola River is a catchment of about 7000 km^2 in extent at the eastern extent of South Africa (Fig. 1). It is located on the coastal plain immediately upstream of Mozambique. The river descends steeply from its source at 2200 metres above mean sea level and passes through a narrow gorge between the Lebombo and Ubombo mountains, where the Pongolapoort Dam is now situated. Below the dam the river meanders across a gently sloping floodplain with numerous pans that are dependent upon periodic flooding by the river. The floodplain extends for approximately 50 km in length, varying in width between 0.8 and 4.8 km to the confluence of the Pongola and Usutu Rivers, on the border with Mozambique. The Pongolo River joins the Usuthu River to form the Rio del Maputo that flows into the sea at Maputo in Mozambique. As a dominant feature of the landscape comprising the river, floodplain lakes and temporarily flooded areas, it was a catalyst for human settlement offering access to diverse ecosystem services that sustained livelihoods. For thousands of years, the Thonga people, who have made the floodplain their home, have had rights to benefit from the flooding regime (to cultivate the enriched soils that were exposed once flood waters had receded, to harvest fish, to gather reeds and to use other floodplain resources).

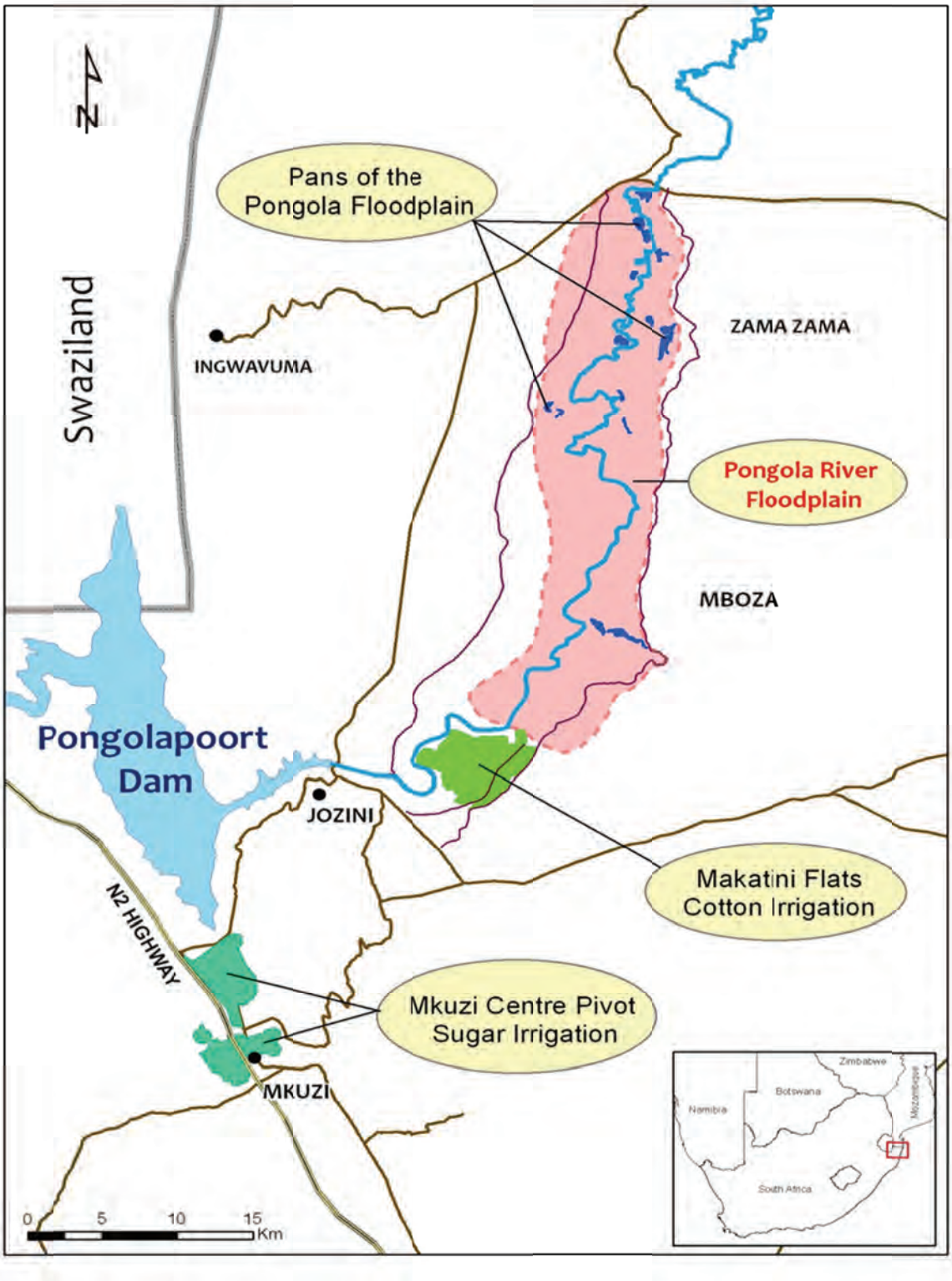

Figure 1. The Pongola Dam and the downstream floodplain with the larger floodplain lakes. The Pongolo River joins the Usuthu River at the border with Mozambique

Based on the well-established theory of property rights, we borrowed and applied seven important principles for the establishment of effective property rights regimes for the

governance of common pool freshwater ecosystems (Anderies et al., 2004). The seven principles relate to boundaries, rules for benefits and costs sharing (operational-choices), collective-choice arrangements, monitoring, sanctions, conflict resolution and self-organization (Table 1). The principles were initially developed by Ostrom as design principles for common-pool resource institutions and were based on extensive field work and extensive reviews of case-study literature. We used the principles as part of our analytic framework to analyse property rights regime shifts on the Pongola River floodplain. The phases of the regime shifts can be divided into three main eras: pre-impoundment, post-impoundment phase 1, and post-impoundment phase 2 (Table 2). We now discuss each of the eras in turn.

Table 1: Seven important principles for the establishment of effective property rights regimes for the governance of aquatic ecosystem services (Source: Adapted from Anderies et al., 2004)

KEY ATTRIBUTE	PRINCIPLE
1. Boundaries	Clearly define the boundaries of an aquatic ecosystem as well as the individuals or households who have rights to benefits
2. Benefits and Costs	Ensure there is proportional equivalence between the benefits and costs associated with particular aquatic ecosystem services. Associated Rules specifying the amount of resource products that a user is allocated are related to local conditions and to rules requiring labor, materials, and/or money inputs (operational-level rights: access and withdrawal)
3. Collective-Choice Arrangements	Ensure that most individuals affected by harvesting and protection rules are included in the group that makes changes to the rules (collective-level rights: management, exclusion and alienation)
4. Monitoring	Make certain that the monitors who actively audit biophysical conditions and user behavior are accountable to the users or are the users themselves
5. Graduated Sanctions	Make sure that the users who disobey rules receive graduated sanctions
6. Conflict-Resolution Mechanisms	Ensure access to low-cost, local arenas for users and managers to resolve conflict among users or between users and the managers
7. Minimal Recognition of Rights to Organise	External governmental authorities should not contest the rights of users to devise their own institutions and that users have secure tenure

Pre-impoundment era

We suggest that the pre-impoundment era was strongly associated with strong horizontal governance and sustainable outcomes that were underpinned by a common property rights regime. This era dated from the pre-colonial period (1650s) to impoundment period (1963), when construction of the dam started. The primary purpose of the dam was to control floods and provide an assured supply of water for a single use (irrigation to approximately 40,000 ha of land adjacent to the floodplain). Prior to the building of the Pongolapoort Dam, the natural flooding regime governed many of the characteristics of the floodplain (floodplain pans, diverse ecosystems and the patterns of land use of the communities living adjacent to the

floodplain) as well as the property rights regime. Local communities were highly dependent on the flooding and subsistence agriculture remained an important use of the floodplain. The right to exploit the flood benefits was controlled on behalf of the traditional authorities by the local Izinduna (Headmen). The Pongola region formed part of the former KwaZulu homeland and the land surrounding the floodplain area was governed through communal tenure.

Table 2: A summary description of the phases of property rights regime shifts on the Pongola River floodplain

KEY ATTRIBUTE	Pre-impoundment era	Post-impoundment phase 1 era	Post-impoundment phase 2 era
8.Boundaries	The floodplain during this era had clearly defined boundaries under traditional authorities and the individuals or households who had rights to claim flood benefits were clearly identifiable through the same local authorities. The rights to access benefits were held collectively and administered under communal tenure (Heeg and Breen, 1994; Jaganyi et al., 2008; Lankford et al., 2010). Rights to benefits were thus shared and could be revised to adjust as need arose (see Yandle, 2007).	The introduction of government control saw the breakdown of traditional boundaries and the de facto system of rights to flood benefits transformed into a de jure system.	While the introduction of water committees began the process of reconstructing some form of boundaries, this was however not enough, as individuals or households who had rights to flood benefits were not clearly identifiable.
9.Benefits and Costs	There was a relatively proportional equivalence between the benefits and costs (inputs/risks) associated with the flooding; access to the flood benefits was determined by the communal tenure system (operational-level rights).	The relationship between the benefits and costs associated with the flood releases become entirely distorted; the amount of benefits allocated were largely disproportional to the inputs/risks (among agriculturists, grazers and fishermen; on-floodplains vs. off-floodplains users).	The relationship between the benefits and costs associated with access to flood releases continued to be distorted; the amount of benefits allocated were still largely disproportional, with certain groupings getting unfair shares.
10. Collective-Choice Arrangements	The local user groups who were affected by communal tenure rules were included in the decision processes of the traditional authorities (collective-level rights). The multiple livelihood strategies drawing on resources on and off the floodplain were governed by rules, norms and values that were shaped by experience and knowledge of how the system was structured and functioned.	The local user groups who were affected by flood release rules were no longer included in the decision processes, which were largely dominated by government.	The local water committees did not ensure that the local user groups who were affected by flood release rules were included in the decision processes, still largely dominated by government. The evidence suggests that a system developed during this era in which rights to use of land for cultivation on the floodplain dominated over rights to the use of other resources. Whilst sustainability was evidenced in the ability to reduce and manage certain risks, this was only amongst those who were part of the newly demonstrated memberships, and more particularly those who pursued crop production. It can thus be argued that the decisions emanating from the Water Committees led to greatly reduced risk for floodplain cropping which in the absence of effective governance led to considerable expansion of

KEY ATTRIBUTE	Pre-impoundment era	Post-impoundment phase 1 era	Post-impoundment phase 2 era
			cultivation on the floodplain that was increasingly ecologically, socially and economically unsustainable. This understanding directs that we question the future of flood irrigation for subsistence agriculture. It also shows very clearly a collapse of governance.
11. Monitoring	Prior to construction of the dam the people living along the floodplain were subject to traditional authority and were largely isolated from the influences of central government and the mainstream economy. The users of ecosystem services were involved in monitoring the biophysical conditions of the floodplain as well as user behaviour and were accountable to themselves as users (operational-level).	The local users of ecosystem services were never involved in monitoring the biophysical conditions of the floodplain as well as user behaviour as government was largely accountable to itself.	While local monitoring had improved to some extent, the monitoring of biophysical conditions of the floodplain as well as user behaviour continued to be largely government driven.
12. Graduated Sanctions	Sustainability was dependent upon the social processes and relationships through which rights were granted, recognised and respected. Appropriate sanctions were effected by traditional authorities.	There was no explicit system for effecting appropriate sanctions to law breakers.	The local water committees were weak to facilitate a system for effecting appropriate sanctions to law breakers.
13. Conflict-Resolution Mechanisms	Ensure access to low-cost, local arenas for users and managers to resolve conflict among users or between users and the managers	The governance system in place did not provide for effective access to local low-cost conflict resolution mechanisms.	The local water committees did not provide for effective access to local low-cost conflict resolution mechanisms.
14. Minimal Recognition of Rights to Organise	The traditional authorities ensured access to local low-cost conflict resolution mechanisms. The communal tenure system recognised the rights of users to devise their own rules to secure tenure. Stakeholders held overlapping use and decision-making rights that were established and adjusted through the social relationships among those holding property rights (see Meinzen-Dick & di Gregorio 2004).	The government of the day never recognised the rights of users to devise their own rules to secure tenure, a situation that encouraged an open access regime.	The local water committees never provided for the recognition of the rights of users to devise their own rules to secure tenure.

Given that the flow of the Pongolo River was not regulated during this era, the natural variations in river flow determined patterns of floodplain productivity and use: the summer floods replenished water in the floodplain lakes and stimulated fish migration for breeding allowing them to be captured in mono-baskets set in the inlets to the lakes. As waters receded small fish could be captured by young women using cloth seine nets. With lower water levels new grass growth became available for grazing livestock, reeds could be harvested for

construction and when water levels in the lakes were low enough, the chief or local iNduna (Headman) would arrange for isifonya fishing. This was major social occasion when residents would congregate and moving in a line across the lake, they would drive fish into shallow water where they could be captured with thrust baskets (Heeg and Breen, 1994). People and the floodplain were intricately linked in a complex and dynamic social-ecological system centered on the common pool resource.

Based on the seven principles of effective property rights regimes (Table 2), we assert that the floodplain during this era had clearly defined boundaries under traditional authorities and the individuals or households who had rights to the flood benefits were clearly identifiable through the same local authorities. There was a relatively proportional equivalence between the benefits and costs (inputs/risks) associated with the flooding; access to the flood benefits was determined by the communal tenure system (operational-level rights). The local users groups who were affected by communal tenure rules were included in the decision processes of the traditional authorities (collective-level rights). Prior to construction of the dam the people living along the floodplain were subject to traditional authority and were largely isolated from the influences of central government and the mainstream economy. The multiple livelihood strategies drawing on resources on and off the floodplain were governed by rules, norms and values that were shaped by experience and knowledge of how the system was structured and functioned. The rights to access benefits from the floodplain ecosystem services were held collectively and administered under communal tenure with ownership was vested in the collective (Heeg and Breen, 1994; Jaganyi et al., 2008; Lankford, 2010). Rights to benefits were shared and because this did not involve full ownership, sharing could be revised to adjust the amounts of benefits and associated costs flowing from the property as need arose. As a consequence, stakeholders held overlapping use and decision-making rights that were established and adjusted through the social relationships among those holding property rights. Sustainability was dependent upon the social processes and relationships through which rights were granted, recognised and respected.

Common property institutions evolved to regulate who, when, where and how the range of ecosystem services could be accessed (Heeg and Breen, 1994; Jaganyi et al., 2008; Lankford, 2010). Geographically, socially and economically isolated from the rest of the country, rights to access and use resources were a responsibility of the traditional authority, with little influence from central government (Torres, 1980). The users of ecosystem services were also involved in monitoring the biophysical conditions of the floodplain as well as user behaviour and were accountable to themselves as users (operational-level). Appropriate sanctions were effected by traditional authorities. The traditional authorities ensured access to local low-cost conflict resolution mechanisms. The communal tenure system recognised the rights of users to devise their own rules to secure tenure.

Post-impoundment phase 1 era

We characterise the post-impoundment phase 1 era as a period that was strongly associated with weak unstructured governance and unsustainable outcomes. This was underpinned by a public property rights regime which was in essence a de facto open-access property rights regime. This period dated from 1973, when the construction of the dam was completed, to around 1986 when the first local management committees were established. During this era, the Department of Water Affairs (DWA) (formerly the Department of Water Affairs and Forestry) operated the dam without any consultation of stakeholders. Governance was based on an unstructured process of flood releases whose timing proved to be fairly sporadic and

entirely unpredictable. With this lack of certainty about flood releases, conflicts developed between agriculturists, grazers and fishermen who no longer knew how to protect their access to respective resources. There was no clear regime of flood releases and the imperfect system that did exist did not take on board the emerging interests of those who used the floodplain to support their livelihoods. The unstructured scenario was evidenced through the flood releases which "proved to be fairly sporadic particularly towards the end of this era (1984-1986) (see Table 3). The timing was entirely unpredictable." (van Vuuren, 2009).

This era pointed to the fact that, just as river environments are dynamic, so too are social systems; just as the effects of disturbances are propagated through ecosystems, so too are disturbances propagated through social systems. The evidence suggests that it is commonly not the immediate effect that holds greatest consequence because as disturbances are propagated so they may be magnified and dispersed with unintended outcomes. However one might identify the ecological impacts of flow regulation and seek to mitigate them in an equitable fashion. It is clear that potentially far greater impacts emerged during this era from the realization of opportunities, the differentiation of society, the redistribution of rights and the marginalization of sectors who previously had protection within the communal system.

Table 3: Managed flood releases showing variability in timing and volume (Source: Basson, Denys and Beck, 2006: 33)

YEAR	MONTH	Q_{peak}	VOLUME
1984	February	1480	1080
1984	September	850	224
1985	March	375	507
1986	February	415	178
1986	October	340	132

Based on the seven principles of effective property rights regimes (Table 2), we assert that the introduction of government control saw the breakdown of traditional boundaries and the de facto system of rights to flood benefits transformed into a de jure system. The relationship between the benefits and costs associated with the flood releases become entirely distorted; the amount of benefits allocated were largely disproportional to the inputs/risks (among agriculturists, grazers and fishermen; on-floodplains vs. off-floodplains users). The local users groups who were affected by flood release rules were no longer included in the decision processes, which were largely dominated by government. The local users of ecosystem services were never involved in monitoring the biophysical conditions of the floodplain as well as user behaviour as government was largely accountable to itself. There was no explicit system for sanctioning law breakers. The governance system in place did not provide for effective access to local low-cost conflict resolution mechanisms. The government of the day never recognised the rights of users to devise their own rules to secure tenure, a situation which encouraged an open access regime.

Post-impoundment phase 2 era

We are of the view that the post-impoundment phase 2 era was strongly associated with weak vertical governance and unsustainable outcomes that were still underpinned by a public property rights regime. With growing discontent amongst the local community, a small number of articulate persons of some standing tried to mobilise popular support in order to establish some local bodies that would take a more proactive approach in improving matters. So began the establishment of a number of water committees on the floodplain with representation from a range of water users such as stock owners, women and traditional

healers. These committees were supported by local development initiatives and NGOs who championed the process; and in some cases money was raised from overseas aid organizations to support the committees.

However, these committees were active only from 1986 to 1996. The late 1990s coincided with a decline in funding to the NGOs as international donors channelled their funding to the new government. At the same time, the era saw the emergence of a power group of cotton farmers on the floodplain, resulting in unproductive power struggles within the community and the water committees. This scenario appeared to have reignited the conflicts that were evidenced in the post-impoundment era (Poultney and Bruwer, 2002) (see also Box 1).

BOX 1: CONTINUING CONFLICTS

With the habitat loss and changes as manifested in reduced grazing areas on the floodplain, the situation could be reached during the next drought that the communal floodplain land will not be able to cater in the grazing requirements, resulting in **conflict between floodplain inhabitants and non-floodplain inhabitants.** A politically inspired **move to destabilise** the Combined Phongolo Floodplain Water Committees was executed by a group who referred to themselves as Powadeta, a group who started farming cotton on the floodplain.

The **conflict** and the resultant alteration in flood releases had its origin during March 1997. The negotiated October 1996 release was coupled to a negotiated and agreed March 1997 release to benefit the ecology. When it became time to make the March 1997 release, there was **pressure from cotton farmers** who did not want a release as they had started farming cotton in the floodplain. These farmers were politically inspired and demanded that they would only tolerate one flood per year and this should happen during September each year. The conservation authorities on the other hand **put severe pressure on the Department of Water Affairs and Forestry** and to stick to the negotiated release of March 1997. The Combined Phongolo Floodplain Water Committees **were intimidated** by the politically motivated minority and were reluctant to speak up for **fear of retribution**. Top management in the Department of Water Affairs and Forestry were reluctant to sanction a decision to have the March 1997 release as artificial releases put the onus on the department to accept **liability for damages** so caused. Having been warned about the pending claims by the cotton farmers, the Department had no option but to not make an artificial release. This turned out to be a serious mistake, as it **created a precedent** that repeated itself on a number of subsequent occasions, even after the promulgation of the National Water Act in 1998 that allocated the right of environmental water to aquatic ecosystems.

Despite all these negotiations the cotton farmers again **held the other floodplain users to ransom** by again renaging on a negotiated release during March 1999 that was coupled to the October 1998 release.
A release of 800 m^3/s was negotiated with the communities for October 1999. No coupled release was negotiated for February/March 2000. **The conservation agencies were unhappy about this situation and feel that the Department of Water Affairs and Forestry are not looking after the floodplain ecology properly.**

Schreiner, 2006:246

Based on the seven principles of effective property rights regimes (Table 2), we assert that while the introduction of water committees began the process of reconstructing some form of boundaries, this was not enough as individuals or households who had rights to flood benefits were still not clearly identifiable. The relationship between the benefits and costs associated with access to flood releases continued to be distorted; the amount of benefits allocated were still largely disproportional, with certain groupings getting unfair shares. The local water committees did not ensure that the local users groups who were affected by flood release rules were included in the decision processes, still largely dominated by government.

The evidence suggests that a system developed during this era in which rights to use of land for cultivation on the floodplain dominated rights to the use of other resources. Whilst sustainability was evidenced in the ability to reduce and manage certain risks, this was only amongst those who were part of the newly demonstrated memberships, and more particularly those who pursued crop production. It can thus be argued that the decisions emanating from the Water Committees led to greatly reduced risk for floodplain cropping. This, in the absence of effective governance, led to considerable expansion of cultivation on the floodplain that was increasingly ecologically, socially and economically unsustainable. This understanding directs that we question the future of flood irrigation for subsistence agriculture. It also shows very clearly a collapse of governance.

While local monitoring had improved to some extent, the monitoring of biophysical conditions of the floodplain as well as user behaviour continued to be largely government driven. The local water committees were too weak to sanction law breakers. The local water committees did not provide for effective access to local low-cost conflict resolution mechanisms. The local water committees never provided for the recognition of the rights of users to devise their own rules to secure tenure.

A brief analysis of factors driving the property rights regime shifts

In postulating a regime shift from a common property to public property regime it was necessary to analyse the probable factors that directed the shifts. From the perspective of this study, while the relationship between ecosystem services and human benefits is often complex and uncertain, it is tempting to suggest that the shifts were mediated by the bundles of rights that people held over time to control and use the services related to flooding patterns. Clearly, the Pongola River floodplain provides an excellent example of a complex social-ecological system driven by property rights which mediated the relationship between freshwater ecosystem services and human benefits. We have extended the example to illustrate the consequences of failing to establish and enforce bundles of rights in terms of both control and use.

The case study suggests that in many instances traditional property rights were not being acknowledged. This was compounded by the fact that such rights were not adequately addressed in the relevant legal frameworks. As a consequence, both the community as well as government together with its state functionaries failed to adequately respond to the need to sustain freshwater ecosystem services. For example, the case study provides evidence to suggest that cultural services were sacrificed in the face of livelihoods when households were forced to prioritise provisioning services over cultural activities in order to meet food production or income. This is despite the fact that the community (users) and government (controller) had both long established rights over the freshwater ecosystem services. This is indicative of the significant adverse social and ecological consequences that prevailed. We thus argue for the urgency of implementing a property rights regime that can lead to a more sustainable relationship between ecosystem services and human benefits on the Pongola River floodplain.

It is important to note that currently the property rights arrangements for the coordination of flood releases from the Pongola Dam are centred around a Water Users' Association (WUA) called the Imfunda Yopongola WUA. The WUA was established through the National Water Act of 1998 (RSA 1998) with the intention of decentralizing powers and responsibility for stakeholder coordination pertaining to the Pongolapoort Dam. There is a strong expectation

of democratic representation through the WUA as the intention is to have various stakeholder groups to democratically nominate their representatives. But there remain serious challenges to realising the full potential of the WUA. The most immediate challenge relates to the need to harmonise the expectations of the WUA and the Department of Water Affairs (DWA) concerning the new formalised status of the WUA and its responsibility to raise fees from its constituents. Continuing hopes on the part of the WUA to receive funds from the state for operations have constrained its working and prevented it from assuming a broader role in floodplain governance.

Conclusion

We set out to present a property rights perspective for interpreting and managing regime shifts in the provision of freshwater ecosystem services. Based on the case of the Pongola River floodplain, we have attempted to demonstrate that regime shifts happen when changes in internal processes or when external shocks trigger a completely different system behaviour. The Pongola case clearly illustrates why and how property rights are important in mediating regime shifts in the provision of freshwater ecosystem services. The case study provides insights into the consequences of failing to recognise, establish and enforce bundles of rights in the management of regime shifts.

This case study has illustrated that a property rights perspective provides a better way of understanding relations between ecosystem services and human benefits. This is especially the case in contexts in which collective use of ecosystem services is susceptible to externalities that make difficult governance. We have developed an integrated framework based on theories of ecosystems services and property rights to expose and highlight inherent inadequacies in the governance of ecosystem services. Property rights are increasingly being viewed as a concept of great importance for dealing with a wide range of problems related to freshwater governance. It is now generally acknowledged that improving performance of freshwater governance requires an emphasis on property rights. Property rights can be conceived as a key governance mechanism for achieving key societal goals such as environmental justice and sustainable development. As an instrument of governance, they regulate and facilitate access to and use of freshwater resources. Importantly, they govern who can do what, when and how with freshwater ecosystem services. They are about who gets what, when, where and how. Property rights go beyond central governments to include the private sector, civil society and local communities in the governance of fresh water resources. However, while there is a growing appreciation of the importance of property rights, the methods and tools for a property rights approach to freshwater governance are poorly developed.

With the advent of democracy in South Africa and a growing appreciation of water scarcity we have seen a shift away from the notion of ownership to rights of use. This shift marks explicit acknowledgement that water and the associated ecosystems, need to be understood and managed as common pool resources. As our understanding of the links between ecosystems and society has developed we are encouraged to view ecosystems as providers of services from which we can derive benefits. Society's interest in aquatic ecosystems is thus focused on how the benefits of access to and use of services should be apportioned, a process that requires trade-off and collective decision making. The need to allocate rights to benefit from ecosystem services that are highly variable in time and space, stresses the central importance of understanding the concept of property rights in the context of common pool resources and embedding this in dialogue addressing the sharing of benefits.

Although much has been done in developing a case for property rights, there has not been much effort made in developing and enhancing a property rights approach. Partly, this is because the importance of a systematic property rights approach to freshwater governance has not been widely recognised. While a few exceptions exist, the general trend has not given explicit attention to the development and application of property rights-based methods and tools for generating solutions to given problems. For example, a few recent studies, meetings, workshops and conferences in southern Africa have discussed the necessity of property rights to fresh water development and sustainability. These activities, albeit negligible, are an indication that the theme of property rights is replacing the perception that freshwater governance can be treated as a discrete entity in isolation from the rest of the contextualizing social system.

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Appendix 2: Text for Technology Transfer (TT) Report (part of Deliverable 5)

Linking Property Rights, Ecosystem Services and Water Resources: An Introduction

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Preface

"*What is often referred to as property is really the access right to a stream of benefits from a given set of resources*." Neil Meyer

A team of researchers recently conducted a research project for the Water Research Commission. It was entitled *'Embedding Property Rights Theory in Cooperative Approaches to the Management of Aquatic Ecosystem Services in South Africa'*. In conducting the research, engaging with other researchers and stakeholders, and compiling various reports four things became apparent:

1. Well defined property rights can make an important contribution to the equitable, efficient and sustainable allocation of the benefits derived from water resources.
2. In South Africa application of the concept of property rights in the context of natural resources is poorly understood, and the language used in explanations and descriptions is, at times, difficult to understand.
3. Water resources supply not one but a host of ecosystem services. Specific rights need to be assigned to each benefit that emanates from each ecosystem service.
4. Failure to develop and apply appropriate property rights regimes compromises attainment of the intentions of the National Water Act particularly to: "...protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource".

This document aims to introduce property rights, ecosystem services and associated concepts as they relate to water resource management; to illustrate their importance and relevance to the South African situation, and to do so simply in a way that promotes a broader understanding and appreciation.

Introduction

In 2012 a group of intrepid 'water resource advocates' from the Dusi-Umngeni Conservation Trust (DUCT) walked the length of the Umngeni River from its source to the sea. Their purpose was to profile various water resource management issues they encountered along the way. At Nagle Dam in the Valley-of-a-Thousand-Hills they discovered that the dam's sluice-gates were closed and, as a consequence, there was little flow in the river downstream of the dam. Not only did this compromise the ecology of the river system but rural residents downstream of the dam were deprived of their rights to the benefits from the water and its flow. Further downstream, where the Msunduzi River joins the Umngeni, flow was restored but the water was of questionable quality. As there was no dilution from the Umngeni River the rights local residents have to clean water were compromised. The reason for closing the sluice-gates was to ensure a reliable supply of water to the residents and businesses of Durban.

This is but one example of many that illustrates where we find ourselves – as development progresses rights to benefit from natural resources, including water resources, are regularly being compromised, often because we are either unaware of who holds rights to benefits or because we assume some rights to be of little consequence. And, it is often those who can least afford the loss of benefits- rural residents who are directly reliant on the natural resource base for survival – who endure the most serious personal consequences.

There are many ways in which people benefit from access to water resources. As competition for access to benefits increases trade-offs among users becomes more necessary and complex. For some the trade-off may be measured in economic terms while for others it may pose a threat to survival. Because rivers connect people in space and time it is not surprising that rights to benefit from river flow have evolved over hundreds of years. In recent times as the nature of these rights to benefits has become more clearly understood, we have come to appreciate the diverse implications of trade-offs, sometimes also for people who may seem to be remote from the issue of immediate concern. The fundamental and complex challenge is how we allocate and share the benefits of water resources in ways that achieve what we collectively aspire to – "some, for all, forever".

The only way in which we can achieve 'some, for all, for ever' is to be able to regulate access to benefits of water resources so that adjustments can be made in response to changes in supply of and demand for benefits. This principle was recognised in the drafting of the National Water Act of 1997 when inalienable riparian rights, for example, gave way to allocation of rights to use that are subject to review. However, until now, only some benefits such as the right to benefit from discharging effluent into a river, or the right to benefits from abstracting water are subject to regulation. When only some access rights are acknowledged it is difficult at allocate rights to access benefits equitably and to direct use toward sustainability.

Internationally and in South Africa there is a growing research focus on understanding the water resource allocation process so as to address issues of scarcity, equity and sustainability. This research brings together the concepts of property rights; of the water resource as a common pool resource; of cooperative approaches to water resource management; of the biophysical nature of water, and of aquatic ecosystem services. Each one of these concepts is complex and combining

them greatly increases the complexity. But, we recognise that water resource allocation is a complex process that will not be addressed through simple solutions. We need to engage with, understand and incorporate this complexity into decision making processes around allocation.

This short narrative introduces us to the concepts listed above; the international experience of property rights as a mechanism for governance and management, and to the South African experience both in practice and in law. It concludes with a motivation for the inclusion of a property rights and ecosystem services based approach to water resource allocation at the local level, particularly the level of Water User Associations. In doing so it attempts to improve the collective understanding of water users, regulators, policy makers, planners, practitioners, teachers and researchers – everyone involved in and with water resources.

The Key Concepts

Following are brief explanations of the key concepts. We will use two important water resources – the wetland systems at the source of the Umngeni and Umlalazi Rivers – to illustrate these concepts and their practical applications.

What is a right?

A right provides us with the legal, social or ethical freedom to act or behave in certain ways. Rights are fundamental to the way we conduct our lives, to the nature of our relationships with other people and groups, and with everything that is around us. A right usually relates to the benefits we obtain from someone or something – a right to benefit from access to clean drinking water or a right to benefit from life itself. Rights are granted to a person or group of persons, or a legal entity by other people; they signify an agreement between the parties and as such they are always subject to review and possible withdrawal.

Many of our rights are conferred by the Bill of Rights in our Constitution and, following on from that, our legal system. No rights are absolute. Even the right to life might be withdrawn, either voluntarily through euthanasia or involuntarily through execution or murder. The specifics of a right are regulated through formal and informal rules. Rights come with responsibilities, to behave according to the rules. They come with opportunities to sanction the user.

Cattle farmers in the upper-Umngeni catchment have negotiated the right to graze cattle in the Umngeni Vlei Nature Reserve from the landowner, Ezemvelo-KZN-Wildlife (EKZNW). So, they have secured a right to benefit from the wetland. The right is regulated through contracts which contain numerous rules – who has access, how many cattle can be grazed, when can they graze, what are the costs? Both the right and the rules are subject to regular review and might be withdrawn based on a number of factors. The right also comes with a series of responsibilities. These might include assisting with fire management and fence maintenance. In the granting of this right EKZN also assumes a responsibility for sustaining the wetland so that it provides grazing. Rights are an agreement among parties

What is property?

One of the things or objects that we have a right to is property. Conventionally we think of property as land and its associated infrastructure but it is much more than that. It can be a tangible object or it might be something intangible like an idea (intellectual property). Whether it is tangible or intangible it goes beyond the object itself. It is also the benefits that we gain from access to and use of that object whether it is land, water, air, biodiversity, infrastructure and/or services.

So, Umngeni Vlei constitutes property and the flow of benefits from it also constitutes property. These benefits would include the already mentioned grazing but there is much more than that. There is water yield (quality and quality) benefiting the downstream economy; conservation and

biodiversity protection benefiting the local area, the province and the country, and aesthetics providing spiritual and emotional benefits to users.

What is a property right?

So, if we bring property and rights together a property right is the right to benefit from various forms of property. Property rights are generally categorised by the type of right that is exercised over a specific property. The table below illustrates this:

Type of Right	Who is the owner?	An example	Who controls access?	Who is the manager?
Public	State	National Park	State	State
Private	Private	Freehold land	Individual owner	Individual owner
Common	Group	Common land	Joint owners	Joint owners
Open Access	No-one	Open ocean fishery	Uncontrolled	None

Legally, in South Africa, all water resources are public property – they are 'owned' by the State and managed in the public interest (more of that later in Section 4. However, the reality is a little more nuanced than that. In the upper-Umngeni catchment Umngeni Vlei Nature Reserve is public property, owned and managed by Ezemvelo-KZN-Wildlife. That is quite simple. However, downstream of this the Umngeni River flows through wetlands that are on private property. The landowner manages and is able to sell on this land and its wetlands. The landowner can, effectively, exclude others from benefitting from the wetland – they simply cannot access it. So, the wetland is, effectively, private property. Despite this the state can intervene should it believe such intervention to be in the public interest Also downstream of Umngeni Vlei is a large dam, Lake Lyndhurst. It is surrounded by a syndicate of landowners who each own about 20 ha of land. However, the dam itself constitutes common property – it is owned and managed by the syndicate for the collective benefit of the members. The upper catchment area on the escarpment is serviced by a series of gravel roads and tracks. Historically, nobody took responsibility for their management so they were not effectively maintained and deteriorated accordingly. Despite being on private and state land these roads were, in effect, accessible to all without effective control and were thus open access property.

What is a bundle of property rights?

Nobel Prize winner, the late Elinor Ostrom, and her colleagues teased out what types of rights people could exert over property. Although we commonly imagine that we have 'exclusive rights' this is seldom the case because rights are granted by others to us. For example, the syndicate at Lake Lyndhurst may think it has exclusive rights to the dam but in reality, society or government can place restrictions on what it can and cannot do, and even when it can do it. The result is that there are

often people other than the owner, who may hold rights at the same time. But, this does not imply that all rights holders have the same rights. So, we can identify types of rights and rights holders and distinguish who has what rights. The relationship between bundles of rights and the rights holders are illustrated in the table below.

Bundle of Rights	Owner	Proprietor	Claimant	Authorised user	Authorised entrant
Access	X	X	X	X	X
Withdrawal	X	X	X	X	
Management	X	X	X		
Exclusion	X	X			
Alienation	X				

Moving to the Mbongolwane wetland at the source of the Umlalazi River in Zululand, how might it illustrate this concept? The owner would be the Ngonyama Trust which holds land and manages it on behalf of the Zulu king. The Trust can access, use, manage and exclude others from the wetland (but it is unlikely that it can sell it). The proprietor would be the local Traditional Authority which can access, use and manage the wetland and exclude others. A claimant might be the local hospital that accesses the wetland to abstract water and is involved in management but cannot exclude others. An authorised user would be a reed harvester who can access and use the resource but has no rights beyond that. An authorised entrant would simply be someone passing through, possibly a buyer of harvested reeds.

What is a common pool resource?

While we are usually conscious of property to which we have been granted specific rights, we are less conscious of property rights that we share with others. For example, we share national parks, dams and the sea-shore and we exercise our rights to access and use these resources. However, we sometimes share in ways that exclude others, particularly when the resource is scarce and use by one person reduces the ability of another person to use the resource. It is helpful to categorise resources according to how easy it is to exclude potential users and how use subtracts from use by others.

Elinor Ostrom and her team also categorised resources into four types illustrated below. These categories were based on two variables – the ability to exclude or prevent someone else from using the resource (exclusion), and the degree to which the use of a resource by someone limits the ability of someone else to use that resource (subtractability).

An example of a public good would be the spectacular view of the Umngeni Vlei from the surrounding hills – it is difficult to prevent anyone accessing a view and one person's viewing does not usually prevent another from accessing the view. An example of a private good would be the

holiday homes of syndicate members around Lake Lyndhurst. Members can exclude others from using these homes and their use prevents others from use. An example of a toll (or club) good would be the Lake Lyndhurst syndicate itself. The inclusion of another member would not affect anyone's access to the dam and the additional member would reduce per capita costs of managing the dam. An example of a common-pool resource would be the wetlands downstream of Umngeni Vlei – despite being on private land it is difficult to exclude people from using them (historically, attempts were made to drain these wetlands for agricultural use) and one person's use often compromises use by someone else, particularly downstream users.

		Subtractability	
		Low	**High**
Exclusion	**Difficult**	Public goods	Common-pool resources
	Easy	Toll-goods	Private goods

The combined difficulties of excluding people from accessing the benefits of common pool resources and the effects one person's use has on others emphasises the need for rules that govern access and use. Ostrom developed design principles for the governance of common-pool resources. Recognising that water is a common-pool resource, Marty Anderies and his colleagues, adapted these design principles for the governance of water resources. The simplified design principles are as follows:

1. The boundaries of the water resource and its beneficiaries (social-ecological system) are clearly defined
2. Costs match benefits and returns match investments (investing is worthwhile)
3. Those who use the resource or who are affected by its use are included in making and changing rules of use (users are decision makers about use)
4. Those who monitor changes in the system (ecological and people) are accountable to users or are the users
5. Those who disobey the rules are sanctioned or penalised accordingly
6. There are low-cost ways to resolve conflict
7. Those who have rights are allowed to organise themselves to take advantage of their rights

Later we will use examples to illustrate how the absence of these design principles can compromise water resource use.

The water resource as an ecosystem service

An ecosystem however we may choose to bound it in space, comprises a set of assets each of which delivers a set of benefits. For example, a floodplain is an ecosystem with a number of assets such as reed-beds, lakes, river channels and wetlands. Each of these produces services that vary in the mix, the amounts and when they deliver what to whom.

When we think of the water resource we naturally think of water. We might extend this to think of water's numerous forms – rain, snow, ice, dew, mist, fog, steam and floods – but we rarely think further than that. However, the water resource is not just water. It includes the aquifer, river, lake wetland or estuary that contains and directs it and the life directly supportive of and supported by water.

This water resource delivers multiple ecosystem services which benefit society and individual people. The Millennium Ecosystem Assessment (MEA) divides these services into four interlinked groups. These include provisioning services such as food and water which are tangible benefits that we make direct use of; cultural services which are less tangible such as spiritual enrichment, recreation and knowledge generation, and regulating and support services such as the purification of water and air, climate regulation and crop pollination which act as the ecological foundations for the other services (and for each other). Using our Mbongolwane example here are a few of the ecosystem services supplied by the wetland that benefit us directly and indirectly:

- Provisioning services – food, water, medicinal plants, reeds, grazing
- Cultural services – baptism sites, birding, hunting, fishing
- Regulating and supporting services – flood attenuation, water purification and waste treatment, soil formation, habitat provision, disease control

Two things stand out here. The first is how important water is as an ecosystem service in its own right and how it acts, together with land, as the 'delivery agent' for many of our other ecosystem services. Second, if we reflect on our definitions of property and of ecosystem services, it is apparent that an ecosystem service is a form of property over which we can exert or be allocated rights.

What is the relevance of all this?

What key points should we note from our explanation of the various concepts?

- Our ability to sustainably access the benefits of water resources requires that we establish sets of formal and informal rights which tell us what we have rights and rules that regulate how we exercise our rights.
- Water resources in whatever form and the benefits that accrue from them are types of property.
- Water resources are usually common pool resources.
- Common pool resources are best governed and managed as common property regimes.
- Water resources supply multiple benefits to society and individuals and, because of high subtractability it is necessary to consider all services when making allocation decisions.

The international experience

"All these cases had taught her that, over time, human beings tended to draw up sensible rules for the use of common-pool resources. Neighbours set boundaries and assigned shares, with each individual taking it in turn to use water, or to graze cows on a certain meadow. Common tasks, such as clearing canals or cutting timber, were done together at a certain time. Monitors watched out for rule-breakers, fining or eventually excluding them. The schemes were mutual and reciprocal, and many had worked well for centuries." This is an extract from a tribute to the late Elinor Ostrom that appeared in The Economist. She devoted much of her life to researching property rights and common pool resources. The quote illustrates one of her key observations – that users of common pool resources such as grazing land, irrigation systems, fisheries and forests cooperate through a set of rights and rules to ensure that 'things work', particularly over the long term.

There are numerous examples that confirm this observation. They range from the lobster fisheries of Maine to the rice paddies of Laos and the estuarine fisheries of Vietnam. It is worth summarising the key observations from the Maine lobster fishery.

Prior to 1920 the lobster grounds off the coast of Maine were 'owned' by lobster fisherfolk. They sorted out amongst themselves who could fish where – dividing the area up into zones for individuals – and with what gear. If anyone disobeyed the rules they were usually penalised through the destruction of their fishing gear. The fishery during this time was regarded as sustainable and catch returns remained fairly stable over the years. After 1920 two changes occurred that fundamentally changed the system. The state of Maine assumed ownership of the fishing grounds and the boats became motorised. So, the informal zoning system was scrapped and the fisherfolk could cover much larger areas. The result was overfishing and a collapse in fish stocks. More recently property rights systems around the fishery have been revised and the fishery is recovering.

There is criticism from certain quarters that most examples are historic, that the world has 'moved on', that things are somehow different now. But, are they? Take a shared irrigation system. Owners will establish the extent of the system and define the users; there will be a schedule of who can use water and when; work parties comprising owners will maintain the system for mutual benefit; owners monitor usage, sanctioning anyone who breaks the rules, and the entire system is self-organising – it works!

What can we distil from this international research experience?

- It is self-evident that it is through property rights regimes that we determine who gets access to what benefits where and when, who makes the decisions, how these decisions are made and who is excluded.
- It has regularly been observed that where aquatic ecosystem services have become depleted – a fishery has collapsed or an irrigation system has failed – it has been because property rights are vague, insecure, not enforced, or all three. By contrast, where property rights were well-defined and secure, depletion was less likely to occur.

- Where resources are plentiful and there is little competition for them there is little need for or incentive to establish a formal property rights regime. However, as scarcity grows and competition increases so does the need and incentive for a formal system.
- Clearly defined and enforced property rights improve social coordination and guide society's energy towards a common good. It's a bit like a game of football – if everyone understands the rules of the game and obeys the referee we are likely to have a better, more enjoyable game.
- Clearly defined property rights provide incentives for investment in the management of the resource. Again, we can draw on the football analogy. If we are able to play and our enjoyment of playing grows we are more inclined to get involved in mowing the field, and painting the lines and goalposts.
- Most research has focused on property rights as they relate to one specific ecosystem service – a fishery, an irrigation system or timber from a forest. Very few have tackled the complexity of multiple ecosystem services – the benefits a water resource supplies – with different rights attached to each service.
- While secure and well defined property rights are usually desirable, success is not guaranteed. Similar approaches can produce entirely different and negative results depending on the social context and the biophysical nature of the resource. In a social system with high disparities between rich and poor, the property rights regime might be well defined and enforced but there might be no equity – all benefits might flow to the most powerful. Also, property rights are context sensitive. They have to reflect social (including economic and political) and the ecological circumstances and they must continually adapt to accord with changing conditions.

The Law

To take effect a particular property rights system or regime needs to form part of a legal system. What does the law in South Africa say about water property rights?

The Constitution

In any discussion about our right to water resources we need to consider what the Constitution has to say about it. In Section 27 of the Bill of Rights it states that *everyone has the right to have access to sufficient food and water.* In Section 24 it states that *everyone has the right to an environment that is not harmful to their health and well-being*. In Section 25 it states that *no one may be deprived of property except in terms of law of general application, and no law may permit arbitrary deprivation of property.* Reading these together what conclusion can we draw? Recognising that water resources are property, we have a right to sufficient water of adequate quality and we cannot be arbitrarily deprived of this right.

The National Water Act

Our National Water Act takes its lead from the Constitution. What does it say? The obvious starting point is how the Act defines water:

- 'Water resource includes a watercourse, surface water, estuary or aquifer'
- 'Resource quality means the quality of all the aspects of a water resource including the character and condition of instream and riparian habitat, and the characteristics, condition and distribution of the aquatic biota
- '"Reserve" means the quantity and quality of water required to protect aquatic ecosystems in order to ensure ecologically sustainable development and use of the relevant water resource'

So legally the water resource is water including the biophysical context in which it occurs – a wetland, lake, river, estuary or subterranean aquifer.

The vision of the Act is "Some, for all, for ever". "Some" recognises that we are a water scarce country; "for all" recognises equity, and "for ever" recognises sustainability. That is the overall intention of the Act. This cannot be achieved unless rights of access are achieved and there is an appropriate rights regime.

The Act states explicitly that the national government has authority over the water resources of South Africa. So, in property rights language the State is the 'owner' of the water property so it is public property. The State initially allocates water to satisfy four fundamental requirements:

- Basic human needs – the 25 litres per day
- Ecosystem health – there needs to enough water retained in the stream, river, wetland or estuary so that it can continue to function as healthy ecosystem, i.e. it continues to deliver the agreed benefits to beneficiaries in the long term.
- Strategic and future needs – to service national priorities such as power generation and economic development
- International obligations – we share river systems with other countries and so need to be mindful of their requirements.

Beyond this there are three levels of allocation:

- Schedule 1 use which is for small-scale productive use primarily by individual households. No license is required.
- General Authorisations which allow limited use of larger volumes of water that might have a limited impact on the water resource. The construction of a small dam (under 50 000 cubic meters) would be an example.
- What is commonly called licensed use which is generally for large-scale commercial, industrial or agricultural use and which, as the name implies, requires a formal license.

It is worth noting that that the system of allocation appears to take a very narrow perspective. It confines itself to allocating water rather than the water resource and the full range of services derived from the water resource.

A Note on Legal Pluralism

As we are all aware, the law is complex. All aspects of the law are subject to interpretations. In South Africa, and in most countries of the world, this complexity is compounded as we have more than one legal system in operation. There is our formal legal system and then there is our customary or traditional legal system. This is termed legal pluralism. So, the same water resource might attract different sets of property rights and rules depending on which system is applied.

Using the Mbongolwane wetland as a specific example; in order to establish the right to cultivate crops in a wetland, under customary or traditional law, a group of people will seek permission from the local iSinduna (headmen) or iNkosi (chief). Under contemporary democratic law, to establish the same right, the group would have to follow a complex environmental authorisation procedure determined the provincial Department of Agriculture and Environmental Affairs. So, in the strictest sense, under current legislation cultivation of the wetland is illegal but it is a de facto reality.

What is the South African experience?

In South Africa, with few exceptions, very little research has been conducted on how property rights affect the allocation of the full range of benefits we derive from water resources. But we can draw on numerous case-studies to illustrate the effect. One such is the Pongola River floodplain. This is an illustrative example of where changes in property rights regimes have compromised water resource governance and management.

Briefly, the Pongola River floodplain has been the home of the Thonga people for thousands of years. Their lives revolved around the seasonal flooding of the system which delivered many benefits; (ecosystem services) for example, nutrient rich soil for subsistence agriculture, water for domestic use, pastures and stock watering, and fish for food. In 1973 the Pongolapoort Dam was built and the lives of the Thonga people changed fundamentally and forever. The supply of aquatic ecosystem services from the floodplain was disrupted in ways that diminished the ability of people to sustain their well-being and their social cohesion. The result is that conflict has dominated proceedings for the past twenty years. Let's use the design principles of property rights regimes listed previously to analyse what happened:

- Boundaries – prior to the upstream dam being built those who had rights of access and the benefits they could access were well defined through a customary rights regime administered by the traditional authority. Central government control of flood releases introduced stakeholders acting from outside of the system known by the people of the

Pongola Floodplain; the government changed the boundaries of the biophysical resource and of those who had access to that resource.

- Benefits and costs – prior to the dam for the people of the floodplain, benefits matched costs and returns mostly exceeded investments. Post-dam, the balance became distorted. Unnatural patterns of flow increased risk such that investment in agriculture, for example, may not have yielded expected benefits either because crops were flooded or because the floods did not arrive.
- Collective choice – prior to the damming of the river communal decision making involving the users took place. Post-dam decision making relating to flow was carried out by central government authorities largely without consultation, and who were for the most part, inaccessible to people of the floodplain.
- Monitoring – prior to the dam local users understood and monitored the biophysical conditions of the floodplain and the way rights were exercised. They adapted their resource-use behaviour based on what they encountered. Post-dam while locals continued monitoring they encountered unfamiliar flow conditions consequent on monitoring and decision making by central government that did not acknowledge accountability to the people living downstream.
- Sanctions – Prior to the dam rights to resources were granted, recognised and respected. Where resource users broke the rules they were penalised accordingly. Post-dam with critical decision making occurring outside of the customary system it became increasingly difficult to exercise authority at the local scale. As the 'rules of the game' changed the power to sanction users weakened. Conflict resolution – prior to the dam these were handled locally by the traditional authority that was easily accessed and operated at very low cost. Post-dam conflict resolution often involved government officials, some from as far afield as from Pretoria, making conflict resolution difficult and costly for those living downstream particularly as they were also not well enough informed to influence decision making. Those who had influence encouraged government to release flows that met their needs rather than those that might be more equitable.
- Rights to organise – prior to the dam rights to organise at a local level were recognised and encouraged. Post-dam while these rights were still recognised, rights were being negotiated outside of the traditional authority. The resultant legal pluralism caused uncertainty at best and opportunity for exploitation at worst.

We can conclude that the pre-dam era was characterised by strong governance through a common property regime that regulated, in an equitable and sustainable manner, who could access the various aquatic ecosystem services and under what conditions they could be accessed. The post-dam era has been characterised by unstructured governance underpinned by a weak and inappropriate property rights regime.

Another example is coal mining in the Mpumalanga Highveld. Abstraction of water, the destruction of wetlands and water pollution through mining activity is compromising the rights of downstream users, primarily rural people, to the benefits that would normally accrue. The boundaries of the system have not been agreed and because there is no register of who has what rights, either formal or informal, we are not aware of who gains what benefit and who carries what costs and for how

long. Under these conditions people's rights are invariably infringed and commonly the least influential are most affected.

Moving on to our legal system, how does it engage property rights? The National Water Act requires that water in South Africa must be '*protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons….*' So, at a broad level everyone has the right to benefit from water resource property. However, at the specific level there are no mechanisms to practically implement this. As an example, within a Water User Association there is no mechanism to determine who in the Water User Association gets what. First, we must define the resource which, as we have illustrated, is much more than just water. Then we are able to define the benefits that can and are being derived and who the beneficiaries are. Only then can we consider who has what rights and determine how rights allocation affects attainment of equity and sustainability.

Also, there is no way of balancing the needs of that Water User Association against the needs of water users downstream and upstream. In addition, within the legislation and amongst water users there is little recognition and understanding of the nature of ecosystem services delivered by water resources. Because of this rights to these ecosystem services cannot be assigned.

We can safely conclude that, in South Africa, the governance and management of our water resources is not achieving equity, efficiency and sustainability. This is in large part because:

- Water resource property rights are poorly understood, poorly defined and, as such are not applied in a sufficiently comprehensive way.
- They are not included sufficiently in water policy, legislation and regulations.
- Transparency in and accountability for decision making in the allocation of water resources although not intentionally so, is weak.
- We have not reviewed and incorporated, where appropriate, international trends and developments in water property rights regimes.
- National government is unable to 'reach down' to the local level – the level of the user – and facility the establishment of effective common property rights regimes for aquatic ecosystem services. Because of this it is difficult to mobilise civil society to work with government toward the intentions of the constitution

So, where to from here?

Water resources, as defined by the Act, deliver multiple benefits to people living in proximity and distant from its course. It is not possible to satisfy all demands for these benefits. This means that to '*protect aquatic ecosystems in order to ensure ecologically sustainable development and use of the relevant water resource'* we should institutionalise a way of allocating rights to benefit from aquatic ecosystem services.

Are we moving in the right direction? Decentralization of rights is desirable. The general expectation is that Catchment Management Agencies (CMAs) should play a significant role towards achieving

this. However, as only 9 CMAs have been delineated this level of decentralisation is not sufficient so we need to move to the next level, that of Water User Associations (WUA). It is important to establish a system as shown in the table in Section 2 where there are bundles of rights and rights holders. We have to view WUAs as institutions in the context of bundles of rights. It is WUAs that operate at a restricted localised level, and are in effect co-operative associations of individual water users who wish to undertake water-related activities for their mutual benefit. What should we understand by water related activities? Mutual benefit cannot be addressed constructively if we do not acknowledge and take the diversity of "water-related benefits" into account. Can we manage 'for their mutual benefit' without some institutional arrangement for allocating rights to such benefits?

What are the key lessons we have learnt and need to take forward?

1. We cannot move toward a just and sustainable society (environmental justice) if we will not acknowledge the full range of aquatic ecosystem services and their beneficiaries

2. Our current approach to ecological sustainability is focused on sustaining the supply of benefits. To be successful we must also learn how to better manage the demand for benefits

3. We do not have to reinvent the wheel. Property rights, evolved over thousands of years and offer the instruments to manage demand for benefits

4. We have reached a stage in South Africa where we have sufficient knowledge and understanding to engage in action research that focuses on giving effect to managing for 'mutual benefit" while sustaining the resilience of the resource. This research might focus on Water User Associations as managers of the administration of rights to ecosystem services?

Appendix 3: Text of WRC Policy Brief (part of Deliverable 5)

Water Research Commission

Policy Brief

January 2013

Water Resource Policy

Incorporating Property Rights and an Ecosystem Services Approach into in Water Resource Allocation Decision Making in South Africa

Introduction

Recent research conducted on behalf of the Water Research Commission indicates that:

- Well defined property rights can make an important contribution to the equitable, efficient and sustainable allocation of the benefits derived from water resources.
- In South Africa the concept of property rights in the context of water resources is poorly understood and has rarely been applied.
- Water resources supply not one but multiple ecosystem services that benefit society and individuals. Specific rights need to be assigned to each benefit that emanates from each ecosystem service.
- Failure to develop and apply appropriate property rights regimes compromises attainment of the intentions of the National Water Act particularly to: "...protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource".

So, how do we integrate the concepts of property rights and ecosystem services into the governance and management of water resource allocation decision making in South Africa?

Understanding the concepts

Property rights

A right provides the legal, ethical and moral freedom to act in a certain way; it is a formal or informal contract with others and, as such, is continuously being modified and might be withdrawn. Property is a tangible or intangible object and the benefits that accrue from utilizing that object. So, a property right simply the right to benefit from an object, be it land, a water resource or even an idea.

Property rights are conventionally divided four categories: private property where the rights are held by an individual or a private institution (for example, a business); common property where the rights are held by a group; state or public property where the rights are held by government, usually for the benefit of its citizens, and open access where nobody hold the rights and there is no management.

There are bundles of property rights which recognise that, for any piece of property, different individuals and groups might hold different rights – alienation (to sell), exclusion, management, withdrawal and access. The highest order of rights – the right to the entire bundle – would be held by the owner of the property and this descends through the levels of proprietor, claimant, authorised user and authorised entrant.

Water resources are primarily common pool resources – it is difficult to exclude others from accessing the resource and on individual or group's use usually affects the ability of others to use the resource – which requires governance and management though a common property regime. The following are the design principles for a water resource governance and management system:

- The boundaries of the water resource and its beneficiaries (social-ecological system) are clearly defined
- Costs match benefits and returns match investments (investing is worthwhile)
- Those who use the resource or who are affected by its use are included in making and changing rules of use (users are decision makers about use)
- Those who monitor changes in the system (ecological and people) are accountable to users or are the users
- Those who disobey the rules are sanctioned or penalised accordingly
- There are low-cost ways to resolve conflict
- Those who have rights are allowed to organise themselves to take advantage of their rights

Ecosystem services

An ecosystem, however we may choose to bound it, comprises a set of assets each of which delivers a set of benefits. For example, a floodplain is an ecosystem with a number of assets such as reed-beds, lakes, river channels and wetlands. Each of these produces services that vary in the mix, the amounts and when they deliver what to whom.

This water resource delivers multiple ecosystem services which benefit society and individual people. The Millennium Ecosystem Assessment (MEA) divides these services into four interlinked groups. These include provisioning services such as food and water which are tangible objects that we make direct use of; cultural services which are less tangible objects such as spiritual enrichment, recreation and knowledge generation, and regulating and support services such as the purification of water and air, climate regulation and crop pollination which act as the ecological foundations for the other services (and for each other). A wetland or river system might provide the following services:

- Provisioning services – food, water, medicinal plants, reeds, grazing
- Cultural services – baptism sites, birding, hunting, fishing
- Regulating and supporting services – flood attenuation, water purification and waste treatment, soil formation, habitat provision, disease control

Reflecting on our definitions of property rights and of ecosystem services, it is apparent that an ecosystem service is a form of property over which we can exert or be allocated rights.

The International experience

Internationally there is a large body of research that examines property rights. What can we distil from this? What can we distil from this international research experience?

- It is self-evident that it is through property rights regimes that we determine who gets what resources where and when, who makes the decisions, how these decisions are made and who is excluded.
- It has regularly been observed that where aquatic ecosystem services have become depleted – a fishery has collapsed or an irrigation system has failed – it has been because property rights are vague, insecure, not enforced, or all three. By contrast, where property rights were well-defined and secure, depletion was less likely to occur.
- Where resources are plentiful and there is little competition for them there is little need for or incentives to establish a formal property rights regime. However, as scarcity grows and competition increases so does the need and incentives for a formal system.
- Clearly defined and enforced property rights improve social coordination and guide society's energy towards a common good.
- Clearly defined property rights provide incentives for investment in the management of the resource.
- Most research has focused on property rights as they relate to one specific ecosystem service – a fishery, an irrigation system or timber from a forest. Very few have tackled the complexity of multiple ecosystem services – what water supplies – with different rights attached to each service.
- While secure and well defined property rights are usually desirable, success is not guaranteed. Similar approaches can produce entirely different and negative results depending on the social context and the biophysical nature of the resource.
- Property rights are context sensitive. They must reflect social (including economic and political) and ecological circumstances and they must continually adapt to accord with changing conditions.

The South African Experience

In South Africa, with few exceptions, very little research has been conducted on how property rights affect the allocation of the benefits we derive from water resources. But we can draw on numerous examples to illustrate the effect. Two of these are the Pongola River floodplain and coal mining in the upper Olifants River catchment. In both instances, compromising the design principles listed above resulted on profound changes in property rights regimes which, in turn, compromised water resource governance and management.

How does the South African engage property rights? The National Water Act requires that water in South Africa must be '*protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons….*' So, at a broad level everyone has the right to benefit from water resource property. However, at the specific level there are no mechanisms to practically implement this. As an example, within a Water User Association there is no mechanism to determine who in the Water User Association gets what. Also, currently there is no way of balancing the needs of that Water User Association against the needs of water users downstream and upstream. In addition, within the legislation and amongst water users there is little recognition and understanding of all the ecosystem services delivered by water resources. Because of this rights to these ecosystem services cannot be assigned.

We can safely conclude that, in South Africa, the governance and management of our water resources is not achieving equity, efficiency and sustainability. This is in large part because:

- Water property rights are poorly understood, poorly defined and, as such are not applied.

- They are not included sufficiently in water policy, legislation and regulations.
- Transparency in and accountability for decision making in the allocation of water resources is weak.
- We have not reviewed and incorporated, where appropriate, international trends and developments in water property rights regimes.
- National government is unable to 'reach down' to the local level – the level of the user – and facility the establishment of effective common property rights regimes for aquatic ecosystem services.

Conclusions and Recommendations

1. Water resources, as defined by the Act, deliver multiple benefits to people living in proximity and distant from its course. It is not possible to satisfy all demands for these benefits. This means that to '*protect aquatic ecosystems in order to ensure ecologically sustainable development and use of the relevant water resource'* we should institutionalise a way of allocating rights to benefit from aquatic ecosystem services.
2. Decentralization of rights is desirable. At the CMA level decentralisation is not sufficient so we need to move to the next level, that of Water User Associations (WUA). It is Water User Associations that operate at a restricted localised level, and are in effect co-operative associations of individual water users who wish to undertake water-related activities for their mutual benefit.
3. What are the key lessons we have learnt and need to take forward?
4. We cannot move toward a just and sustainable society (environmental justice) if we will not acknowledge the full range of aquatic ecosystem services and their benefits
5. Our current approach to ecological sustainability is focused on sustaining the supply of benefits. To be successful we must also learn how to better manage the demand for benefits
6. We do not have to reinvent the wheel. Property rights, evolved over thousands of years and offer the instruments to manage demand for benefits
7. We have reached a stage in South Africa where we have sufficient knowledge and understanding to engage in action research that focuses on giving effect to managing for 'mutual benefit" while sustaining the resilience of the resource. This research might focus on Water User Associations.

Further Reading

This policy brief is based on a WRC report: *Embedding Property Rights Theory in Cooperative Approaches to the Management of Aquatic Ecosystem Services in South Africa*. (Report No. to insert). Contact publications at Tel: (012) 330-0340; Fax: (012) 331-2565; E-mail: orders@wrc.org.za; or visit: www.wrc.org.za

Appendix 4: Report on Deliverable 5

On 14 August 2012 at the final Reference Group meeting of this project a deviation from the intended Deliverable 5 was agreed to. The original Deliverable 5 stated:

A series of information sessions with lead players in water resource management in South Africa that builds a platform of common understanding.

Instead it was agreed that Deliverable 5 should focus on:

1. The compilation of a final report (not specified in the original Memorandum of Agreement but implicitly intended as part of Deliverable 5)
2. The development of material that would foster improved understanding on property rights and water resources amongst South African water sector constituents
3. Direct engagement on the subject with constituents of the water sector as and where possible

To this end:

1. The final report has been compiled (this document)
2. Text for a Water Research Commission Technology Transfer (TT) publication has been prepared (Appendix 2 of this document). In cooperation with the WRC appropriate photographs will be sourced to add value to the publication.
3. Text for a WRC Policy Brief has been prepared (Appendix 3 of this document)
4. Duncan Hay presented on Property Rights and Water Resources to the WRC Khuluma Sizwe Series Dialogue at the University of Zululand on 18 October 2012
5. Duncan Hay presented on Property Rights and Water Resources to the National Wetlands Indaba on 26 October 2012
6. Dr Bimo Nkhata presented on Property Rights and Water Resources to the International Conference on Freshwater Governance on 7 November 2012.