Linking Property Rights, Ecosystem Services and Water Resources: AN INTRODUCTION

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Water Research Commission

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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.

On the Pongola River floodplain residents have been systematically deprived of their rights to water resources (Henny Kok)

Acknowledgements

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1. 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.

The sluice-gates at Nagle Dam which, when closed, reduce downstream flows and affect the rights of downstream users (Penny Rees)

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.

2. 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.

Umngeni Vlei Nature reserve where farmers have negotiated the right to graze cattle (Duncan Hay)

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 have 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.

Lake Lyndhurst – a common property with multiple owners surrounded by private property with individual owners

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.

The Mbongolwane Wetland is illustrative of the bundles of rights that exist and who they accrue to (Duncan Hay)

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.

Water resources supply a broad range of ecosystem services that benefit us (Henny Kok, David Rattray, Amy Panikowski)

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.

3. 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.

A Main lobster-boat – 1935 (unknown)

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.

4. 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.

In South Africa, legally, a water resource includes the context in which the water occurs, in this case a river system

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.

5. 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.

The Thonga people subsisted well on the Pongola floodplain for thousands of years (Hennie Kok)

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.

Coal-mining has the potential to deprive those living downstream of their rights to good quality water (Angus Burns)

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

6. 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?

7. Additional online resources

Anderies, J.M., Janssen, M.A., Ostrom, E., 2004. A framework to analyse the robustness of social-ecological systems from an institutional perspective. http://www.ecologyandsociety.org/vol9/iss1/art18/

Beck, T. 1998. Common Property Resource Access by the Poor and Class Conflict in West Bengal. http://archive.idrc.ca/cbnrm/documents/publications/cpr_ar.htm

Lankford, B. Pringle, C. Dickens, C. Lewis, F. Chotray, V. Mander, M. Goulden, M. Nxele Z. and Quayle, L. 2010. The impacts of ecosystem services and environmental governance on human well-being in the Pongola region, South Africa.: http://www.uea.ac.uk/dev/prespa

Ostrom, E. 2000. Private and common property rights. http://encyclo.findlaw.com/2000book.pdf

Ross Saxer S. 2010. The Fluid Nature of Property Rights in Water. http://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1039