

Property rights, institutional regime shifts and the provision of freshwater ecosystem services on the Pongola River floodplain, South Africa

Bimo Abraham Nkhata

Monash South Africa; Water Research Node; South Africa

bimo.nkhata@monash.edu

Charles Breen

University of KwaZulu-Natal; School of Agricultural, Earth and Environmental Sciences;
South Africa

Duncan Hay

University of KwaZulu-Natal; School of Agricultural, Earth and Environmental Sciences;
South Africa

Melanie Wilkinson

Sustento Development Services, South Africa

Abstract: This paper proposes a property rights perspective to interpret institutional regime shifts in the provision of freshwater ecosystem services. Institutional regime shifts are conceived as persistent changes in the structure and function of a system. Property rights are viewed as an important component of institutional regimes. The paper draws on a case study of flow regulation on the Pongolo Floodplain in South Africa to illustrate the central role of property rights in mediating institutional regime shifts. The case study illustrates that there are many combinations of property rights that underpin institutional regime shifts in the provision of freshwater ecosystem services. It provides useful insights into the consequences of failing to recognize, establish and enforce bundles of rights. A major thrust of the case study is that the nature and context of property rights are important in determining the long-term provision of these services. By examining the configurations of property rights that have governed the Pongola River flood-

plain over the years, the paper demonstrates the importance of explicitly defining and categorizing the range of rights.

Keywords: Property rights, institutional regime shifts, freshwater ecosystems services, common pool resources, provisioning, Pongola floodplain, South Africa

Acknowledgements: We wish to acknowledge the funding contributions of the Water Research Commission of South Africa and the International Water Security Network. The International Water Security Network is funded by Lloyd's Register Foundation, a charitable foundation helping to protect life and property by supporting engineering-related education, public engagement and the application of research. We thank Jackie Crafford for constructive critique of the draft manuscript and Victor Bangamwabo for preparation of the map.

1. Introduction

There are many types of freshwater ecosystems such as wetlands, rivers, lakes, and floodplains which all provide multiple ecosystem services in proportions that are unique and variable over time and space (Nkhata et al. 2012). Changes in the provision of freshwater ecosystem services are typically attributed to changes in ecosystem structure, function and composition (Crépin et al. 2012). For example, natural variations in the quantity, quality and flow of water are often viewed as the key – if not the only – determinants of the nature and substance of the services provided by floodplains (Costanza 2008; Fisher and Turner 2008). This conventional perspective essentially suggests that the state of a freshwater ecosystem at a particular point in time is always decisive in configuring the provision of freshwater ecosystem services used and enjoyed by people. While this conventional viewpoint might be valid to some extent and in some contexts, it overlooks some fundamental aspects of human organization which influence the provision of many freshwater ecosystem services. For instance, while logic and evidence indicate that the quality of governance has implications for the provision of freshwater ecosystem services, the conventional perspective ignores the fact that progress towards sustainable provision largely depends on how effectively relationships among users of benefits are governed (Nkhata et al. 2012).

Misconceptions around the provision of freshwater ecosystem services may lead to inadvertent consequences. For example, such misconceptions may result in several benefits and beneficiaries going largely unrecognised and unacknowledged (Reed and Bruyneel 2010). In some cases, the manner in which boundaries for ecosystems are conveniently set may lead to less attention being given to beneficiaries that maybe considered to be 'outside' of the system (Fisher and Turner 2008). In other cases, unbalanced focus on services that are perceived to be more dominant (usually in ecological terms) and more conspicuous may lead to the undervaluing of other equally vital services (such as cultural benefits) and

the non-recognition of the temporal aspects of the provision of ecosystem services (Farley and Costanza 2010). This understanding suggests that while the provision of ecosystem services arguably results from both ecological and human processes (Reed and Bruyneel 2010), the ways in which ecosystem services accumulate to beneficiaries are ultimately configured by a complex system of societal norms, rules and rights that manifest in the form of human institutions.

In this paper, we propose that the long-term provision of ecosystem services is typically characterized by institutional regime shifts through which users of benefits interact with ecosystem services and influence each other's behaviours to advance individual and common interests. Drawing on a case study of the Pongola River floodplain of South Africa, we employ a property rights perspective to interpret institutional regime shifts in the provision of freshwater ecosystem services. We particularly focus on the implications of flow regulation for the floodplain to illustrate the central role of property rights in mediating institutional regime shifts in the provision of freshwater ecosystem services. The case study illustrates that there are many combinations of property rights that underpin institutional regime shifts in the provision of freshwater ecosystem services. By examining the configurations of property rights 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. The case study provides insights into the consequences of failing to recognize, establish and enforce bundles of rights. A major thrust of the case study is that the nature and context of property rights are important in determining the long-term provision of these services.

2. Institutional regime shifts and property rights

There has been a steady build-up of interdisciplinary knowledge about the range of societal arrangements required in the provision of 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 governance 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 property rights for configuring access to and use of benefits derived from ecosystem services.

Similarly, the literature on ecosystem services has started to seriously and explicitly incorporate analyses of institutions related to the provision of ecosystem services (Costanza 2008; Fisher and Turner 2008; Farley and Costanza 2010; Vatn 2010). Such research attention to societal arrangements has grown in tandem with efforts to enhance collective action and devolve natural resource management to local communities. While there is general agreement that these efforts are relevant and vital to the provisioning of ecosystem services, surprisingly little

or no attention has been given to understanding the importance of institutional regime shifts in the long-term provision of ecosystem services.

By institutional regime, we refer to a body of fundamental rules and rights that systematises society and ultimately influences the provision of ecosystem services (Vatn 2010). As Ostrom (2005) illustrates, these rules and rights exist in diverse social settings such as in the home, in the neighbourhood, in local, regional, national, and international councils as well as in governments, firms and markets. An institutional regime therefore provides a set of conditions and a normative framework that directs the decisions and actions of the managers and users of ecosystem services (Ostrom 2005). It can be institutionalised at different levels of social interaction (global, regional, national and local) to establish particular social processes and structures.

In the real world, an institutional regime manifests itself through the dominant traditions and practices that engender shifts and persistence in the prevailing social system. Shifts in an institutional regime happen when changes in its internal processes or when external shocks trigger a completely different system behaviour (Crépin et al. 2012). Persistence is a function of the time period over which such shifts take place. An institutional regime shift, thus, denotes the characteristic behaviour of a social system which is maintained by mutually reinforced processes and feedbacks.

Property rights can be viewed as an important component of institutional regimes associated with the provision of freshwater ecosystem services (Pomeroy et al. 2010). This is because they govern who can do what, when and how with freshwater ecosystem services (Pollard and Cousins 2008). In simple terms, a property right denotes an enforceable authority that permits a user to make specific decisions and carry out actions related to a particular stream of benefits. The exercise of property rights is characterised by the presence of rules that require, authorize or forbid particular actions and behaviours. 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 discharging waste into a river are all expressions of the exercise of property rights in the provision of freshwater ecosystem services. In this context, property rights regimes can be one of the four types: private, public, common or open-access (Schlager and Ostrom 1992). Accordingly, the institutionalization of property rights engenders a property rights regime, a body of fundamental rules and rights regarding access to, use of and control over benefits (Schlager and Ostrom 1992).

Property rights influence the choices available to managers and users of freshwater ecosystem services and the extent to which the impacts of use on third parties have to be taken into account (Deacon 2012). They offer the means to contain the use of services within the limits of the capacity of ecosystems to provide specific services. Property rights can thus be considered to be a key driver of both institutional and ecological regime shifts as well as a major determinant of human reactions to those shifts (Deacon 2012). Property rights, as an instrument of institutional regime shifts, regulate and facilitate access to and use of freshwater

ecosystem services. They can be conceived as a key institutional mechanism for achieving important societal goals such as environmental justice, peace and economic development. For example, it has been shown in Australia that reforms in property rights can result in important improvements in how water is used, with net gains for society as a whole. By making property rights arrangements more flexible, the 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.

We view property rights regimes as embodying the claims, entitlements and obligations people hold regarding the use and disposition of the benefits derived from freshwater ecosystem services (Deacon 2012). Such rights cannot exist without recognition by others in the form of relationships involving the individual rights-holder (Schlager and Ostrom 1992). 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 (Schlager and Ostrom 1992). 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 as alienation rights.

Given the temporal variability of institutions, however, property rights regimes can be conceived to be flexible and fluid, shifting by season and year. In certain instances, such temporal variability can lead to institutional 'fuzziness' which can create problems for collective action and governance in the provision of ecosystem services (see Kemerink et al. 2011). Property rights regime shifts occur in tandem with societal expectations and the context in which the associated rules are applied.

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 institutional regime shifts in the provision. Surprisingly, while ecological regime shifts have been extensively studied in the ecological sciences, especially given their perceived importance in influencing the provision of ecosystem services, there has not been a corresponding accumulation of knowledge about institutional regime shifts as they relate to the provision of ecosystem services.

3. Description of the study area and methods

3.1. Study area

The Pongola River is a catchment of about 7000 km² in extent at the eastern edge of South Africa (Figure 1). It is located on the coastal plain immediately upstream of Mozambique. The river descends steeply from its source at 2200 metres above

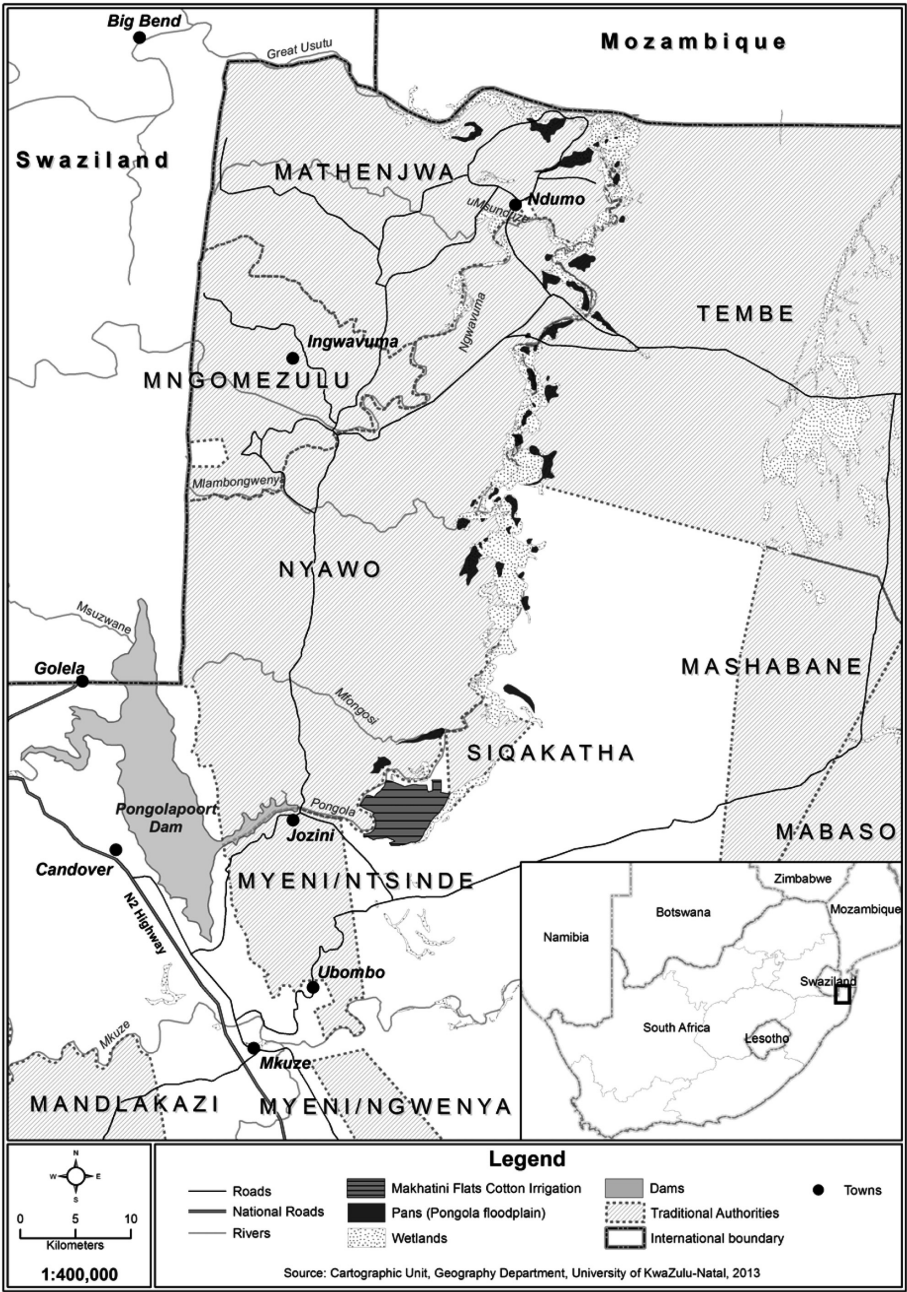


Figure 1: The Pongolapoort Dam and the downstream floodplain showing the larger floodplain lakes and the boundaries of the traditional authorities.

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 (small lakes associated with the floodplain) 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 Pongola River joins the Usutu 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, the floodplain was a catalyst for human settlement offering access to diverse ecosystem services that sustained livelihoods.

For thousands of years, the Thonga people and the floodplain were intricately linked in a complex and dynamic social-ecological system. These communities, who have made the floodplain their home, developed a system of recession floodplain agriculture in which cattle rearing has been particularly important (Buchan 1988). Heeg and Breen (1982) reported that in 1988 about 2970 cattle owners received annual returns worth approximately 100% of the asset value of their 19300 cattle that were reliant on floodplain grazing. According to Heeg and Breen (1994), about 35 926 people (27 % of the population of Maputaland) were resident in the immediate vicinity of the floodplain and were assumed to have subsistence rights over floodplain. The 1960 and 1970 population censuses show a clear discrepancy between the growth rates of males and females in terms of contributing to the population growth of Maputaland. Whereas the male population increased by only 8%, females increased by 19.7%. Heeg and Breen (1979) attributed this discrepancy to the male population seeking employment opportunities outside of Maputaland. Migrant labour provides exposure to new ways and means of living and can be assumed to have influenced the aspirations people living around the floodplain who also were to increasingly come under the influence of people migrating into the area (Buchan 1988). Between 1973 and 2005, the population of the Makatini Flats and surrounding areas in Ingwavuma and Ubombo districts increased from 39715 to 70000 (Heeg and Breen 1982; Eastern Cluster 2005).

The Pongolapoort dam (Figure 1) was built during the apartheid period to provide water for sugar cane irrigation designed to support white farmer upliftment (Lankford et al. 2010). According to Breen (2016, pers. comm.), the original objective of impounding the river was to over time increase sugar production on the Makatini Flats, a highly fertile area adjacent to the floodplain on both sides of the river. Breen (2016, pers. comm.) contended that the intention was to “stabilize” the frontier bordering Mozambique and Swaziland through the creation of 40,000–50,000 ha of irrigation on the Makatini Flats. At the time, it was believed that high economic growth would automatically follow impoundment, and as such consideration was never given to alternative development options (McCartney et al. 2004). McCartney et al. (2004) noted that subsequent changes in political and socio-economic circumstances (such as the drop in the price of sugar) meant that the expected economic growth did not occur, however. They

observed that only about 3,000 ha of irrigation area were eventually established. As a result, only two types of major stakeholders (government functionaries and rural smallholder residents) ended up dominating the use and management of the Pongola Floodplain (McCartney et al. 2004). In terms of the current context of floodplain use, Lankford et al. (2010) observed that the areas surrounding the Pongola are predominantly rural in character. They further noted that there are no homesteads or permanent settlements on the floodplain, which is mostly associated with subsistence agriculture, and as such there is very little formal commercial agriculture.

3.2. Methods

Using a qualitative approach (Patton 2005), we employed documentary analysis as the main data collection method. The documentary analysis facilitated the examination of a wide range of textual records, which included official publications and reports from organisations, national policy and legislative documents, minutes of meetings, and workshop proceedings. We established three main categories of sources from which documents were collected: governmental, non-governmental and others (Table 1). Our knowledge of the Pongola also prevailed given our collective professional experience and engagement with its history and management. It should be noted however that the case study we present herein is

Table 1: List of sources from which documents were collected.

Category	Entity
Governmental	Department of Water and Sanitation
	Water Research Commission
	Council for Scientific and Industrial Research
	Department of Water and Sanitation (Regional Office)
	The KwaZulu-Natal Planning Commission
	uMgungundlovu District Municipality
Non-governmental	eThekweni Municipality
	Institute of Natural Resources
	University of KwaZulu-Natal
	Greennetwork
	Dusi-uMngeni Conservation Trust
	Wildlife and Environment Society of South Africa
	Pietermaritzburg Chamber of Business
	Durban Chamber of Commerce and Industry
	Upper-uMngeni Catchment Management Forum
	The Msunduzi Catchment Management Forum
Others	Msunduzi Innovation and Development Institute
	GeaSphere KZN
	Charles Breen
	Kate Pringle
	Duncan Hay

neither meant to be comprehensive nor exhaustive; rather it is only designed to be exploratory and illustrative.

Based on the well-established theory of common-pool resources, we identified seven principles for the establishment and maintenance of long-enduring institutional regimes for governing natural resources (Anderies et al. 2004). The seven principles relate to boundaries, rules for benefits and costs sharing, collective-choice arrangements, monitoring, sanctions, conflict resolution and self-organization (Table 2). 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 seven principles as part of our analytic framework to analyse the evolution of property rights regime shifts on the Pongola River floodplain. Our data analysis systematically identified key events and episodes within textual records through the application of the seven principles. The identified key events and episodes were then used to make replicable and valid inferences about the data. Our directed analysis used the framework to determine the initial phasing scheme as well as to explore the data deductively. The textual records were read and re-read, and categorised into three main eras: pre-impoundment, post-impoundment phase 1, and post-impoundment phase 2. Through an iterative process of phasing similar events and episodes into the three broad phases, we finally produced a summary description of the property rights regime shifts on the Pongola River floodplain (Table 3).

Table 2: Seven design principles for the establishment of long-enduring institutional regimes for governing sustainable resources (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 organize	External governmental authorities should not contest the rights of users to devise their own institutions and that users have secure tenure

4. Property rights regime shifts on the pongola river floodplain

Our data analysis revealed that the property rights regime shifts on the Pongola River Floodplain can be divided into three main eras: pre-impoundment, post-impoundment phase 1, and post-impoundment phase 2 (Table 3). These shifts in property rights regimes in the long term provided a 'trigger' for change in the provision of freshwater ecosystem services. We now discuss each of these eras in turn.

4.1. Pre-impoundment era (Pre-1963)

This era dated from the pre-colonial period (1650s) to the time (1963) when construction of the dam started (Table 3). By the 1650s, the Thonga people had made the floodplain their home which was governed through a common property regime based on five traditional authorities: Mashabane (Inkosi Gumede), Tembe (Inkosi Tembe), Nyawo (Inkosi Nyawo), Mathenjwa (Inkosi Mathenjwa), and Siqakatha (Inkosi Nxumalo) (see Figure 1). The right to exploit the flood benefits was controlled on behalf of the traditional authorities by the local Izinduna (Headmen). The documentary analysis revealed, that prior to the construction of the Pongolapoort Dam, the Thonga people enjoyed the full bundles of property rights (access, withdrawal, management, exclusion and alienation) to benefit from the ecosystem services associated with the floodplain as a common pool resource. According to Jaganyi et al. (2008), these bundles included, for example, the rights to cultivate the enriched soils that were exposed once flood waters had receded, the rights to harvest fish, the rights to gather reeds, the rights to regulate internal patterns of use, the rights to determine access and the composition of participants, and the rights to alien particular benefits. Given that the flow of the Pongolo River was not artificially regulated during this era, Lankford et al (2010) contend that the provision of ecosystem services during this era was largely influenced by institutional regimes.

As part of the former KwaZulu homeland, the Pongola region and the land surrounding the floodplain area was governed through communal tenure. Many writers (such as Heeg and Breen 1994; Jaganyi et al. 2008; Lankford et al. 2010) have observed that the communal tenure system enabled local communities to develop a system of flood recession agriculture in which fishing and farming were particularly important. The summer floods replenished water in the floodplain pans and stimulated fish migration for breeding which enabled local communities to capture the fish in mono-baskets set at the inlets to the floodplain pans. As water 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, and reeds could be harvested for construction. According to Heeg and Breen (1994), traditional authorities such as the chief or local iNduna (headman) would periodically arrange for a traditional fishing ritual (isifonya) which was a major cultural occasion on the floodplain. During this cultural event, residents would congregate in large numbers to drive fish into shallow waters where they

were captured using thrust baskets. Appropriate sanctions were imposed by traditional authorities on users that violated traditional fishing rules. The traditional authorities ensured access to local low-cost resolution mechanisms if and when conflicts ensued.

The documentary analysis showed that the common property rights regime largely governed the patterns of ecosystem service use by the local communities. Local communities were highly dependent on the flooding and subsistence agriculture remained an important use of the floodplain. Jaganyi et al. (2008) noted that the floodplain during this era had clearly defined administrative boundaries and the individuals or households who had rights to use the flood-based ecosystem services were clearly identifiable through the five traditional authorities. The rights to access and withdraw benefits were held collectively and administered under the common property regime (Heeg and Breen 1994; Jaganyi et al. 2008; Lankford et al. 2010). The benefits and costs of managing the floodplain resources were thus shared and could be revised to adjust as need arose. In this regard, Buchan (1988) contends that there was a relatively proportional equivalence between the benefits and costs (inputs/risks) associated with the flooding.

Torres (1980) observed that prior to the 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 were governed by traditional rules, norms and values that were shaped by local 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 vested in the collective. Torres (1980) further noted that 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.

Many writers (including Heeg and Breen 1994; Jaganyi et al. 2008; Lankford et al. 2010) have observed that access to the flood benefits was determined by the communal tenure system which recognized the rights of users to devise their own rules to secure tenure. Local user groups who were affected by communal tenure rules were appropriately included in the decision processes of the traditional authorities (collective-level rights) and rights to benefits were appropriately shared. Accordingly to Heeg and Breen (1994), because the communal tenure system did not involve full ownership, sharing could be revised to adjust the amounts of benefits and associated costs flowing from the resource as need arose. As a consequence, users held overlapping use and decision-making rights that were established and adjusted through the social relationships among those holding property rights. In this way, one would argue that sustainability was dependent upon the institutional processes and the relationships among users through which rights were granted, recognized and respected.

Based on the foregoing, we wish to affirm that the pre-impoundment era was strongly associated with sustainable resource governance that was underpinned by a

Table 3: A summary description of the property rights regime shifts on the Pongola River floodplain.

Key attribute	Pre-impoundment era (Pre-1963)	Post-impoundment era (phase 1: 1973–1986)	Post-impoundment era (phase: post 1986)
1. Boundaries	<ul style="list-style-type: none"> – Floodplain had clearly defined administrative boundaries – Individuals and households were clearly identifiable – Rights to access benefits were held collectively and administered under communal tenure – Rights to benefits were shared and could be revised to adjust as need arose 	<ul style="list-style-type: none"> – Introduction of government control saw the breakdown of traditional administrative boundaries – De facto system of rights to flood benefits transformed into a de jure system – Institutional fuzziness led to uncertainty about and who had rights to services 	<ul style="list-style-type: none"> – Introduction of water committees began the process of reconstructing some form of administrative boundaries – Individuals and households who had rights to flood benefits were not clearly identified and empowered to participate
Collective-choice arrangements	<ul style="list-style-type: none"> – Local user groups were included in the decision processes of the traditional authorities – Multiple livelihood strategies were governed by local rules, norms and values 	<ul style="list-style-type: none"> – Local user groups were no longer included in critical decision processes, which were largely dominated by government 	<ul style="list-style-type: none"> – Local water committees did not ensure that all local user groups were included in decision processes, still largely dominated by government – Rights to use of land for cultivation on the floodplain dominated over rights to the use of other resources – Sustainability was evidenced in the ability to reduce and manage certain risks – Decisions of water committees led to greatly reduced risk for floodplain cropping
2. Benefits and costs	<ul style="list-style-type: none"> – Relative proportional equivalence between the benefits and costs (inputs/risks) 	<ul style="list-style-type: none"> – Relationship between benefits and costs became entirely distorted – Amount of new benefits was largely disproportional to the inputs/risks (e.g. among agriculturists, grazers and fishermen) 	<ul style="list-style-type: none"> – Relationship between benefits and costs continued to be distorted – Amount of benefits were still largely disproportional, with certain groupings getting unfair shares while others carried costs of reduced access to benefits

Table 3: (continued)

Key attribute	Pre-impoundment era (Pre-1963)	Post-impoundment era (phase 1: 1973–1986)	Post-impoundment era (phase: post 1986)
3. Monitoring	<ul style="list-style-type: none"> – Users were subject to traditional authority and were largely isolated from the influences of central government and the mainstream economy – Users were involved in monitoring the biophysical conditions of the floodplain as well as user behaviour and were accountable to themselves as users 	<ul style="list-style-type: none"> – Users were not fully involved in monitoring the biophysical conditions of the floodplain as well as user behaviour as government was largely accountable to itself 	<ul style="list-style-type: none"> – Local monitoring of resources had improved to some extent – Monitoring of biophysical conditions of the floodplain as well as user behaviour continued to be largely government driven – Weakening of traditional authority decreased the relevance and influence of local monitoring
4. Graduated sanctions	Sustainability was dependent upon the social processes and relationships through which rights were granted, recognized and respected. Appropriate sanctions were affected by traditional authorities.	There were inadequate mechanisms for effecting appropriate sanctions to law breakers.	The local water committees largely directed by self-interest were weak and not able to facilitate a system for effecting appropriate sanctions to law breakers.
5. Conflict-resolution mechanisms	<ul style="list-style-type: none"> – Traditional authorities ensured access to local low-cost conflict resolution mechanisms 	<ul style="list-style-type: none"> – Introduced governance system did not provide for effective access to local low-cost conflict resolution mechanisms 	<ul style="list-style-type: none"> – Local water committees did not provide for effective access to local low-cost conflict resolution mechanisms
6. Minimal recognition of rights to organize	<ul style="list-style-type: none"> – Communal tenure system recognized the rights of users to devise their own rules to secure tenure – Stakeholders held overlapping use and decision-making rights 	<ul style="list-style-type: none"> – Government of the day never recognized the rights of users to devise their own rules to secure tenure, a situation that encouraged an open access regime 	<ul style="list-style-type: none"> – Local water committees never provided for the recognition of the rights of the diverse users to devise their own rules to secure tenure

common property rights regime. Because this regime had evolved in association with unregulated flow over many years it was persistent in the face of seasonal and longer term variations in the supply of and demand for ecosystem services. Common property institutions evolved to regulate who, when, where and how the range of ecosystem services could be accessed. 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.

4.2. Post-impoundment era (phase 1: 1973–1986)

The post-impoundment era (phase 1) dated from 1973 when the construction of the Pongolopoort dam was completed to around 1986 when the first local water committees were established (Table 3). As earlier stated, the dam was built during the apartheid period to provide water for white farmer upliftment through sugar cane irrigation. 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). We characterize the post-impoundment phase 1 era as a period that was strongly associated with institutional ‘fuzziness’ that led to weak property rights held by the Thonga people and unsustainable outcomes. This was underpinned by a public property rights regime which was in essence moving toward a de facto open-access property rights regime. Notably, the Thonga people were divested of their full bundle of property rights to remain with only limited access and withdrawal rights. The transfer of exclusion and alienation rights from the local people to the then Department of Water Affairs was particularly vital in shaping institutional regime shifts on the Pongola Floodplain.

The documentary analysis revealed that during this era the then Department of Water Affairs (DWA) operated the dam without consultation of stakeholders (Eastern Cluster 2005). According to Basson et al. (2006, 33), regulation of flow was conducted largely through an unstructured process of flood releases whose timing proved to be fairly sporadic and entirely unpredictable (Table 3). The imperatives associated with keeping dam levels low to meet dam safety conditions, compounded by design limitations, resulted in patterns of flow that were not within the realms of experience of those using resources on the floodplain. With the uncertainty that resulted from the way in which releases were made, conflicts developed between agriculturists, grazers and fishermen who no longer knew how to protect their access to respective resources (Basson et al. 2006). And, it became increasingly difficult for the traditional authority to exercise control. As suggested by the documentary evidence, there were no clear procedures of flood releases and the dysfunctional system that existed did not adequately consider the interests of those who used the floodplain to support their livelihoods (Buchan 1988; Heeg and Breen 1994; Lankford et al. 2010).

The effects of the weak property rights held by local users were evidenced through the flood releases which proved to be inconsistent towards the end of this era (1984–1986) (see Table 4), which most likely would have led to heighten unpredict-

Table 4: Managed flood releases showing variability in timing and volume (Source: Basson et al. 2006, 33).

Year	Month	Q_{peak} m ³ /sec	Volume 10 ⁶ m ³
1984	February	1480	1080
1984	September	850	224
1985	March	375	507
1986	February	415	178
1986	October	340	132

ability. The local user groups who were affected by flood release rules were no longer included in critical decision processes, which were largely dominated by government (Lankford et al. 2010). The relationship between the benefits and costs associated with the flood releases became entirely distorted, whereby the amount of new benefits allocated was largely disproportional to the inputs/risks (among agriculturists, grazers and fishermen (Buchan 1988). The documentary evidence showed that the local users of ecosystem services were not fully involved in monitoring the biophysical conditions of the floodplain as well as user behaviour as government was largely accountable to itself. Worse still, there were inadequate mechanisms for effecting appropriate sanctions to law breakers. The prevailing property rights regime did not provide for effective access to local low-cost conflict resolution mechanisms. The introduction of government control saw the breakdown of traditional administrative boundaries and the de facto system of rights to flood benefits transformed into a de jure system (Basson et al. 2006). This weakness was exacerbated by the fact that the government of the day never recognized the rights of users to devise their own rules to secure tenure, a situation that encouraged an open access regime.

This era points to an important insight about the variability of property rights regimes: just as natural 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. This understanding suggests that it is commonly not the immediate effects of property rights regime shifts that hold the greatest consequence. As the disturbances are propagated through the system, so too are the effects magnified and dispersed with unintended outcomes. In this case, however, one might identify the institutional impacts of flow regulation and seek to mitigate them based on an understanding of property rights regime shifts. From the foregoing, it is clear that potentially far greater impacts emerged during this era from the discriminatory realization of opportunities, the differentiation of society, the redistribution of rights and the marginalization of sectors who previously had protection within the communal system.

4.3. Post-impoundment era (phase 2: post 1986)

We are of the view that the post-impoundment phase 2 era (from 1986 onwards) saw the continuation of a relatively weak property rights regime that was associated

with unsustainable outcomes that were underpinned by a public property rights regime (Table 3). With growing discontent amongst the local community, a small number of articulate persons of some standing tried to mobilize popular support in order to establish some local bodies that would take a more proactive approach in improving matters. The era witnessed the beginning of 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 that championed the process of property right regime shift. In some cases, money was raised from overseas aid organizations to support the committees.

The documentary analysis revealed that these committees were only active from 1986 to 1996 (Poultney and Bruwer 2002). The late 1990s coincided with a decline in funding to the NGOs as international donors channelled their funding to the new government. It was during this era that South Africa as a country witnessed a great socio-political transformation through the dismantling of the apartheid system in 1994. 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; Jaganyi et al. 2008) (see also Box 1). The cotton farmers became dominant over time as crop producers were generally influential in the water committees. Between 1983 and 1998, flood releases were negotiated with the local water committees on the floodplain and various stakeholder organizations. In many instances, consensus was achieved and the releases were made after appropriate warnings (Eastern Cluster 2005). Yet, the floodplain communities perceived the artificial flood releases, which were intended to maintain the environmental requirements of the floodplain, as not meeting their needs or the needs of the environment. As Salagae (2007) demonstrates elsewhere, key perceptions on environmental impacts revolve around: (i) reduction in water required to maintain floodplain resources, (ii) deterioration in water quality and (iii) decrease in available floodplain land and natural resources.

It is suggestive that the property rights regime developed during this era led to a situation whereby rights to use of land for cultivation on the floodplain dominated rights to the use of other resources. Whilst elements of sustainability were evidenced in the ability to reduce and manage certain risks, this was only amongst those who were part of the newly established memberships, and more particularly those who pursued crop production. It can thus be argued that the decisions emanating from the water committees served only to reduce risks for floodplain cropping. In the absence of an effective property rights regime, this scenario led to considerable expansion of cultivation on the floodplain that was increasingly ecologically, socially and economically unsustainable.

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. As Kemerink et al. (2011) claim, the local water com-

BOX 1: CONTINUING CONFLICTS From Schreiner (2006, 246) with emphasis added

Note: the name of the river has been variously stated in literature as Pongola, Pongolo and Phongolo

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 reneging on a negotiated release during March 1999 that was coupled to the October 1998 release.

A release of 800 m³/sec 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

mittees and the traditional authority were too weak to sanction law breakers particularly as they had the support of central government. The pluralistic form of the property rights regime that emerged undermined the traditional property rights regime. And the local water committees did not provide for effective access to local low-cost conflict resolution mechanisms, particularly for those whose traditional rights were being infringed. The local water committees never provided for the recognition of the rights of users to devise their own rules to secure tenure.

We assert that while the introduction of water committees began the process of reconstructing some form of inclusive administrative 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. According to Heeg and Breen (1979), the local water committees did not ensure that the local users groups who were affected by flood release rules were

constructively included in the decision processes, still largely dominated by government. And it is suggested that the water committees did not ensure that all interests and rights established over hundreds of years were taken into account.

4.4. Factors driving the property rights regime shifts

In postulating the regime shifts, 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.

With the advent of democracy in South Africa and a growing appreciation of water scarcity, there was a shift away from the notion of ownership to rights of use (RSA 1998; Pollard and Cousins 2008). This shift marked explicit acknowledgement that water and the associated ecosystems, need to be understood and managed as common pool resources. As the understanding of the links between ecosystems and society developed, society was encouraged to view ecosystems as providers of services from which human benefits can be derived. Society's interest in freshwater ecosystem service thus focused on how the benefits of access to and use of services would be apportioned, a process that required trade-offs and collective decision making (Pollard and Cousins 2008). The need to allocate rights to benefit from ecosystem services, that are highly variable in time and space, stressed 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.

The 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 (RSA 1998). As a consequence, both the community as well as government together with its state functionaries failed to adequately respond to the need to sustain the diversity of freshwater ecosystem services. For example, the study provides evidence to suggest that by prioritising certain activities (cultivating cotton) over others (fishing and grazing) households were forced to adapt 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.

This study shows that when we identify ecosystem services and associated property rights it exposes the complexity of stakeholders thereby avoiding the tendency to regard users as a necessarily a 'united community' (see also Kemerink et al. 2011). When these links are made explicit it becomes easier for individuals and groups to claim their rights. But, as Scott (2008, 126) observes "...many users, who have a 'right' to make some use of the natural resource do not hold individual property right to it or to its use. What right they do have lacks exclusivity, transferability and divisibility" and this makes it difficult to identify individual users. Our study emphasises the need for institutional arrangements that empower individuals and communities who have established rights to resources so that their claims to rights are properly accounted for in decision making. But as shown above, those who depended on floodplain resources were disadvantaged in a number of ways.

5. Conclusion

We set out to present a property rights perspective for interpreting institutional 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 case study has clearly illustrated why and how property rights are important in mediating institutional regime shifts in the provision of freshwater ecosystem services. It has provided insights into the consequences of failing to recognize, establish and enforce bundles of rights when dealing with institutional regime shifts. As demonstrated in the case study, exclusion and alienation rights were particularly vital in shaping institutional regime shifts on the Pongola Floodplain.

Arguably, a property rights perspective provides a useful 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 which make governance difficult. We have developed an integrated approach to water governance based on theories of ecosystems services and property rights to expose and highlight the inherent inadequacies in the literature on institutional regime shifts. 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.

Literature cited

- Anderies, J. M., M. A. Janssen, and E. Ostrom. 2004. A Framework to Analyse the Robustness of Social-Ecological Systems from an Institutional Perspective. *Ecology and Society* 9(1):18. [online] URL: <http://www.ecologyandsociety.org/vol9/iss1/art18>.
- Basson, G. R., F. J. M. Denys, and J. S. Beck. 2006. *Pongolapoort Dam Flood Release Operational Analysis – Socio-hydrological Investigation, Historical Flood Releases and Mathematical Modelling*. Project No.: 2003-321, ASP Technology (Pty) Ltd and Department of Water Affairs and Forestry, Directorate: Water Resource Planning Systems, Pretoria, 129 pages.
- Breen, C. M. 2016, personal communication. Charles Breen was Part of a Research Team that Conducted Research on the Pongola Floodplain for over four decades beginning in the 1970s. Email: breenc39@gmail.com.
- Buchan, A. J. C. 1988. *Changing Patterns in Pastoral Land Use of the Makhatini Flats and Pongolo Floodplains*. In eds. R. D. Walmsey and C. P. R. Roberts, Occasional Report No. 36. Foundation for Research Development, CSIR, Pretoria.
- Costanza, R. 2008. Ecosystem Services: Multiple Classification Systems are Needed. *Biological Conservation* 141:350–352. <https://doi.org/10.1016/j.biocon.2007.12.020>.
- Crépin, A., R. Biggs, S. Polasky, M. Troell, and A. de Zeeuw. 2012. Regime Shifts and Management. *Ecological Economics* 84(2012):15–22. <https://doi.org/10.1016/j.ecolecon.2012.09.003>.
- Deacon, T. R. 2012. Fishery Management by harvester Cooperative. *Review of Environmental Economics and Policy* 6(2):258–277. <https://doi.org/10.1093/reep/res008>.
- Eastern Cluster. 2005. *Comments by Department Of Water Affairs Chief Director: Pongolapoort Dam: History, Releases and Allocations* (7pp). Compiled by J.C. Perkins and D. Everitt. Department of Water Affairs, Durban, South Africa.
- Farley, J. and R. Costanza. 2010. Payments for Ecosystem Services: from Local to Global. *Ecological Economics* 69:2060–2068. <https://doi.org/10.1016/j.ecolecon.2010.06.010>.
- Fisher, B. and R. K. Turner. 2008. Ecosystem Services: Classification for Valuation. *Biological Conservation* 141:1167–1169.
- Heeg, J. and C. M. Breen. 1979. *The Pongolo Floodplain: its Functioning and Role in the Development of the Makatini Flats*. An impact statement commissioned by the Secretary for Cooperation and Development, Government of the Republic of South Africa, Pretoria, South Africa.
- Heeg, J. and C. M. Breen. 1982. *Man and the Pongola Floodplain*. A report of the Committee for Inland Water Ecosystems National Programme for Environmental Sciences. Council for Scientific and Industrial Research, Pretoria, South Africa.
- Heeg, J. and C. M. Breen. 1994. Resolution of Conflicting Values on the Pongola River Floodplain (South Africa). In *Wetlands and Shallow Continental Water*

- Bodies*, eds. B. Patten, S. Jorgenson and S. Dumont, 303–359. The Hague: SBP Publishing.
- Jaganyi, J., M. Salagae, and N. Matiwane. 2008. *Integrating Floodplain Livelihoods into a Diverse Rural Economy by Enhancing Co-operative Management: A Case Study of the Pongola*. Pretoria: Water Research Commission.
- Kemerink, J. S., R. Ahlers, and P. van der Zaag. 2011. Contested Water Rights in Post-apartheid South Africa: The Struggle for Water at Catchment Level. *Water SA* 37(4):585–594. <https://doi.org/10.4314/wsa.v37i4.16>.
- Lankford, B., C. Pringle, C. Dickens, F. Lewis, V. Chhotray, M. Mander, M. Goulden, Z. Nxele, and L. Quayle. 2010. *The Impacts of Ecosystem Services and Environmental Governance on Human Well-being in the Pongola Region, South Africa*. Report to NERC (Natural Environment Research Council). University of East Anglia Norwich, UK and Institute of Natural Resources, Pietermaritzburg, South Africa, 156. [online] Available from: <http://www.uea.ac.uk/dev/prespa> [Accessed 1 February 2011].
- McCartney, M., J. Jaganyi, and S. Mkhize. 2004. Comprehensive Option Assessment: The Pongolo. In United Nations Environment Programme (UNEP): *Dams and Development Project (DDP) Comprehensive Options Assessment of Dams and their Alternatives*. Pages 35–39, DDP Secretariat, P.O. Box 30552, Nairobi, Kenya.
- Nkhata, B. A., A. Mosimane, L. Downsborough, C. Breen, and D. J. Roux. 2012. A Typology of Benefit Sharing Arrangements for the Governance of Social-ecological Systems in Developing Countries. *Ecology and Society* 17(1):17. <http://dx.doi.org/10.5751/ES-04662-170117>.
- Ostrom, E. 2005. *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press.
- Patton, M. Q. 2005. *Qualitative Research Encyclopedia of Statistics in Behavioral Science*. John Wiley & Sons, Ltd. <http://onlinelibrary.wiley.com/doi/10.1002/0470013192.bsa514/pdf>.
- Pollard, S. and T. Cousins, eds. 2008. Community Based Governance of Freshwater Resources in Southern Africa. In *Review of Cases of Community Based Governance of Freshwater Resources in Southern Africa to Inform Potential Arrangements of Communal Wetlands*. Pretoria: Water Research Commission.
- Pomeroy, R., L. Garces, M. Pido, and G. Silvestre. 2010. Ecosystem-based Fisheries Management in Small-scale Tropical Marine Fisheries: Emerging Models of Governance Arrangements in the Philippines. *Marine Policy* 34:298–308. <http://dx.doi.org/10.1016/j.marpol.2009.07.008>.
- Poultney, C. and C. Bruwer. 2002. The Lubombo Waterways Programme Environmental Flow Releases from the Pongolapoort Dam. In *Proceedings of the Fourth International Ecohydraulics Symposium: Environmental Flows for River Systems. Environmental Flows, Power Relations and the Use of River System Resources*. Cape Town 3–8 March 2002.

- Reed, G. M. and S. Bruyneel. 2010. Rescaling Environmental Governance, Rethinking the State: A Three-dimensional Review. *Progress in Human Geography* 34(5):646–653. <https://doi.org/10.1177/0309132509354836>.
- RSA (Republic of South Africa). 1998. *National Water Act*. Gov. Gaz. 398, No. 19182. Cape Town.
- Salagae, M. A. 2007. Perceptions of the Impacts of Artificial Flood Releases on the General Use of the Natural Resources of the Pongolo River Floodplain, South Africa. Menv.Dev. thesis submitted to the University of KwaZulu-Natal.
- Schlager, E. and E. Ostrom. 1992. Property-rights Regimes and Natural Resources: A Conceptual Analysis. *Land Economics* 68(2):249–262. <https://doi.org/10.2307/3146375>.
- Schreiner, B. 2006. The Government-and Society Challenge in a Fledgling Democracy – Ecosystem Governance in South Africa, with a Particular Focus on the Management of the Phongolo Floodplains and Reservoir. In *Governance as a Trialogue: Government-Society-Science in Transition*, eds. A.R. Turton, H.J. Hattingh, G.A. Maree, D.J. Roux, M. Claasen and W.F. Strydom, 237–251. Berlin: Springer-Verlag.
- Scott, A. 2008. *The Evolution of Resource Property Rights*. Oxford, UK: Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780198286035.001.0001>.
- Torres, J. 1980. The amaThonga People of Maputaland with Special Reference to the Inhabitants of the Pongola Floodplain Area. In *Studies on the Ecology of Maputaland*, eds. M. N. Bruton and K. H. Cooper. Southern Africa, South Africa, Grahamstown and Durban: Rhodes University and Natal Branch of Wildlife Society.
- Vatn, A. 2010. An Institutional Analysis of Payments for Environmental Services. *Ecological Economics* 69:1245–1252. <https://doi.org/10.1016/j.ecolecon.2009.11.018>.