aMadumbe Farmer at Mbongolwane Wetland **Photographer: Amy Panikowski**

Wetlands in South Africa: Their Contribution to Well-being

Report to the

Water Research Commission

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Although wetlands are important for local communities and biodiversity, the services and products they deliver for local livelihoods and river basins are insufficiently known, and inadequately valued and understood by authorities. Cools and others (2013)

Executive Summary

Background and Rational

So as to achieve well-being people access ecosystem services. Especially important are those services sourced from water resources – rivers, streams, wetlands, coastal areas, lakes and dams.

It is widely accepted that unmanaged competition is causing degradation that reduces the supply of ecosystem services. This is particularly prevalent at wetlands where inappropriate land use leads to declining supply relative to need, competitive behaviours and over-utilisation. There is a need to do things differently. Evidence and observation suggest that intellect and energy might be focused on the following:

- Governance and management of what?
- Governance and management by whom?
- What governance systems?
- What management process or system?
- What should be monitored and reported?

Aim (Proposition)

Building on these five questions, the central working proposition for this research project is: *Sustaining the linkages between well-being and wetlands requires governance and adaptive management systems through which rights to access, use and benefit from the ecosystem services derived from wetlands are granted, acknowledged and honoured.*

Results and Conclusion

Historically, wetlands have played and continue to play a critically important role in the evolution and development of societies. Large sectors of society remain directly and indirectly dependent on

the flow of benefits from wetlands. Despite this our recent history is characterised by ongoing destruction on a large scale. Although there is a notable trend towards understanding wetlands as providers of multiple benefits, governance systems that promote wise use of these benefits are still evolving.

In South Africa the benefits accruing from wetlands include, amongst others, water, food, building material, craft material, livestock grazing and watering, crop agriculture, fishing and hunting, aesthetics, spiritual fulfilment, tourism, research and recreation. The estimated loss of wetland area ranged from 20 to 50%. There is a continuing attrition of traditional rights to wetland resources caused primarily by a lack of appropriate property rights-based governance systems. It is acknowledged that in South Africa a rapidly evolving society is less directly dependent on wetlands for subsistence. However, the role of wetlands in contributing to water security is increasing.

Our understanding derived from this historical perspective indicates that whatever process or decision support system we establish it should define wetlands as social-ecological systems; focus on governance and adaptive management; take into account property rights regimes, and acknowledges the role of resource users by devolving governance and management to the local level.

Engaging wetlands in the context of well-being requires a systematic approach in which one establishes what the attributes of well-being and livelihoods are; what benefits are derived from wetland-based ecosystem services; what a wetland 'system' is; through what governance systems rights to ecosystem services are allocated; how the 'system' might be managed, and how the necessary trade-offs might be achieved.

The review and analysis indicate that there are three primary conceptual frameworks that inform thinking at three different scales – the social ecological system, property rights and adaptive management. But, on their own they are not sufficient – empathy and equity are required to make them work.

Six cases were used to illustrate the application and or relevance of the various conceptual tools. They were located at Mbongolwane, Craigieburn, Papenkuils, Pongola, Mpenjati and on Mondi commercial forest land. The case-studies confirmed to a large extent what the historical perspective and the research into a systematic approach were suggesting: wetlands should be engaged as social ecological systems; that unambiguous property rights established with equity and empathy are key to the trade-offs required in benefit sharing, and that an adaptive management approach that recognises the user as the key manager and decision maker. In addition it was recognised that each

wetland social-ecological system is unique so a recipe-based approach using one tool is inappropriate. Depending on circumstances and issues a range of tools and approaches are required. It was also recognised that complexity has the potential to paralyse efforts and that a certain level of 'requisite simplicity' is required when dealing with issues.

A practical guide and technical decision-support system were developed to illustrate how users might get more out of wetlands without compromising their integrity, and to assist them in this decision making process.

Future research

Future research might be directed at Mbongolwane as an appropriate "Green Village" case study and at improving understanding of risk in a water security context.

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Chapter 1: Introduction and purpose

1.1 The Central Proposition

So as to achieve well-being people access ecosystem services. These services include water to drink and bathe, food to eat, clothes to wear, spiritual and cultural fulfilment, products to trade, and numerous forms of protection. Many people are directly reliant on these services; without them survival is compromised. Especially important are those services sourced from water resources – rivers, streams, wetlands, coastal areas, lakes and dams.

It is widely accepted that unmanaged competition is causing degradation that reduces the supply of ecosystem services. This is particularly prevalent at wetlands where inappropriate land use leads to declining supply relative to need, competitive behaviours and over-utilisation. In many instances the traditional and central governance and management systems designed to halt and reverse these trends are not effective. There is a need to do things differently, but what needs to be done differently? Evidence and observation suggest that intellect and energy might be focused on the following:

- **Governance and management of what?** Reconceptualising wetlands as social-ecological systems rather than as threatened ecosystems or utilities – systems in which human health and wetland health are inextricably linked.
- **Governance and management by whom?** Reconceptualising the users of wetland ecosystem services as the primary and de facto managers of how, where and when these services are accessed, and that governance and management respond to each other in an adaptive cycle.
- **What governance systems?** Implementing governance systems based on clearly defined property rights of individuals and groups to wetland ecosystem services, and ensuring that these rights to access and benefits are appropriately granted, acknowledged and honoured.
- **What management process or system?** Management is led and driven by users through an adaptive and iterative learning process.
- **What should be monitored and reported?** Design and implement a monitoring and reporting system that records performance of the property rights regime and the consequences for human well-being and wetland health.

Building on these five questions, the central working proposition for this research project is: *Sustaining the linkages between well-being and wetlands requires governance and adaptive management systems through which rights to access, use and benefit from the ecosystem services derived from wetlands are granted, acknowledged and honoured.*

A corollary to this proposition is that *the restoration of wetland ecosystem structure and functioning (and hence also wetland ecosystem services) cannot be achieved and sustained in the absence of linked processes of adaptive governance and management.*

1.2 The research process

The research process for this project comprised four 'work packages' which are described in Chapters 2 – 6 of this report. It commences with an historical perspective of wetlands and well-being, outlining international, African and South African experiences (Chapter 2). This is followed by a discussion on a systematic approach to engaging wetlands and wellbeing – concepts, models and frameworks that might assist us in our thinking (Chapter 3). Then six case-studies which illustrate experience of a broad range of concepts and practical engagement are described and analysed (Chapter 4). The historical perspective, systematic approach and case-studies are used to inform the design of a process to support improved wetland-based well-being (Chapter 5). Chapter 6 briefly summarises the practical guide and decision support system. The report concludes with suggestions for further research (Chapter 7).

The individual case-study reports are included as appendices on a CD (Appendix 1 – 6) as is the narrative for the practical guide and the decision support system. (Appendix 7)

Chapter 2: Wetlands and Wellbeing: An historical perspective

The projected continued loss and degradation of wetlands will reduce the capacity of wetlands to mitigate impacts and result in further reduction in human well-being (including an increase in the prevalence of disease), especially for poorer people in lower-income countries, where technological solutions are not as readily available. At the same time, demand for many of these services (such as denitrification and flood and storm protection) will increase. Millennium Ecosystem Assessment, 2005 (Ecosystems and Human Well-being: Wetland and Water – Synthesis)

2.1 Global perspectives

The Ramsar Convention defines wetlands as "….including a wide variety of habitats such as marshes, peatlands, floodplains, rivers and lakes, and coastal areas such as saltmarshes, mangroves, and seagrass beds, but also coral reefs and other marine areas no deeper than six metres at low tide, as well as human-made wetlands such as waste-water treatment ponds and reservoirs." (Ramsar, 2006)

Other, less scientifically orientated sectors of society might take a more human perspective and define wetlands quite differently, by their role in society for example. A local resident might define it as the place where he or she cultivates crops, collects drinking water, grazes cattle in winter months, and harvests reeds for thatch and sleeping mats. The water engineer at the local municipality might define it as a source of water for the purification works that supplies the local town, and the birder sees it as the habitat of a rare kingfisher. The important point is that sectors of society tend to define particular landscape features in terms of their perceived value. To steal from and paraphrase Manson (2001) – any definition of a wetland is beholden to the perspective brought to bear on it. This encourages us to appreciate the centrality of perceptions of value to resource users in the design and implementation of wetland governance and management systems.

However we choose to define wetlands, and viewing them through a social lens, it is clear that wetlands have played and continue to play a critically important role in the evolution and development of societies. Large sectors of society have been and continue to be directly and indirectly dependent on the flow of benefits from wetlands. Four examples illustrate the profound nature of this relationship:

- In 2008 fossil fuels (oil, coal and gas) accounted for 81% of global energy usage (Wikipedia, 2012). Of this, 27% was supplied by coal that was formed entirely by wetland and subsequent geological processes. An unknown but substantial portion of the balance (oil and gas) was also formed through these processes.
- Between 1.5 and 3 billion people world-wide are reliant on groundwater for drinking, some of which has been filtered and enters subterranean storage through wetlands. Forty per cent of global industrial activity and twenty per cent of irrigated agriculture are also dependent on this groundwater (MEA, 2005).
- Global coastal wetland fisheries generate approximately $34 billion on an annual basis and, in Cambodia, between sixty and eighty per cent of animal protein for human consumption is secured from wetland-based fisheries, (MEA, 2005).
- In Africa and other developing countries, the survival of many millions of people living in rural situations is directly dependent on the supply of services from wetland ecosystems.

Despite the obvious relationship between wetlands and society, and the value of wetlands to society, our recent history is characterised by their ongoing destruction on a large scale. Barbier (1993) estimated that during the 20th century half of the world's wetlands had been lost in the development of agriculture and infrastructure. Hansen (2006) provides a stark account of wetland degradation in mainland USA. Historically, wetlands were regarded as 'wasted land' and, from the time of colonization to 1954, 40-44% of all wetlands were converted or in-filled. This was primarily for agricultural purposes. Between 1885 and 1954 the average net loss of wetlands in the USA was in the order of 800 000 acres per annum. From 1954 to 1974 the average net loss halved to about 450 000 acres. Recent trends are more encouraging and reflect an increasing appreciation of the value of wetlands. Since 1974 policy and regulatory reform has moved to a 'no net loss' situation and more recently it has moved still further. In 2004 the US Federal Government indicated its intention to restore, reclaim and protect an additional 3 million acres of wetland over the next 5 years.

Hansen (2006), using information from Bergstrom and Brazee (1991), described some of the values and associated benefits that accrue from wetlands (Table 2.1).

Table 2.1: Wetland functions, services and values (from Hansen, 2006; adapted from Bergstrom and Brazee, 1991)

Wetland	Function	Service	Economic values
Private values			
Forest	Tree growth medium	Commercial timber harvest	Net economic value of timber
Fisheries	Fish habitat	Commercial fish harvest	Net economic value of commercial catch
Mixed values			
Recreation	Wildlife habitat	Recreational fishing and waterfowl harvest	Net economic value of hunting and fishing experience
Public values			
Flood control	Flood retention	Reduced flood flows/peak	Net economic value of reduced damages
Water quality	Water filtration	Cleaner waters	Net economic value of reduced damages
Endangered species	Endangered species	Biodiversity	Net option and existence values

The Millennium Ecosystem Assessment synthesis on Ecosystems and Human Well-being: Wetlands and Water (MEA, 2005) provides a more comprehensive assessment of the global state of wetlands and their value to society. It describes the distribution of wetlands, the species they contain and the ecosystem services supplied by wetlands. It outlines the drivers of loss and change to wetland ecosystems and links these ecosystems to human well-being. It presents a range of scenarios for the future and although it encourages wise use it does not adequately address governance of wetlands as social-ecological systems. It also presents a framework for assessment (See Chapter 3, Section 3.3). While all this information is pertinent it will not be duplicated here. Selecting some of the key findings:

- Globally, wetlands cover about 1 280 million hectares, an unknown but substantial proportion of which are significantly degraded.
- Wetlands deliver a wide range of ecosystem services that contribute to human well-being (Table 2.2)

- The total economic value (market and non-market benefits) of unconverted wetlands is usually greater than that of converted wetlands.
- The increasing competition for the use of wetland-based ecosystem services is causing wetlands to deteriorate more rapidly than other ecosystems.
- The primary causes of wetland degradation are population growth and economic development. Specifically, the direct causes have been infrastructure development, land conversion, water withdrawal, eutrophication and pollution, overharvesting and overexploitation, and the introduction of invasive alien species.
- Climate change is expected to accelerate wetland degradation and to increase the incidence of water-borne diseases in many areas.
- It is poor people in less developed, low-income countries whose well-being is most compromised by degradation of wetlands.
- Water resource development projects (dams, irrigation systems, water transfer systems) have not adequately accounted for the harmful impacts they cause to wetland ecosystems.
- Management requires that increased emphasis is placed on dealing with the indirect drivers of change. This includes, amongst others, removing production subsidies, correcting market failures, increasing stakeholder participation, and increasing transparency and accountability of government and private-sector decision-making.
- The MA conceptual framework for ecosystems and human well-being provides a framework that supports the wise use of wetlands.

Table 2.2: Examples of Ecosystem Services provided by Wetlands (extracted from MEA, 2005)

Services	Comments and Examples
Provisioning	
Food	production of fish, wild game, fruits, and grains
Fresh water[a]	storage and retention of water for domestic, industrial, and agricultural use
Fiber and fuel	production of logs, fuelwood, peat, fodder
Biochemical	extraction of medicines and other materials from biota
Genetic materials	genes for resistance to plant pathogens, ornamental species, and so on
Regulating	
Climate regulation	source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water regulation (hydrological flows)	groundwater recharge/discharge
Water purification and waste treatment	retention, recovery, and removal of excess nutrients and other pollutants
Erosion regulation	retention of soils and sediments
Natural hazard regulation	flood control, storm protection
Pollination	habitat for pollinators
Cultural	
Spiritual and inspirational	source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	opportunities for recreational activities
Aesthetic	many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	opportunities for formal and informal education and training
Supporting	
Soil formation	sediment retention and accumulation of organic matter
Nutrient cycling	storage, recycling, processing, and acquisition of nutrients

[a] While fresh water was treated as a provisioning service within the MA, it is also regarded as a regulating service by various sectors.

Internationally, wetlands are also increasingly recognised as settings that determine human health through:

- Access to safe drinking water
- Access to food
- Exposure to pollutants, toxins and infectious diseases
- Exposure to hazards
- Access to psycho-social well-being
- Access to livelihood opportunities
- Access to various material and psychological coping mechanisms
- Access to medicinal plants (Horwitz and others, 2012)

Although there has been a notable trend toward understanding wetlands as providing multiple benefits to society, and as common pool resources, despite the research of Elinor Ostrom and her colleagues this has not been accompanied by development of governance systems in support of the goal of 'wise use'.

2.2 An African Perspective

African wetlands include, arguably, some of the most biologically productive systems on earth. In some instances rural economies are entirely dependent on the flow of ecosystem services that provide food, water, energy, building material, medicine, seasonal grazing and transportation (Kabii, undated). In addition, some of these of these wetlands are the mainstay of lucrative tourism industries that generate numerous jobs, the Okavango delta being an example.

Relative to more developed regions Africa has a high proportion of wetlands that might be considered in fairly good ecological condition. However, impacts on many are significant and pressure is increasing. Direct impacts include drainage and/or infilling for agriculture, freshwater abstraction, industrial effluent, agricultural pesticides and alien invasive species (Kabii, undated). The indirect causes of many of these impacts are population growth combined with increasing levels of poverty combined with economic development that often focuses on resource extraction (such as mining, timber and fishing).

Schuyt (2004) assessed the consequences wetland degradation to local residents at four wetland systems in Africa. She concluded that:

- A total of sixteen distinct goods and services (ecosystem services) were being supplied by the wetlands of which the most important were fish, agriculture, livestock farming, natural products and medicine, and water treatment and purification.
- The primary direct causes of degradation were dam construction, industrial and infrastructure development, reclamation for agricultural purposes and over-use by local people. The indirect causes were uninformed decision makers, and increasing populations and poverty.
- Solving the problems required the integration of natural and social sciences.

Rebello and others (2009) assessed the wetlands of sub-Saharan Africa in terms of their contribution to agriculture and livelihoods. To summarise their key findings:

- 4.7 – 6.0% of sub-Saharan Africa comprises wetlands with freshwater floodplains and marshes the most common types, covering an area of about 690 000 km^2.
- Within this area are 143 sites that are recognised as Wetlands of International Importance, 93% of which support some form of agricultural or fisheries activity. 71% of these wetlands are threatened by these activities.
- Results from the case-studies indicated that there was significant reliance by households on wetland ecosystem services to provide basic needs in terms of food, income and welfare.
- Wetlands are particularly important sources of benefits for survival during periods of resource scarcity.
- The ability to access the benefits from a wetland are highly dependent on socio-economic status of the individual/household.
- Control of wetland resources is mediated through a complex web of traditional, informal and formal institutional arrangements the effect of which is unclear.
- While it appears that use has a negative impact on environmental quality this is of little concern to users.
- The level of dependence on wetlands is highly site specific.

Drawing on the international experience described in the previous section, and specifically the links that exist between wetland health and human health, it is recognised that the links are most direct in the developing countries that characterise most of Africa (Horwitz and others, 2012). There are few socio-economic buffers between people and the wetlands upon which they depend.

The work of Schuyt (2004) and Rebello and others (2009) form a small part of a rich research effort focusing on wetlands and livelihoods in Africa (See Chiuta and Mharapara, 2009; Chuma and others, undated; IWMI, 2006; McCartney and others, 2010; Wetlands International, 2010). Much of this research work is summarised in Chapter 6 of Appendix 7 of this report. Of this research perhaps the most relevant to this study is the recently published book edited by Wood A, Dixon A and McCartney M, *Wetland Management and Sustainable Livelihoods in Africa* (Wood and other, 2013). It is invaluable to those seeking an in-depth understanding of the relationships that exist between livelihoods and wetlands. Its focus is largely on the agricultural use of wetlands. The authors argue that a paradigm shift is required from considering agriculture as a threat to wetlands to one that appreciates that wetlands play a fundamental role in sustaining the livelihoods of rural poor people. In Chapter 1 a framework for 'people-centred wetland management' is proposed. The essential elements of this framework include:

- People operating in a framework of society, politics and various economic, social and cultural incentives.
- People's contribution is reflected in the institutions and coordinated management, economic and socio-cultural incentives, as well as policy.
- The critical interaction is how people and wetlands interact. This is influenced from both the socio-economic and the environmental aspects with their different characteristics.
- The nature of this interaction determines the outcomes in terms of ecological, economic and institutional sustainability

Chapters 2 – 10 comprise papers by leading wetland researchers in Africa. The final chapter outlines some common themes emerging from these chapters:

- Wetland agriculture makes a significant contribution to the livelihoods of rural resource-poor people.
- The pressure on wetlands is increasing
- Some wetlands are more resilient than others and trade-offs are required to ensure wetlands continue to deliver ecosystem services on a sustainable basis
- Local knowledge and local institutions are key to effective management
- Government policy, particularly related to land tenure, can be a major driver of pressure on wetlands.
- The policy process still tends to be top-down with wetland communities continuing to be excluded from policy debates

The authors conclude by proposing:

- The adoption of socio-ecological systemic approach
- A reflexive and learning approach to adaptive wetland management
- Improving our understanding of and incentives for peoples' wetlands use
- Improving our understanding of required trade-offs
- Empowering local institutional arrangements for wetland management
- Influencing the policy debates on wetland use
- Demonstrations of evolving best practice

Nkhata and others (2009) illustrated how new market forces, deconstruction of social capital and a breakdown of legitimacy led to open access in a fishery on the Rovuma River. This was as a result of a number of interlinked factors; traditions and authority weakened; definition and cohesion of the group of fishermen had been disrupted; tenure over the resource was no longer defined either in location or in person; and there was no legitimate control over who harvests where, when, how and how much. And, it was even not possible to sanction those that were clearly breaching the norms and traditional regulations for fishing. A self-reinforcing cycle emerged, resulting from a lack of sanctioning with more and more people engaging in inappropriate fishing practices.

Collectively these studies suggest need for a shift in emphasis from the wetland to governance because the state of wetlands in Africa increasingly reflects the efficacy of governance.

2.3 A South African Perspective

How rural communities in South Africa benefit from wetlands is described by Turpie and others (2010) and illustrated in Table 2.3. To summarise and add:

- Water is collected for domestic use
- Wetland plants are harvested for food and medicine
- Wetland plants are harvested for building material and craft production
- Clay is collected for building material and craft production
- Crops are cultivated and seasonal grazing and watering of livestock takes place
- Subsistence, recreational and small-scale commercial fishing is practiced

– Various recreational, cultural, religious and tourism related activities are associated with wetlands

Table 2.3: Types of Services supplied by Inland Wetlands (extracted from Turpie, 2010)

Types of Services		Description
Provisioning services	Water	Provision of water for livestock or domestic use
	Food, medicines	Production of wild foods and medicines
	Grazing	Production of grazing for livestock
	Raw materials	Production of fuel, craftwork materials, construction materials
	Genetic resources	Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species
Regulating services	Climate regulation	Carbon sequestration; wetlands are believed by some to be carbon sinks that contribute towards reducing carbon emissions, but the opposite may in fact be true
	Flow regulation	Flood attenuation; reduction of the amplitude and velocity of flood waters by wetlands, reducing downstream damage
		Groundwater recharge; wetlands are commonly thought to provide differential recharge to groundwater relative to surrounding vegetation types, and to contribute to dry season base flows
	Sediment retention	Retention of soil and fertility within an ecosystem
	Waste treatment	Breaking down of waste, detoxifying pollution; dilution and transport of pollutants
	Regulation of pests and pathogens	Change in ecosystem health affects the abundance or prevalence of malaria, bilharzia, liver fluke, black fly, invasive plants, etc.
	Refugia	Critical breeding, feeding or watering habitat for populations that are utilized elsewhere
Cultural services	Abundance, rarity and beauty of species, habitats and landscapes	Providing opportunities for : • cultural activities and heritage • spiritual and religious activities and wellbeing • social interaction • recreational use and enjoyment • research and education

The survey of wetland use (Table 2.4) conducted at the Mbongolwane Wetland in northern KwaZulu-Natal by Kotze and others (2002) is illustrative of the type and extent of use by local rural residents.

Table 2.4. Wetland uses and extent of use by rural households at Mbongolwane Wetland, KwaZulu-Natal (adapted from Kotze and others, 2002)

Uses	Percentage of households engaged in the use
Crop cultivation	78
Harvesting of wetland plants for crafts & construction	70
Water for bathing/ washing	64
Soil for domestic use (building)	48
Livestock watering	40
Drinking water	38
Livestock grazing	36
Medicinal plants	36
Tourism/visitors	36
Cultural/religious	32
Hunting	24
Fishing	12

Kotze and others (1995) provided an estimate of the loss of the natural extent of wetlands in South Africa. It ranged from under 20% in western arid and semi-arid areas to 20-50% in the eastern hinterland, northern KwaZulu-Natal and the former Transkei, and over 50% in the rest of KwaZulu-Natal and the Eastern Cape Province, and the coastal areas of the Western Cape Province. These losses were ascribed almost exclusively to human activities – agricultural and urban development and, with it, increased erosion, dam construction, excessive sediment delivery and alterations to freshwater inflows.

In 2009 Kotze and others (2007) summarised what land-uses impact on the health of wetlands. These are listed in Table 2.5.

Table 2.5 The impact of land-uses on wetlands in South Africa (Kotze and others, 2009)

Uses	Historical impacts on wetlands	Current and future impacts on wetlands
Commercial mixed cultivation	Almost all of the transformation of wetlands on commercial agricultural lands took place prior to the late 1980s with the support of the Department of Agriculture. Wetlands were particularly attractive areas for cultivation prior to the ready availability of electricity for the irrigation of non-wetland areas (Kotze *et al.*, 1995; Kotze, 2002).	Much of the original wetland area that was transformed continues to be used (although some areas have been abandoned). But very little new development in wetlands has taken place since the late 1980s. However, the indirect impacts of irrigated agriculture on wetlands (through its competing demand for water) continue to increase. The greatest proportion of wetland still actively used for mixed agriculture is likely to be planted pastures for dairy production (Kotze, 2002).
Sugar cane production	As above.	Almost all of the original wetland areas developed are still used but little new development in wetlands has taken place since the late 1980s, as above.
Subsistence cultivation	Historically this had little impact because only a limited extent of wetlands was occupied by this land-use.	Much new development of wetland has taken place since the mid 1990s. The extent of wetland converted to subsistence-agriculture lands is likely to continue to increase in the future (Kotze *et al.*, 1995; Kotze, 2002).
Commercial forestry	Extensive planting directly in wetlands (resulting in a high intensity of impact) and across the catchments of wetlands (resulting in reduced water inflows to wetlands) took place prior to the 1980s.	Considerable withdrawal of trees planted in wetlands has taken place since the mid 1990s, with the extensive recovery of wetland habitats. Indirect impacts from forestry water use in wetland catchments have remained fairly stable over the last decade.
Urban and industrial development	Some large wetlands were destroyed during the previous two centuries through urban developments (e.g. harbours and airports) (Kotze *et al.*, 1995).	Although current developments tend to be around remaining wetlands, the incremental loss of small wetland areas is continuing and indirect impacts (e.g. from poor storm water management and pollution) are rapidly increasing, particularly with the accelerated infrastructural development that has been taking place over the last few years, and which is set to continue.
Mining	Mines, especially open cast mines, have impacted upon wetlands through direct destruction of wetlands. Mines have also severely contaminated the water supplies of some wetlands.	Although still impacting upon wetlands, the extent to which mining activities contaminate water supplies is now better controlled (through legal mechanisms) than it was in the past. However, open cast mines, mainly for coal, are continuing to destroy extensive wetland areas in certain locations (e.g. the upper Olifants River catchment, Mpumalanga province).
Water storage dams	In South Africa, both large water-supply dams and farm dams have transformed extensive areas of wetland through deep flooding behind the dam wall, and have interfered with the supply of water and sediment to downstream wetlands.	The number of dams and the resulting loss of wetlands from deep flooding have continued to increase steadily over the last few decades, and are likely to continue to do so in the future.
Livestock grazing* / Erosion	Many of South Africa's wetlands are naturally susceptible to erosion but the occurrence and severity of erosion was increased by human activity, especially through the grazing of livestock. Stocking rates were especially high in the first half of the 1900s, precipitating the extensive erosion of wetlands.	Stocking rates have generally declined towards the end of the 1900s and into the 2000s, and consequently some eroded wetlands are well-stabilised. However, the active erosion of many wetlands continues, albeit at a generally slower rate than at times in the past.
Invasive alien plants	Wetlands were invaded by alien plants widely across South Africa, but especially in the eastern and southern parts. Invasive alien plants are generally favoured by other impacts, e.g. drying out of the wetland's catchment and on-site disturbance of the soil.	Although extensive clearing operations have considerably reduced the extent of alien plants in many wetlands, the extent of alien plants continues to increase widely in many others.

Despite the recognition of the importance of wetlands to South African society, the general observation is of ongoing and persistent degradation. The National Biodiversity Assessment 2011 (SANBI, 2011) indicates that, from a biodiversity perspective, wetlands are the most threatened of South Africa's ecosystems and that 48% of wetland types are critically endangered. What might be the underlying causes? Pollard and Cousins (2008), in their review of community-based governance of freshwater resources in Southern Africa, observed significant changes in roles and responsibilities regarding natural resource management which were compromising and causing concern over land and natural resource tenure – "Despite the best intentions of policy reforms and democratization, there appears to be a 'muddying of the policy waters', with various authorities claiming authority over the control and management of natural resources." There is uncertainty about who has been delegated what and where. In their review, which included case-studies in South Africa, Mozambique, Zambia and Zimbabwe, they observed the phenomenon of legal pluralism in all these countries. Specifically, this related to the overlap of multiple laws and jurisdictions and the overlap of these laws and customary governance systems. It was concluded that insufficient attention was being given to governance systems and that local systems, considered to be resilient, adaptable and enduring, were undervalued and undermined.

Despite new democratic institutions of governance in South Africa committed to promoting equity, enfranchisement and empowerment, we observe a continuing attrition of the traditional rights of people to access natural resources. As property rights regimes collapse, resource user behaviour shifts toward open access and the tendency for overharvesting. The reasons for this are likely to be a combination of the following:

- Property rights regimes (as systems of governance) are poorly understood in the context of wetlands
- Holders of the rights are not identified and use legitimised
- Rights are not defined in relation to the diversity of benefits derived from wetlands
- Process that support the allocation and realisation of rights to access and benefit is inadequately conceptualised and is poorly defined
- Understanding of the relationship between bundles of ecosystem services (benefits) and property rights is inadequate for effective governance.
- Development unwittingly prejudices some rights holders favouring others
- Monitoring and reporting is neither appropriately designed nor implemented and this compromises governance and capacity for adaptive management

One should also note that South Africa is a rapidly developing and evolving economy, and change, even in rural areas, is accelerating. With widening access to processed products such as food and fibre there less direct reliance on natural resources for well-being and, where the reliance remains, the nature of the reliance is changing. As an example: when water is reticulated to homes, residents no longer have to collect water at the local wetland; roofs are now of corrugated iron rather than thatch from reeds; cropland in wetlands is lying fallow as subsistence agriculture becomes less necessary, even unappealing, and stock numbers are declining in many areas. These changes signify a shift in the value resource users attached to wetlands. A shift is also evidenced in values, such as biodiversity, that new resource users attach to wetlands. Consequently the importance of retaining the ecological integrity of wetlands persists even when motivation for doing so changes. While in the past the primary beneficiaries of the wetland ecosystem services would have been local residents, the 'catchment of beneficiaries' has expanded, become more diverse and more dispersed across the landscape, and even the country. This makes the management of the wetland and the allocation of benefits far more complex – the common pool resource is becoming common to a greater pool of beneficiaries. And, more people believe that the Constitution grants them rights to such benefits.

2.4 Relevance of these perspectives to the design of a decision support system

What key messages should we take into account in developing a decision support system that restores and improves the well-being of wetland social-ecological systems?

- The historical focus on the state of wetlands focused attention on the symptoms of degradation and not on the causes. It is the choices we make and exercise that must be managed if the benefits of wetlands are to be realised in the long term.
- Natural wetlands, in addition to the benefits they may provide to distant people, commonly provide essential services that sustain the well-being of people who relate directly to the wetland. These people are defined by their location and dependence on the wetland. It is these people who are the focus of the proposed decision support system because they interact most directly with system and significantly determine its condition.
- Historical perspectives on wetlands and wetland management have generally ignored two significant factors. The first is that the loss of wetland services and the consequent benefits are to varying degrees compensated for by growth in other services and benefits. The second is that not all wetland services are irreplaceable. This means that in the design and

application of a decision support system we need to ensure that consideration of trade-offs, scale and timing are appropriately incorporated.

- Worldwide, the continuing trend of wetland degradation indicates that governance systems are not working as they should. It appears that in many instances the state cannot or prefers not to reach down to the local level. Because of the changes that have occurred at local scale there is uncertainty about how to integrate governance vertically and horizontally and reconstruct local scale governance. There is a hiatus that needs to be resolved, particularly in those situations where a wetland has been (and remains) a common pool resource. There is a fundamental need to design and restore local governance systems that ensure accountability and are able to adapt appropriately to evolving circumstances.
- Where degradation has been curtailed and reversed this has come about because of 1) a growing understanding of the value of these systems and to whom the value accrues followed by 2) strong direct policy intervention 3) strong regulatory enforcement, and 4) compelling economic incentives.

Our analysis indicates that wetland conservation and management has not been conceptualised as linked social and ecological systems in which the states of both are significantly determined by the effectiveness of governance. This is because governance determines the choices we make and implement; it provides the reasoning and regulatory mechanisms that control access and use so that we can adapt to change in demand for and supply of wetland services. A wetland social-ecological system is not a system in the absence of effective governance.

The implications of this understanding for our proposed decision support system are that it should:

- Define wetlands as social-ecological systems
- Focus on governance and adaptive management
- Take into account need for a property rights regime that enables accountability for use
- Acknowledge the role of resource users by devolving governance and management responsibilities to local levels

Chapter 3: Wetlands and well-being, a systematic approach

3.1 Introduction

In order to engage our central proposition (Sustaining the linkages between well-being and wetlands requires governance and adaptive management systems through which rights to access, use and benefit from the ecosystem services derived from wetlands are granted, acknowledged and honoured) and build on what has been learnt in Chapter 2 the following questions are pertinent:

- What are the attributes of well-being and livelihoods?
- What benefits are derived from wetland-based ecosystem services?
- What is a wetland 'system'?
- Through what governance systems are rights to ecosystem services allocated?
- How might the 'system' be managed in a manner that is adaptable and locally relevant?
- How do we achieve equitable trade-offs between competing users and uses?

3.2 Well-being and livelihoods

"After all, life satisfaction is neither a direct, verifiable experience nor a known personal fact like one's address or age. It is a global retrospective judgment, which in most cases is constructed only when asked and is determined in part by the respondent's current mood and memory, and by the immediate context." (Kahneman and Krueger, 2006).

Defining and measuring well-being has proved somewhat illusive but the following attributes, drawn from a combination of sources (NEF, 2011; MEA, 2005) allow us to establish a fairly clear understanding of what well-being is:

- The freedom of choice and action
- The fulfilment of fundamental needs
- A sense of individual vitality
- The ability to undertake activities that are meaningful, engaging, and which make people feel competent and autonomous
- A stock of inner resources to help people cope when things go wrong and be resilient to changes beyond their immediate control

- A sense of supportive relationships and connectedness with others.
- The dynamic process that gives people a sense of how their lives are going, through the interaction between their circumstances, activities and psychological resources

The New Economics Foundation (NEF, 2011) proposes five steps to achieving well-being - 'connect', 'be active', 'take notice', 'keep learning' and 'give'.

The primary constituents of well-being include health, nutrition, safety and protection, material possessions, education/learning, identity, social relations, and creativity. What ultimately constitutes overall well-being is unique to each individual and unique to different groups of individuals.

In the context of this research, where the focus is primarily on rural people living at or near wetlands, is the observation that there is a strong positive correlation between level of income and well-being. This appears obvious but it should be noted that as income grows so does the correlation weaken to the point that, amongst affluent people, little or no correlation is found.

The concept and assessment of livelihoods has come to the fore more recently. It gained traction in the late 90's and early 2000's through work conducted on behalf of the British Government's Department for International Development (DfID). The concept and analytical framework is set out in a series of Guidance sheets summarised in DfID (1999). "A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base." (DfID, 1999).

While the concept of livelihood appears more narrowly and mechanistically defined than that of well-being, it is apparent that they are complimentary - in achieving livelihood outcomes one achieves many of the constituents of well-being. An important advance in the development of the livelihoods concept was the recognition that cash (financial capital) was only one constituent of a basket of capital (or assets) that were required to fulfil livelihoods objectives. The narrower definition of livelihood also lent itself to a fairly objective framework for analysis that is illustrated in Figure 3.1.

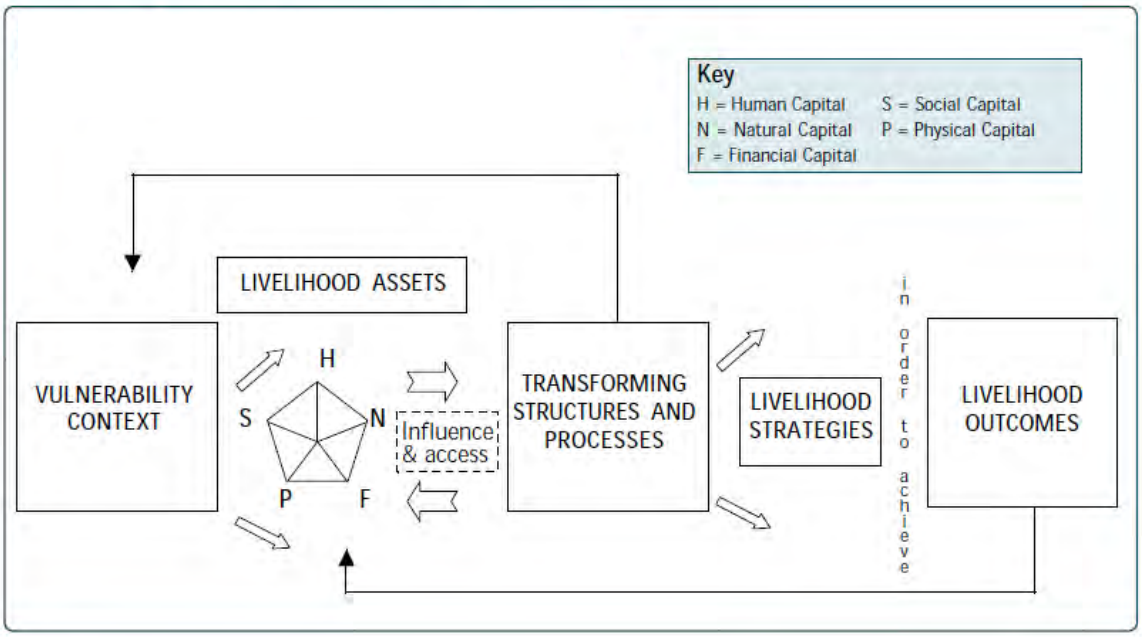

Figure 3.1: The Sustainable Livelihoods Framework (DfID, 1999).

While recognising the value of the sustainable livelihoods approach, in this research we are adopting the more holistic concept of human well-being as it relates to wetlands. We are doing this primarily for two reasons. One of our main points of departure is the Millennium Ecosystem Assessment which uses the term 'well-being' so we will remain consistent in the use of language. Second, we sense that wetlands contribute more to society than livelihood opportunities; they contribute to overall well-being.

3.3 Wetlands as suppliers of ecosystem services

The Millennium Ecosystem Assessment (MEA 2005) illustrated in Figure 3.2 appears to make the first formal attempt to link a bundle of ecosystem services to the various constituents of well-being

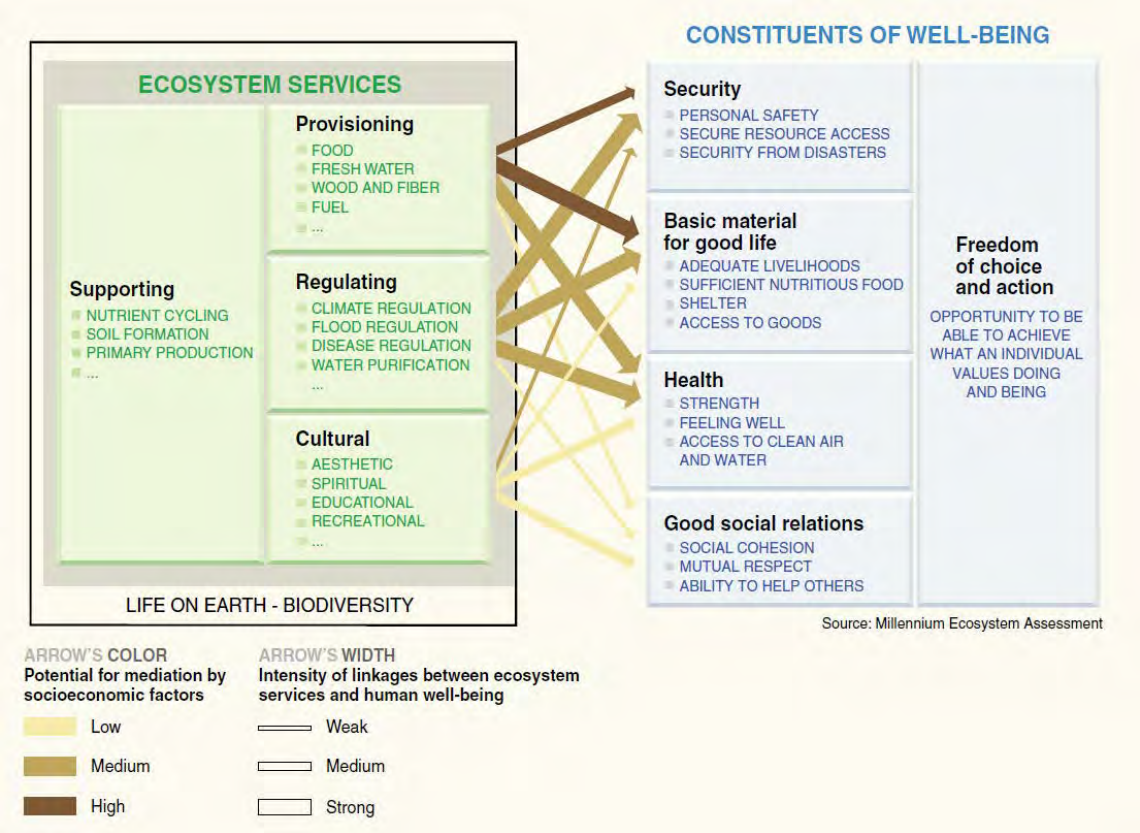

Figure 3.2: The relationship between ecosystem services and well-being as conceptualised in the Millennium Ecosystem Assessment (MEA, 2005)

Despite being central to the Millennium Ecosystem Assessment, the concept of an ecosystem service based approach to natural resource management is still in its infancy. To quote Fish (2011) "….natural and social scientists are still a long way from appreciating fully the practical needs and consequences of thinking about the natural world in this way." However, despite arguments about what constitutes an ecosystem service and how we might measure it, the concept is here to stay. There are two areas that the MEA (2005) does adequately address. The first is how institutions mediate the relationship between ecosystem services (resources) and societal well-being (users) and how societal well-being impacts on the provision of ecosystem services. These are addressed in Section 3.4.

As it relates to wetlands, there are comprehensive inventories of ecosystem services that are derived from wetlands and contribute to human well-being. A useful example is included as Table 3.1.

Table 3.1: A detailed list of ecosystem services and their roles supplied by freshwater wetlands (extracted from Kotze and others, 2007)

Ecosystem services supplied by wetlands	Indirect benefits	Regulating & supporting benefits	Flood attenuation		The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
			Streamflow regulation		Sustaining streamflow during low flow periods
			Water quality enhancement benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
			Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter
		Biodiversity maintenance[2]			Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
	Direct benefits	Provisioning benefits	Provision of water for human use		The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
			Provision of harvestable resources		The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
			Provision of cultivated foods		The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits	Cultural heritage		Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
			Tourism and recreation		Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
			Education and research		Sites of value in the wetland for education or research

Wetland ecosystem services are located in a landscape of other non-wetland ecosystem services upon which rural people may depend. People need the mix of terrestrial and wetland ecosystem services. They also need the mix of ecosystem services (natural assets) and other assets (physical, financial, social and human) so as to achieve well-being. The mix and the relative importance of each asset varies across the population and in time and space.

In the current rapidly commercialising context there are commonly chains of beneficiaries that may extend far beyond the individual who relates directly to the service, the first link in the chain – the reed harvester is far removed from the user of the fibre-based conference bag. As the chain extends and branches the market expands creating opportunity for the 'harvester of the service' to supply a bigger demand and in doing so to improve personal wellbeing, sometimes to the detriment of others. Competition may increase with opportunity so that wellbeing becomes increasingly determined by what is possible. The expectation and standard of well-being change. Because there are usually multiple resource users for any particular system, wellbeing is just as much determined by the governance system that regulates rights of access and use as it is by the demand for and supply of wetland services.

3.4 Wetlands as complex social-ecological systems

Commencing from very divergent views there is the convergence of thinking on wetland governance and management. A health professional's starting point has traditionally been the human body and, until recently, little attention was focused on the management of ecosystems in support of human health. To quote Horwitz and others (2012) "… yet the management of ecosystems is generally given a low priority against the medical imperatives of attending to curing disease." Historically, health professionals viewed wetlands simply as a source of infectious diseases and various hazards. By contrast, the starting point of the wetland ecologist was the ecological health of the wetland. Although many studies illustrated how wetlands were used and their importance in local economies, much less attention has been given to how access and use are regulated and more particularly, how rights are allocated, and abuse controlled.

All this has changed. Health professionals are now recognising that a healthy wetland regularly reduces disease infection rates. To quote Horwitz and others (2012) again: "To public health practitioners, then, wetland ecosystems can be usefully articulated as *settings* for people's health, where the influences of cultural, economic and political factors are also located." This echoes earlier comments by Forget and Lebel (2001) that "thinking about public health has evolved towards a much more global, more ecologic approach." Similarly ecologists have coined a phrase – working wetlands – which recognises that wetlands generate a considerable flow of benefits for people (McCartney and others, 2005); are establishing the agricultural potential of wetlands (McCartney and others, 2005); are developing techniques for assessing the ecosystem services supplied by wetlands (Kotze and others, 2009), and economists have developed tools to establish the livelihood value of wetlands (Turpie, 2010). Ecologists and health practitioners both now recognise that people

are an intrinsic part of wetland ecosystems – both, from divergent starting points, have arrived at the 'door' of the social-ecological system.

Social-ecological systems have been defined variously as people, their natural and human-made resources and the relationships among them (Anderies and others, 2004), linked systems of people and nature (Roux and others, 2009) or "…. a bio-geo-physical unit and its associated social actors and institutions. Social-ecological systems are complex and adaptive and delimited by spatial or functional boundaries surrounding particular ecosystems and their problem context." (Glaser and others, 2008). While it is generally agreed that these systems are 'real things', Jahn and others (2008) advance an additional view: "It is yet also possible to understand social-ecological systems as models of knowledge about real-world phenomena."

A recently completed Water Research Commission project developed an approach to support estuary-based economic empowerment (Bowd and others, 2012). Following the comparative analysis of a number of frameworks, that of Anderies and others (2004) was chosen as the conceptual basis for the process (Figure 3.3).

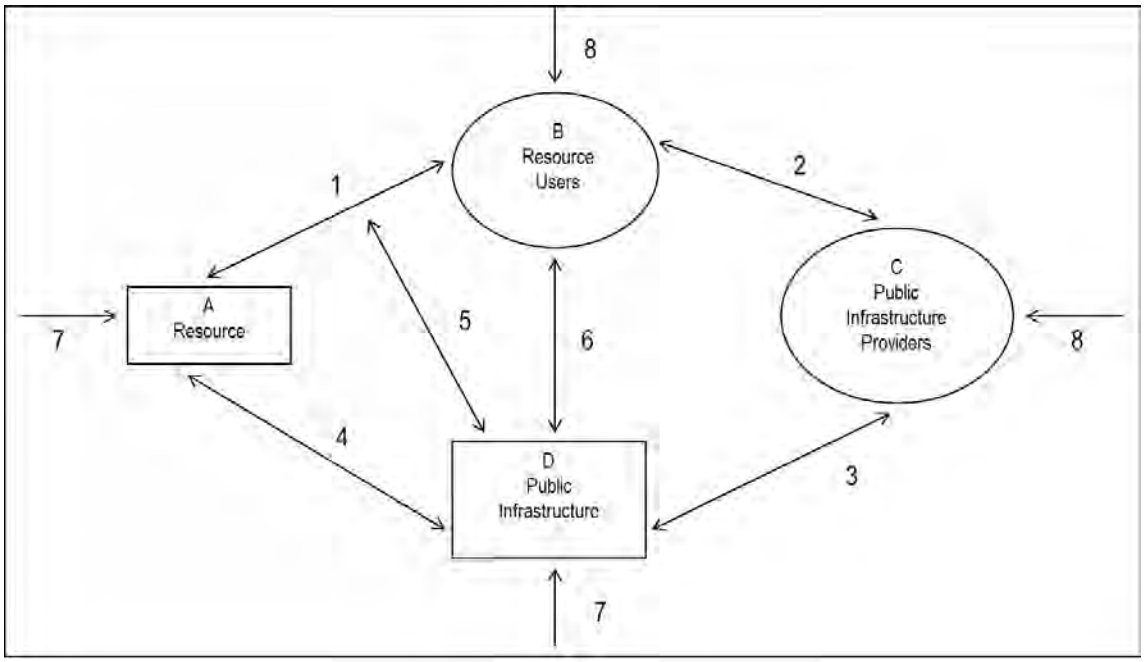

Figure 3.3: A Framework illustrating a social-ecological system as conceptualised by Anderies and others (2004).

Explaining the Anderies and others (2004) framework in some detail and using questions that link us back to our proposition:

The system

A social-ecological system is a human construct, a model of how we see the world, and as such there can be no definitive boundaries. So, we define the system according to the purpose of study. For example, we could delimit the system (set the boundary) by focusing on those who live locally and are directly linked to the wetland through use of services. If the Okavango Swamps is the wetland we may choose to set the boundaries to include resource users who benefit directly from the swamps but also those (e.g. Angola and Namibia) who may affect the flow of water into the swamps. The boundaries are thus made to be fit for purpose. The Anderies framework is a depiction of how we understand a social-ecological system. It allows us to set the boundary to fit the purpose and so it would be equally applicable across scales from local to international. With this in mind, the first question is:

- What is the purpose of the investigation?

As we have indicated earlier, the purpose we have set for this study relates to wellbeing of resource users who engage the wetland directly. This would allow us to set the spatial boundary to include local residents who use the wetland services. This does not necessarily exclude the influence of, for example, central government. For the purpose of the study central government would be regarded as exerting influence from 'outside' the system as we have chosen to define it. Once we have a conceptual bounding for the study we can achieve more precise answers to the questions that the framework raises, while appreciating that we can reset the boundary as we learn more about the system. Questions to which we would need answers are:

The resource (the natural asset)

- What is the resource defined in terms of services and how do they vary in time and space?
- What have been trends in supply of ecosystem services?
- What does it comprise? (What are its key biophysical features?)
- What are its spatial limits?
- How is it connected to other resources and should this affect system boundaries?

The resource users

- Who makes use of the wetland services?
- Where are they from?

- What is the state (or states) of well-being of people using the wetland and are there any obvious trends?

The public infrastructure providers

- Who has responsibilities for governing this wetland?
- What government departments, systems of traditional leadership and other agencies should be participating?
- Who makes the rules or laws that dictate how people use the wetland?
- How influential are those whose wellbeing is most affected by access to wetland services?
- Who supplies the infrastructure, services and equipment that allow the use of the wetland?

The public infrastructure

- What are the rules, conventions and norms that govern use?
- Are there rights of access that govern use?
- What infrastructure and services are in place to support use of the wetland?

The relationship between the users and the resource (Arrow 1)

- Who is using the wetland?
- What is being used from the wetland and what is it being used for? (What ecosystem services are being supplied by the wetland?)
- How important are the uses? (What is the contribution of various ecosystem services to the well-being of people in the system and at what scale?) (What proportion of household income is coming from the wetland?)
- How are the various uses changing over time and what is causing these changes?
- How are the various uses organised and allocated to people? (What property rights regime is in place for each ecosystem service?)
- How does one use of the wetland affect another use or other uses of the wetland? (Are there conflicting or contradictory property rights regimes in place?)
- How are the uses of the wetland affecting its health? (What is the impact of use on the ecosystem?)
- Are there potential uses that have been thought of that would benefit people but are not being used?

- What is the trajectory of change? (rapid, slow, gradual, erratic, large spatial scale, small spatial scale)
- How would these potential uses benefit people?
- What issues exist around the use of the wetland that we have not covered?

The relationship between users and public infrastructure providers (Arrow 2)

- What are the processes for ensuring participation when establishing and implementing rules of use?
- How is infrastructure and service delivery planned and implemented?
- How are decisions recorded and circulated?
- Do the users play a role in making decisions? If so, how does this happen?
- Does the system work?
- What are the problems that are encountered?
- How might these problems be solved?
- How is progress assessed and reflected in adaptive management?

The relationship between public infrastructure providers and public infrastructure (Arrow 3)

- What processes do the public infrastructure providers use to establish policy and regulations?
- How do the infrastructure providers plan and adapt the infrastructure and service delivery?
- Is compliance monitored and is sanctioning effective?
- How effective is maintenance of infrastructure and services?

The relationship between public infrastructure and the resource (Arrow 4)

- What impact are the rules having on resource levels/condition?
- What impact are the physical infrastructure and services having on resource levels/condition?

The relationship between public infrastructure, and the resource and the users (Arrows 5 and 6)

- Do the users think that the rules of use are fair and effective?
- Do the users think that the infrastructure and services are appropriate and adequate?
- Are the users participating in making the rules, and managing and governing the wetland?
- Are the users participating in developing and maintaining infrastructure and services?

The impact of external driving forces on any component or any relationship within the system (Arrows 7 and 8)

- What are external forces impacting on the system (resource, resource users, public infrastructure providers and public infrastructure)?
- How are they impacting on the system?
- How are they affecting people's well-being?

The Anderies framework provides structure, a contents page that can be used to develop assessments of how the wetland contributes to wellbeing. Answers to the questions provide the insights necessary for adaptive management.

3.5 Wetlands as common pool resources subject to common property theory

Moving from the system to the governance of the system it is evident that for a resource users to benefit from the ecosystem services supplied by a wetland they require rights of access and use. Some key questions include:

- What rights have been granted, and by whom, to individuals or identified groups and what are these levels of rights (see Table 3.2)?
- To what ecosystem service does the right relate – is it water for drinking or for irrigating crops or for harvesting materials?
- Are there variations in these rights in space and time?
- Are there conflicting rights
- Are the rights appropriate to the supply of and demand for services

Ostrom and Schlager (1996) disaggregated rights and positions (Table 3.2) and so provided a framework for analysing rights within the context of a social-ecological system.

Table 3.2: Bundles of Rights Associated with Positions (extracted from Ostrom and Schlager, 1996)

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	X	

Exclusion	X	X			
Alienation	X				

Nkhata and others (2012), drawing on, amongst others, the seminal work of Ostrom and colleagues, reviewed the international research experience of property rights and aquatic ecosystem service management. To summarise two general points: first, wetlands and many other aquatic systems can be considered common-pool resources – the exclusion of users is difficult and each user has the potential to subtract from the welfare of others. (A common pool resource is common to a 'pool' of resource users, not necessarily every one. This is why it is a requirement that the users and resource are bounded. If this is done, then, within the group, it may be difficult to exclude but it may be easy to exclude 'outsiders'.) Second, common-pool resources lend themselves to effective governance through the implementation of appropriate common property rights regimes.

Specifically, Nkhata and others (2012) demonstrated that property rights regimes regulate and coordinate the allocation and sharing of benefits that accrue from ecosystem services; that clearly defined property rights build 'social capital' for the common good; that secure property rights provide incentives for investment in the management of the resource; and finally, that secure property rights result in improved resilience of the social-ecological system.

So, at a wetland, different individuals or groups might have different bundles of rights for different ecosystem services within different property rights regimes that might vary both in time and space. As an example, local women living near a wetland might have right of access to conduct agriculture in certain sections of that wetland and the right to withdraw water for household needs anywhere in the wetland at any time of the year. They might also have the right to harvest (withdraw) reeds in April from certain sections of the wetland and the right to exclude non-locals from this right. They might have no right with respect the harvesting (withdrawal) of medicinal plants, a right allocated to the local herbalist and traditional healer. It is our view that these rights are poorly understood and have been eroded – by both omission and commission they are not granted, not acknowledged and not honoured.

3.6 Adaptive Management

The theory and practice of adaptive management as it relates to freshwater resources is detailed in McLoughlin and others (2011) and Kingsford and Biggs (2012). To highlight key aspects pertinent to this study:

- It is designed to engage complex social-ecological systems where there are high levels of uncertainty
- It is a learning-by-doing approach with ongoing negotiation, learning, iteration and adaptation
- It facilitates social learning taking into account both social and ecological dimensions of a system
- It focuses on achieving consensus through cooperation
- It recognises that while knowledge and understanding will always be incomplete, action is required

So, if we recognise wetlands as complex social-ecological systems it is inevitable that we should use an adaptive management – a 'management by experiment' – approach in support of both social and ecological well-being.

Current 'state-of-the-art' is Strategic Adaptive Management (SAM). The process is illustrated in Figure 3.4. It supports the realisation of our proposition. It is, in effect, a rigorous process followed by stakeholders to:

- Achieve a shared vision for and understanding of a wetland social-ecological system
- Established the preferred state
- Set and implement operational objectives
- Monitor, review and refine

Importantly, it engages the detail of where, what, how, when, who and how much.

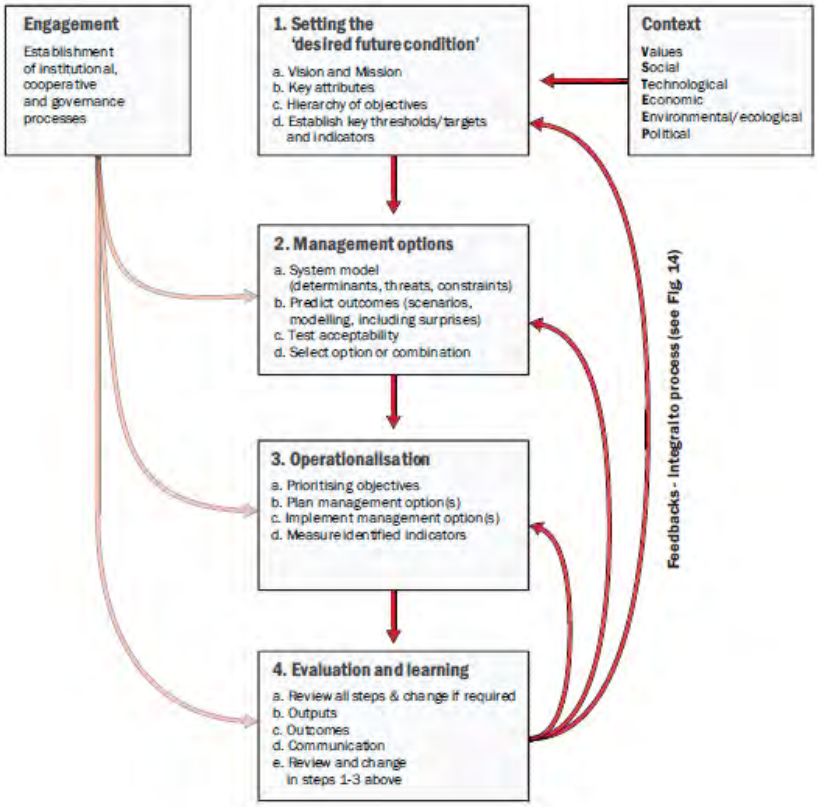

Figure 3.4: A generic strategic adaptive management framework (extracted from Kingsford and Biggs, 2012)

3.7 Benefit sharing

Opportunity for conflict and contestation arise whenever something is to be shared. For example there may be disputes around who has a legitimate claim to benefit or about how the benefits should be distributed. Because core values are such strong determinants of behaviour, they may even determine whether or not a claimant believes the benefit should be accessed. Benefit sharing involves trade-offs among claimants and therefore has to be guided by a set of principles that regulate decision making, access and behaviour so that a preferred distribution can be determined and implemented. Six important principles are:

- Legitimacy must be established for all claimants
- Those who have rights participate in decision making
- Rights to access and use must be unequivocal and require accountability
- Use of benefits should be efficient and yield optimal return

- Distribution should be equitable and empathetic
- Distribution should be adaptable and accommodate change

Population growth commonly results in demands that cannot be matched by the supply of benefits from natural systems. The implication is that we need to improve and sustain efficiency in the use of benefits while ensuring equitable distribution. To do this we must give attention to making sure that those who are allocated rights to access and use ecosystem services have the capacity to optimise benefit.

There are three important determinants of capacity (Wigboldus and others 2010):

- Context. Does the environment in which the rights holders operate enable efficient use of the services? How can this be improved?
- Capabilities. Do the rights holders have the capabilities (e.g. skills) necessary to enable efficient use of both the rights and the capabilities they have? How can the capabilities be improved?
- Capacity Assets. Do the rights holders or the group have the necessary assets (finance, hardware etc.) to enable efficient use? How can the assets be improved?

Paying attention to capacity development in benefit sharing improves efficiency and the return that can be achieved from the basket of ecosystem services. It also reduces potential for conflict caused by perceptions of wastage.

The informal mantra of the South African Department of Water Affairs “Some for all forever” reflects an intention for equitable sharing of the benefits from access to and use of the services deriving from aquatic ecosystems such as wetlands. So, recognising firstly that the majority benefits deriving from wetlands are accessed collectively and wetlands should be governed as common pool resources, and secondly that trade-offs between competing users are inevitable, how are equitable benefit sharing arrangements achieved?

The term ‘benefit’ generally implies an advantage or gain from something and so we may consider a benefit as something that promotes well-being. But, because what each of us needs to improve wellbeing may be quite different, individuals and groups value wetland ecosystem services differently and we can readily appreciate that sharing issues will continue to form the core basis of debates about the governance and management of the use of wetland ecosystem services. Given that the supply of and demand for aquatic ecosystems services are so variable in time and space (Koch and others, 2009), there are widely differing opinions on how to respond to the complexity

surrounding benefit sharing arrangements. Complexity in turn is fuelled by heightened uncertainty about the likely consequences for wellbeing of both collective and individual choices. As demands for access to and use of aquatic ecosystem services become more diverse and grow, relative scarcity will increase fostering competitive rather than cooperative behaviours necessary for sustainable and equitable allocation of the associated benefits.

It is increasingly appreciated that governance and management systems that provide an acceptable degree of security of access to ecosystem services is necessary for fostering sustainable use because investment (effort, finances etc.) is usually required to realize the benefits of wetland ecosystem services.

In such complex contexts, governing and managing the use of the benefits of wetland ecosystem services is not simply a matter of setting a utility function and selecting the alternative leading to the preferred set of consequences. On the contrary, it requires a systemic framing of key determinant variables which define the effectiveness, efficiency, equity and sustainability of benefit sharing arrangements. Knowledge about benefit sharing must be scientifically reliable and evolve to remain contextually relevant.

3.8 Conclusion

We have three frameworks informing our thinking at three different scales: Anderies and others (2004) framework which informs our understanding at the scale of the social-ecological system, Ostrom and Schlager's (1996) property rights matrix informing governance, and the Strategic Adaptive Management framework outlining a detailed management process. The key question, moving forward is how do these frameworks, together with our social and historical perspective of wetlands, inform and assist in structuring a decision support system which supports our proposition.

Sharing the benefits of natural systems such as wetlands is increasingly a fact of life. If ecosystem services are to be sustained we must contextualise ecosystems as connected to, even embedded in, social systems; we must move away from protecting wetlands, for example, to sustaining social-ecological systems. We cannot do this until we share understanding of how to conceptualise social-ecological systems, the benefits we can derive from them and the roles they play in wellbeing. The frameworks we have elaborated are an aid to achieving this. But they are not sufficient because sharing is stressful as it involves trade-offs, taking from some to give to others, and what we once

had we may no longer receive. Ways of achieving this have evolved over millions of years and have been expounded by Ostrom and colleagues. The lesson is clear: a property rights regime that is founded on equity and empathy offers an instrument we can apply as we learn and develop the capacity to live within the changing limits of sustainability.

Chapter 4: Case-study descriptions

4.1 Introduction

Building on the historical perspective (Chapter 2) and conceptual foundations (Chapter 3) what can be learnt we learn from a variety of cases in order to design a process *to promote reflection, learning, dialogue and adaptive decision-making which directs governance and management toward sustainable access and use of wetland ecosystem services for human well-being?*

In order to build collective understanding six thematically and/or geographically based case-studies were selected (see Figure 4.1 for geographical locations):

Figure 4.1 Location of five of the six case-studies in South Africa (Mondi included several sites)

1. Mbongolwane - an ongoing analysis of wetland-based natural resource use at the Mbongolwane Wetland in northern KwaZulu-Natal
2. The Governance of Craigieburn – a meta-reflection on the governance of the Craigieburn Wetland in Mpumalanga
3. The Waterblommetjies of Papenkuils – A social-ecological systems analysis of the Papenkuils Wetland in the Western Cape

4. Property Rights, Ecosystem Services and Water Resources (Pongola) - An introduction to property rights and water resources with a focus on wetland and floodplain examples
5. Mpenjati Estuary - Connecting supply and demand: a process for stakeholder learning about trade-offs in social-ecological systems
6. Mondi – a social-ecological systems analysis of Mondi's approach to wetlands and livelihoods.

The Papenkuils, Craigieburn, Mbongolwane and Mondi cases were specifically commissioned for this project. The estuaries case study draws on a recently completed long term research and application programme, the Eastern Cape Estuaries Management Programme, of which the Water Research Commission was a major funder. The property rights case study is drawn from a recently completed study on property rights and water resources commissioned by the Water Research Commission.

Why were these case-studies chosen? To a certain extent their choice was opportunistic. Researchers were already engaged or were able to engage almost immediately, or the cases formed part of recently completed research projects. Apart from that these cases:

1. All focused on the relationship between wetlands (in the broadest sense) and human well-being
2. Were located, if geographically defined, in biophysically diverse settings
3. Were located in three provinces in diverse social and political settings
4. Where the case-study was a specific site, included groups of people who relied significantly on wetland resources for their well-being
5. Drew on a broad range of diverse expertise and perspectives from AWARD, the WWF Mondi Wetlands Project, University of KwaZulu-Natal, Monash and Eco-futures
6. Drew on the insights of experienced researchers, many of whom had been linked to a particular case for some time
7. Were cost-effective

One of the key strengths of the cases was the diversity of perspectives – the authors focused on different aspects and viewed them through different 'lenses'. Following in Table 2.1 is an attempt to summarise the focal areas of the case-studies.

Table 4.1: The level of emphasis placed by the respective case studies on different themes encompassed in the research

Key themes/elements	Case-studies					
	Papenkuils	Craigieburn	Mbongolwane	Pongola	Mpenjati	Mondi Land
Reflection and learning	***	*****	******	***	******	*
Dialogue/ communication	*	***	***	*	******	***
Adaptive decision-making/ management	***	***	*	*	***	***
Governance and access	***	******	***	******	*	******
Use of wetland ecosystem services	******	*	******	***	***	*
Human wellbeing	***	***	******	*	*	*

Level of emphasis: *=Low, ***=Intermediate, ******=High

Following are short summaries of each case, focusing on the key findings. The full descriptions are appended.

4.2 Mbongolwane Revisited (Appendix 1)

Introduction

Mbongolwane wetland located in northern KwaZulu-Natal is a National Freshwater Ecosystem Priority Area (NFEPA), providing habitat for the endangered Crowned Crane.

In 2002 research was conducted here (Kotze et al, 2002) to establish the extent to which local residents were making use of wetland-based natural resources. A portion of this research, specifically a survey of local residents was repeated in 2013. The primary purpose of this second survey was to determine what changes had taken place in wetland natural resource use in eleven years and what was driving these changes. A second purpose was to assess briefly how the use of various 'tools' might have contributed to different emphases in conducting this research. The third

purpose was to assess briefly the extent to which local residents (one living at Mbongolwane and two in Eshowe) could conduct the field research and contribute to the compilation of a report.

Key findings

Wetland use

- The intensity of wetland use was declining markedly driven by an aging user group and lack of use by younger people.
- There appeared to be no increase in wetland cultivation to compensate for declining sugar cane cultivation.
- There were fundamental contradictions between legal provisions related to wetland natural resource use and what is actually taking place at Mbongolwane. While formal authorisation is required for most direct use this is not obeyed, nor is it enforced.
- Local conventions, customs and rules around the use of the wetland (allocation of plots, seasons for harvesting of reeds and sedges, grazing and watering of livestock etc.) were less strictly enforced than before.
- Land-use competition around the wetland, particularly between new sugar cane cultivation and stock grazing was of concern. Specifically, respondents were concerned that cattle would make increased use of the wetland for grazing.
- Also of concern was the potential impact of cane cultivation on the wetland.
- Succession of sedge species was taking place in the wetland, the concern being that the species most commonly used for craft, ikhwane, was being out-competed by other species.
- Communal use and communal benefit from the wetland was being substituted by private/household use and private/household benefit.
- Respondents indicated that they received very little public sector support, were supportive of the role played by the Traditional Authority, and were supportive of the role played by NGOs and research organisations in the past.

The use of local researchers

Three local locally based researchers were used to conduct the survey. All were formally educated, were fluent in English and isiZulu, had worked together extensively before, were familiar in the area, and were available to conduct the work

An informal assessment of their performance indicated that they successfully completed the task; learnt significantly from the experience; were cost-effective, and were not perceived to be intrusive. Limitations included a tendency to ask leading questions, and confusion (on the part of both respondents and researchers) on the concept and use of percentages.

Reflections on frameworks and models

Those conducting the research on Mbongolwane in 2002 did not have access to the models and frameworks described in the previous deliverable. The question was posed – if these frameworks and models had been used how might they have affected the results of the research?

- An ecosystem services approach (MEA, 2005) might have broaden the net to capture more uses and more users.
- The Anderies et al (2004) framework would have assisted in the overall organisation of the research, and would likely have increased emphasis on public infrastructure and public infrastructure providers. The framework would have also forced more detailed and explicit consideration of external forces affecting the system.
- The various property rights frameworks (Nkhata et al, 2013) would have likely focused more thought on issues of access and tenure.
- Strategic adaptive management would have encouraged one to assess the extent to which the users were the managers of the system and the extent to which they were adopting a management approach that was strategic and adaptive.

4.3 Craigieburn (Appendix 2)

Introduction

AWARD (the Association for Water and Rural Development), in collaboration with Leap (Learning Approaches to Tenure Security) has conducted research for over ten years on natural resource management and governance in the rural village of Craigieburn, Mpumalanga. A key component of this work was (and remains) the 'wise use' of wetlands and their governance. AWARD was asked to reflect on this experience and extract key lessons in governance and management.

Worldwide wetlands sustain livelihoods and contribute to well-being, particularly of the rural poor. Colonial rule saw prohibition of wetland use, and 'sustainable use' and the support there-of is a relatively recent policy response. It recognises that, in some cases, access to wetland ecosystem services is essential to sustain life. This policy response has, in turn, led to the concepts of 'best practice' and 'wise-use'.

In South Africa ongoing research has highlighted some key perspectives: firstly that wetlands do not exist in isolation but are part of broader, mutually reinforcing systems; secondly that wetlands are subject to two governance regimes – statutory and customary; and thirdly that, since 1994, there has been an institutional vacuum for natural resource management in communal areas.

Craigieburn lies in the Sand River Catchment and most of its residents are vulnerable, relying primarily on various social grant systems for survival. Wetlands play a critical role in supporting various livelihood options and are used for cultivation, reed harvesting and cattle grazing (in winter). Within this context the overall objective of the AWARD project was to facilitate wise and effective governance of natural resources in Craigieburn. This was to be achieved through developing an understanding of the evolving policies on land tenure, land and natural resource management, and to assess the implications of these emerging policies for local stakeholders; collaboratively exploring the (governance) needs of the Craigieburn community through an understanding of the past and present tenure and land administration arrangements and their evolution, and current and future needs, so as to develop appropriate future institutional arrangements; and, based on the research, to explore a number of potential models for governance and to evaluate this against the local institutional reality. The overall orientation was one of action-research allowing for collaborative reflection and action.

Key Findings

Decentralisation: Decentralisation of decision making to the local level does not necessarily improve the decision making process, particularly where multiple actors were making contradictory decisions and local and traditional governance institutions are in conflict. Also, local level decision making often focuses on short-term gains rather than long term sustainability.

Democracy: Democracy is regularly misinterpreted as 'I can do as I like' particularly by those who had achieved political power.

The community: There are widely differing perceptions, both internally and externally, on what constitutes a community and, with that, what constitutes community rights. This regularly leads to confusion on who is 'in', who is 'out', and who has ownership, power and authority. In the context of CBNRM this raises the question as to whether communities can act to ensure sustainable natural resource management. Also, in the Craigieburn example, the community was perceived as marginalised and this discourse reinforced its marginalisation.

Boundaries: Boundaries are not simply spatial but are also temporal and relational. Spatially there are three different sets – traditional, administrative and catchment. These complicate all governance institutions. In a temporal context there are boundaries between eras, regimes and institutions. In many instances people who appear unwilling to comply are simply unaware of the requirements of the 'new order'. Transitions between temporal boundaries are largely unmanaged. Relational boundaries relate to who interfaces and interacts with whom. The various interactions fundamentally affect the balances of power that are central to decision making. At Craigieburn it was particularly the uneasy relationship between traditional authorities and municipal structures that complicated governance. This lack of cooperative governance fundamentally affects access to and the sustainable use of natural resources.

Meaning: Different people and different groups of people understand various words and concepts differently. Also, different languages and cultures interpret these concepts and words differently. Key to successful and democratic natural resource management is a common understanding of terms like governance, rights, custodianship, ownership, power, responsibility and authority.

Historical context: Understanding the historical roots of why and how things are the way they are is critical to facilitating their transformation. The transition of land administration in communal areas has been difficult partly because the historical context has not been explicitly addressed.

The System: In engaging the governance of a system one needs to consider the social-ecological system in its entirety. One needs to consider a system's ecology, its economy, its social dynamics, and the relationships between these components, and how the components and relationships are changing, and what is driving these changes.

Roles of authority: Where the authority for different decisions is located needs to be explicitly identified and understood. This allows for improved coordination of governance and avoids bureaucratic gridlocks.

Integration: Because of the complex arrangement of multiple governance instruments, particularly local and traditional governance instruments, integration of different systems and arrangements is essential.

Property rights: Understanding who has access to what and under what conditions ('bundles of rights') is central to sustainable natural resource management. Also required are effective sanctions for those who do not recognise and honour these rights.

Security of tenure: Linked very closely to the lesson on property rights, security of land tenure contributes positively to the investment in this land and how it is managed.

Communication: Ongoing communication and interaction is vital for a thriving democratic governance process. This builds trust and allows for the establishment of positive relationships. Lack of communication and interactions, particularly on the part of authorities, is fundamentally disempowering.

Vision: A common vision that is internally generated and owned allows the owners to reflect on practice and performance, and to move to best practice and sustainable use.

Pro-poor: Adopting a specific pro-poor stance results in an enabling environment that safeguards the poor from exploitation and rights abuses.

Support: Local people consistently request external support in facilitating processes and developing solutions. This implies that people are unable or unwilling to take responsibility and assert their authority. So interventions should focus on social processes that strengthen capacity at the local level. This, in turn, will build adaptive capacity and resilience in the social-ecological system.

Policy development: Importantly also is the need for people to keep abreast of policy developments in the wider environment as these are likely to impact on their own way of doing things and how they express their democratic choices.

Representativeness: Craigieburn is not a unique case-study but typifies the situation found in many rural areas of South Africa. How governance is conceptualised and practiced has major implications for poor rural households.

4.4 Papenkuils Wetland (Appendix 3)

Introduction

The Papenkuils wetland is located on a floodplain in the upper Breede River catchment in the Western Cape Province. The wetland system supplies several provisioning services which include land for vineyards, grazing for livestock and habitat for waterblommetjies, a traditional food. The system also supplies a number of regulatory services. These include flood attenuation and water quality enhancement through nutrient assimilation. The system supplies a diversity of beneficiaries that range from commercial farmers with large land-holdings, to seasonal labourers who supplement their income through the harvesting and sale of waterblommetjies.

The specific purpose of this case study was to apply the Anderies et al (2004) Social Ecological system framework, the Millennium Ecosystem Assessment (MEA 2005) Framework and the Strategic Adaptive Management Framework (Kingsford et al. 2011) so as to better understand the contribution of the wetland to the well-being of users.

Key Findings

The resource system and ecosystem services: The use of the Millennium Ecosystem Assessment ecosystem services framework (MEA, 2005) was effective in describing the resource, identifying the ecosystem services and identifying the main drivers of change to the biophysical system.

Users: A diverse range of groups made use of the wetland. These included wine farmers; livestock owners, waterblommetjie harvesters, downstream water abstractors, downstream recreational users, Muslim pilgrims, the local municipality and Eskom.

Benefits: An equally diverse range of benefits accrued to these wetland users. These included harvestable resources, viticulture, carbon storage, water storage, groundwater recharge/ discharge, flood attenuation, nutrient assimilation and the maintenance of biodiversity. In terms of direct beneficiaries an outstanding feature was the waterblommetjie harvesters. A waterblommetjie is an indigenous wetland plant the flower of which is consumed as a vegetable. The harvesters work as

seasonal farm labourers in summer and autumn and harvest waterblommetjies from the wetland in late winter and spring. The income derived from harvesting is greater (R 500 per week) than farm labour (R 300 per week). The harvesters are drawn from vulnerable communities and this additional income is vital to sustain their well-being.

Public infrastructure and public infrastructure providers: The use of the wetland resource is governed by National Acts, which include the Conservation of Agricultural Resources Act (Act 43 of 1983); the National Water Act (Act 36 of 1998), the National Environmental Management Act (Act 107 of 1998) and in addition, various localised strategies; including Critical Biodiversity Areas; and the Catchment Management Strategy of the Breede Overberg Catchment Management Agency. Numerous public infrastructure providers are involved in governance and management actions. These include the Provincial Department of Agriculture, CapeNature, B O C M A, Central Breede River Water User Association, Holsloot Water User Association, Breede Valley Municipality, Mondi Wetlands Programme, WWF and Biodiversity in Wine Initiative and the Western Cape Department of Environment And Development Planning. Of specific interest is that, technically, the harvesting of waterblommetjies is illegal and the harvesters are trespassing in order to harvest. However, this is largely disregarded by both the authorities and the harvesters. There is general recognition that vulnerable people need to earn income from this activity. The rules of harvesting are set by the harvesters themselves.

Strategic Adaptive Management: There is a stewardship agreement which covers most of the wetland. For this a vision is shared by the two landowners and associated stakeholders, there is an objective hierarchy and linked to this a management plan. Management action, as a result of the plan, is in its infancy and so one cannot establish, as yet, whether the process is responsive and adaptive. The Catchment Management Strategy for the Breede Water Management Area also provides the context for achieving the desired state of the wetland but this is only at a very broad level. It does not deal with specific short term concerns raised, for example, by the water user association. So, at Papenkuils the key ingredients of Strategic Adaptive Management are emerging: there is engagement amongst stakeholders; governance and management responsibilities are fairly well defined, and there is a plan. However, the full range of management options is not being considered and not all public infrastructure providers have bought into the process.

Interdisciplinary approach: The Anderies et al (2004) framework, the MEA Assessment Framework and the Strategic Adaptive Management process were most useful in developing a systematic understanding of the Papenkuils Wetland social-ecological system. The broad understanding of the social-ecological system was used to identify specific actions towards achieving the dual goals of (1)

increasing the direct income from the wetland derived by local people, particularly to the poorest members of society and (2) maintaining the wetland's resilience and the benefits which the wetland provides to broader society. Strategic adaptive management was promoting action. When the purpose was explicit and agreed on, people were empowered to act. It also encouraged the involvement of all stakeholders. The interdisciplinary approach to well-being, through the application of the Anderies et al (2004) and associated frameworks, was most effective in determining the impact of resource use on the well-being of the users. It was a useful assessment tool in that it encompassed both the biophysical and the institutional dimensions by including the four interconnected sub-components of the resource, the resource users, public infrastructure and public infrastructure providers. The broad understanding of the social-ecological system was used to explore ways in which the wetland could continue to provide direct income to local people, particularly to the poorest members of society, without compromising the wetland's resilience and the benefits which the wetland provided to broader society.

Trust: A key element that became apparent during the study and the various surveys was that of trust. Specifically there is increasing trust between waterblommetjie harvesters and landowners and between the harvesters and their own communities which have developed over time. In the absence of any formal rights held by the harvesters this is essential. Trust is also apparent in a number of other spheres and this is leading to improved collaborative action.

4.5 Property Rights, Ecosystem Services and Water Resources (Appendix 4)

Introduction

Recently completed research for and on behalf of the WRC indicated that well defined property rights can make an important contribution to the equitable, efficient and sustainable allocation of the benefits derived from water resources including wetlands. However, 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. In addition, 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. Our failure to develop and apply

appropriate property rights regimes currently 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".

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.

Key findings

The concepts

A right provides us with the legal, social or ethical freedom to act or behave in certain ways. They relate to the benefit we are able to secure from something or someone. Realising a right comes with rules and responsibilities

Property is a tangible (for example, land) or intangible (for example, intellect) object from which we gain a benefit.

A property right is the right to benefit from various forms of property. They are categorised into four different types depending on who is the owner – **public** owned by the state, **private** owned by a private entity (person or company), **common** owned by a group and **open access** owned by nobody.

A bundle of property rights recognises that different groups or individuals might have different types of rights over different types of property. These include (from the strongest to the weakest) the right to **sell or alienate**, the right to exclude others, the right to **manage**, the right to **extract** benefit and the right to **access**.

A common-pool resource is a resource where the exclusion of others from accessing the resource is difficult and where access by one usually affects the ability of someone else to access that resource. The design principles for the governance and management of these resources include the following:

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

Ecosystem services are a form of property over which we can exert or be allocated a range of rights:

- 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

The relevance of all this is that:

- 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.

International experience

There are several key lessons that can be distilled from the international experience:

- 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 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.
- Clearly defined property rights provide incentives for investment in the management of the resource.
- Most research has focused on property rights as they relate to one specific ecosystem service. 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.

The South African Experience

Through an analysis of South African institutional and governance provisions for water resources and through two case study examples (the Pongola River floodplain and the Olifants River catchment) the following becomes apparent:

- 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.

Conclusion

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?

4.6 Mpenjati Estuary (Appendix 5)

Introduction

As part of the Eastern Cape Estuaries Management Programme researchers developed a framework for analysing natural resource based economic opportunities at an estuary and for assessing the risks inherent in establishing an enterprise based on these economic opportunities. This framework was further refined and used at Mpenjati Estuary on the KwaZulu-Natal South Coast as part of a collaborative planning exercise on the use of estuary-based ecosystem services.

Key findings

The theory: As the relative scarcity of ecosystem services increases, attention focuses on sustainable use that is efficient and fair. Negotiation, and collaborative planning is central to achieving this but it is acknowledged that everyone involved has unique and incomplete mental models about the issue. Everyone has a different understanding. So as to achieve consensus it is necessary to build a common understanding of the issue. This is done within the ambit of three broad goals: ecological sustainability, fairness and maximising utility or human welfare. Sustainability can thus be envisaged as a co-evolutionary process that reflects the interactions between changing linked social and ecological systems.

Landscapes are ecologically and socially heterogeneous and complex. Their value is a major force in shaping user perceptions about how the system or a subsystem is structured and functions. These constrained mental models have to be expanded to accommodate the system views of other stakeholders before it is possible to find solutions that are fair, efficient and direct patterns of use toward sustainability.

Long term sustainability requires integrated management for 'ecological health' and 'social health'. The former relates to the ability of the ecosystem to sustain the supply of services and the latter relates to the contribution sustainable and equitable use of ecosystem services makes to societal well-being. Implied in the concepts of ecological and social health is the notion of being able to sustain health under changing circumstances that arise from both natural forces and deliberate interventions intended to transform the state. Resilience of a state defined by sustainable use of ecosystem services, thus ultimately reflects how society adapts its livelihood demands for such services that change in time and space in response to how we use them and to other factors such as climate change. Acknowledging that not all social benefits are derived from ecosystem services it is necessary, when promoting social-ecological health, to consider both sustaining the supply of services (ecological health) and equity and efficiency in the distribution and use of the sustainable supply of benefits (social health). Maximising social-ecological health under these constraints has much to do with iterative social bargaining processes. This requires social learning that enables participants to understand and monitor both how choices affect the sustainability of service supply, and how they affect livelihood benefit streams deriving from ecosystem services.

Social learning is both a requirement for and an outcome of cooperation. In this case we present a workshop-based process that is designed to help stakeholders reflect together and expand their understandings as they move toward a shared representation of their social-ecological system. Our premise is that stakeholders are 'experts' holding significant understanding that is largely defined by the context in which they engage ecosystem services but individually they are commonly partially informed, even unaware, of the understandings of others deriving benefit from the same system. The process encourages participants to appreciate the need for and to develop a larger, more integrated systems view, cater for divergent views and values, recognise and acknowledge interdependence; and be willing to adapt their context. Whilst it is important that the emergent understanding reflects reality, in the first engagement with the process learning together is more important than the accuracy or precision of the outcomes. These can be improved in subsequent iterations. The process is designed to:

- Draw on individual perspectives to define the issues, determine relevant scenarios, develop among participants a working command of relevant concepts; gather individual understanding, study the issues generating shared insights understandings; and
- Integrate insights through construction of a more comprehensive shared perspective by identifying conflicts, using insights to search for common meanings, evaluating individual

assumptions, generating a common vocabulary, creating common ground, constructing new understandings and producing and testing solutions.

Process design: Six principles informed the design of the process:

1. Acknowledge that knowledge and understanding are context specific and incomplete
2. Acknowledge social-ecological complexity, uncertainty and the need to accept an adaptive, co-evolutionary learning approach to management
3. Acknowledge the variable capacity of the ecosystem to deliver services
4. Acknowledge interdependence of stakeholders with diverse understandings, demands for services, and that demands may not be compatible
5. Be empathetic and willing to address demands in a manner that considers both efficiency and equity
6. Acknowledge that a certain 'requisite simplicity' is required in the participative learning process.

The process: The interactive learning process was designed to help stakeholders develop a working command of the relevant concepts and a shared vocabulary. This enables them to exchange understandings and learn about the role of ecosystems in their society and their roles in determining the condition of ecosystems. It uses ecosystem services to develop the shared insights of the relationships between supply and demand that are necessary for understanding the need for trade-offs when managing for sustainable use. To determine the relationships between supply and demand stakeholders are challenged by questions such as:

- What services can the estuary deliver?
- How good or poor is it at supplying these services?
- Who uses these services?
- How important are the services in the lives of the users?

Responses vary. Some reflect on personal experiences of supply capabilities and their use of services; others may reflect on regulation or the provision of public infrastructure that enables access to and use of estuary services. The more diverse the stakeholder group, the richer the interactions and learning. This encourages reflection, acknowledging and building on the wisdom, knowledge and experiences of all the participants. The primary intention of the first iteration is to create awareness of dynamic interconnectedness and interdependence, expanding and creating overlap among individual mental models.

The model inputs are available data and scores reflecting stakeholder consensus around the supply of and demand for ecosystem services. The scoring system is deliberately simple making it easier for stakeholders holding different views to move away from focusing on detail and toward a consensus score. Typically stakeholders would include resource users (including recreation users, local residents, businesses with interests associated with the estuary, municipal engineering staff and various government authorities) and those who provide infrastructure whether in the form of policy or physical constructions that affect resource user access to ecosystem services.

4.7 Mondi (Appendix 6)

Introduction

Although natural resources management has been explored extensively in South Africa in the context of communal and protected areas, little research has been done on the management of wetland social-ecological systems in the context of privately owned forestry land. Given the national land reform process in South Africa and its potential implications for large commercial forestry land, these contexts calls for research that looks at wetland social-ecological systems across the complex continuum of land rights. Changes in land ownership linked to the national land reform process means that companies will have to deal with new land owners on what was previously its own land, and ensure that the natural resources on their land are managed sustainably or companies will not be able to use the timber grown on this land as it will not comply with FSC standards. Furthermore, there is a paucity of research that explores how adaptive co-management could help strengthen the resilience of wetland social-ecological systems in South Africa, especially in contested privately owned land. Key unanswered questions include, whether an adaptive management approach is at play or not in these contexts? How is management playing itself out? To what extent are they working adaptively? To what extent are they building the adaptive management capacity of the resource users that they are working with? What barriers/ challenges prevent the emergence of these ways of working? Understanding all this, and the barriers that exist is crucial in understanding current management practise.

This research explores wetland social-ecological systems management across the complex continuum of land rights in the forestry sector in South Africa, and the challenges and opportunities that exist for a shift toward adaptive co-management in these contexts. This aim is supported by the following objectives:

1. To understand current decision making processes, stakeholder engagement practice and the policies that inform these in wetlands across the land rights continuum within a private forestry company
2. To explore what elements of adaptive co-management, collaborative management or adaptive management exist within the company's current practice for wetland management across the land rights continuum.
3. To understand the barriers and opportunities that exist in shifting towards an adaptive co-management approach for wetland in the forestry sector.

A case-study approach was used using Mondi as an appropriate example. Approximately one third of Mondi land remains unplanted and contains large wetland areas. Data collection was through structured and semi-structured interviews with wetland users and Mondi staff tasked with managing this land. (Note that this research is still in progress.)

Preliminary findings

Land tenure: Mondi plantations exist within a complex continuum of land tenure (see Figure 4.1).

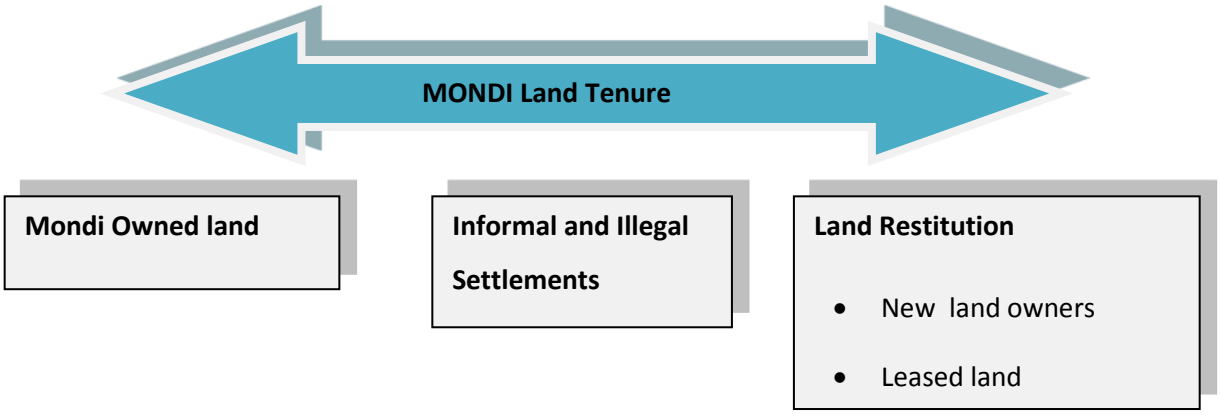

Figure 4.1: Continuum of land tenure arrangements that exist on Mondi controlled land

This ranges from land owned by Mondi through informal or illegal settlements to land which has either been restored to various owners or leased land. It is of particular interest that the two earliest settled land claims appear to be areas where there existed strong collaboration and shared decision making around the land and the resources. Those people settled informally and or illegally within Mondi land have few rights of tenure and feel under considerable pressure because their access to livestock grazing and watering areas is steadily declining. Little cooperation exists here.

Wetland use: The dominant use of wetlands on Mondi-controlled land is for livestock grazing and watering with approximately 12 000 head recorded. Cultivation and raw material harvesting is fairly rare. Given the lack of tenure there appears to be a general reluctance to invest in crop-based agriculture. A key area of contention is the burning of wetland and grassland areas. Livestock grazers set burns more regularly than Mondi considers to be ecologically desirable and also set burns in conditions that place plantations at risk. In most areas there appeared to be uncertainty on the 'rules of wetland use'. This is in contrast to the 'rules of use' for plantation areas which are very clearly specifically set out.

Relevance of wetlands to livelihoods: Informal observations indicate that for the majority of people living on or adjacent to Mondi land wetlands are of limited relevance. Many did not know what a wetland is. The expressed priorities were access to cash income either through jobs or grants, and access to housing and services.

Chapter 5: Key lessons for process design

5.1 Introduction

What might be the key attributes of a process (decision support system) that would contribute to wetland-based well-being? To summarise:

- There should be need for a system.
- It builds on and integrates existing knowledge and understanding
- It is underpinned by a strong conceptual foundation and good science
- It places people at the centre
- It engenders trust amongst stakeholders and stakeholder groupings.
- It facilitates participative learning, knowledge generation and adaptation.
- It should be easily understood and applied by resource users and those who are called upon for advice or regulation.
- It should be adaptable in the full range of contexts.
- In itself, it should contribute to well-being
- It should be usable in data-poor environments.
- It creates realistic expectations which take into account the realities of supply and demand.
- It is robust.
- It supports monitoring.
- It assists in resolving trade-offs

The analytical tools that might assist in better understanding the relationship between people and wetlands were also described. They included the Anderies et al (2004) Framework, the Millennium Ecosystem Assessment (MEA, 2005), Property Rights and Common Property Theory (Nkhata et al 2013), and Strategic Adaptive Management (Kingsford and Biggs, 2012). Some of these analytical tools were applied singly or together in our various case-studies. What emerges and, particularly, what are the key lessons we can take forward into the design of decision support system or systems which support the realisation of improved well-being through wetlands.

We will use the Anderies et al (2004) Framework to frame our synthesis (Figure 3.3).

In order to achieve the intent of the decision support system described above we need to be able to answer the following questions:

- What is the system?
- What is the resource?
- Who are the resource users and how reliant are they on the resource?
- What public infrastructure exists and how does it influence the use of resources by resource users?
- Who are the public infrastructure providers and what roles are they playing?
- What is the relationship between the infrastructure service providers and the users?
- What are the external drivers influencing the system?

So, reflecting on the case-studies what do they indicate? Focus is on the key points.

5.2 What is the system?

The case-studies make the point that a wetland social-ecological system occurs within a broader biophysical and social system. The wetland is part of a larger landscape and linked to it, and those who are dependent on the wetland are within a broader society. So, at the simplest level the process should be able to establish how relatively important is a wetland to the users. Are users obtaining the majority of their livelihood benefits from wetland-based ecosystem services or does it constitute a small portion? Even if that portion is small is it a critical contribution to well-being or might it be easily substituted for something else?

Craigieburn, Papenkuils and Mbongolwane all illustrate how important it is to consider boundaries in process design. At Craigieburn the notion of temporal boundaries is also introduced – change from one state to another over time. What is clear is that in both a temporal and spatial context we are observing rapid change in the use of wetland resources and in who governs that use. With that we are seeing rapid changes in boundaries. Harvesters are arriving by truck from a distance to collect iKhwani – those previously 'outside' the system they are now firmly 'inside' the system.

At a broad level, how we think about wetlands and the relationships between society and wetlands will fundamentally affect the design process of engagement. Arising from the cases and broader reading it is apparent that there is a 'quiet revolution' taking place:

- Historically the health profession has considered wetlands to be sources of pestilence and disease. Now, medical researchers and practitioners are increasingly describing wetlands as settings for human health. A healthy wetland contributes to human health and health is a fundamental constituent of well-being (Horwitz and others, 2012).
- Current policy and legislation regarding wetlands reflects a very strong conservation bias (see Armstrong, 2009). There is, practically, very little one can do in or next to a wetland and remain within the law. The reality is that for eons people have made considerable use of wetland resources and continue to do so. There is increasing recognition that many wetlands are 'hard-working systems' providing a range of benefits to society (expanded on in Section 3.3).
- What is currently receiving considerable attention as it relates to grasslands and will likely follow for wetlands is historic patterns of natural use. Grasslands were intensely grazed, trampled and fertilised by large herbivores. For wetlands, seasonally and particularly during droughts, the same would have occurred. Elephants, hippopotami, buffalo and other large herbivores would have had at times a significant affect as part of an entirely natural process. So, our perception of what is 'natural' is evolving.
- Recent economic thinking has said 'privatise everything'. The argument has been that if you privatise natural resources you will internalise the costs and benefits and result will be more sustainable use. But, then along comes Ostrom and her colleagues and they tell you firstly that you cannot privatise certain resources – they are common pool resources that require governance through a common property regime. Secondly, they explain that there are numerous examples of the successful, long-term cooperative governance of common pool resources. Wetlands are common pool resources and they require collective and cooperative governance and management.

The take-home message here is that whatever process is designed it needs to be able to search out, accommodate and share new knowledge, new concepts and new ideas.

5.3 What is the resource?

A resource exists within the context of and linked to a user. In the Papenkuils case the resource was defined and described using the MEA Framework (MEA, 2005). Provisioning, supporting, and cultural services were identified by the researchers. In the Mbongolwane case the resources were defined in

terms of their use by users – cultivation, harvesting, watering, stock grazing, hunting and religious ceremonies. Which system is better? Both are useful in their own ways. By defining the resource as a range of linked ecosystem services one identifies a broader set of uses and users, particularly indirect downstream users, and one makes the link between various services quite explicit. However, the concept of ecosystem services is quite academic and abstract to many constituents of the system and, so, defining the resource in terms that users understand is often more practical and engaging. But should it be one or the other? Ideally it should be both as part of a participative learning process that leads to a common understanding. Users are likely to relate well to provisioning services and intuitively understand the link between these and regulating and supporting services. It is simply a case of making the linkages explicit.

5.4 Who are the resource users and how reliant are they on the resource?

The Craigieburn, Papenkuils and Mbongolwane cases leave one with a strong sense that these wetlands and the resources they contain are very important to those who are making active use of them. They are fundamental to their livelihoods and their well-being. It is also apparent that it is not simply the utility value of the resources. It is the act of securing the resource and utilising it which, in addition to its utility value, creates identity and self-worth. At Papenkuils the harvesting of waterblommetjies is hard tough work – mostly without a wetsuit, in winter in a wetland – it is not for the faint-hearted. Harvesters take pride in this. Also, they are not supplying only to the affluent external buyers; waterblommetjies are culturally embedded within local cuisine which creates status for the harvesters within their communities.

At Mbongolwane madumbes, the various sedges harvested for mat production and cattle are the essence of being Zulu. While the madumbes make a strong nutritional contribution, sleeping mats and cattle are more symbolic and cultural expressions strengthening identity. Here, also, wetlands are conferred with powerful spiritual qualities used in both conventional religious ceremonies, and a as a source of superstition and traditional belief.

An important difference between Papenkuils and Mbongolwane is the general importance of the wetland to the respective communities. At Mbongolwane the results of the survey indicated that the wetland was important to the entire community, particularly elderly women. At Papenkuils the relevance of the wetland to the broader community from which the harvesters were drawn was confined to recreation (picnics and barbecues at its edge).

5.5 What public infrastructure exists and how does it influence the use of resources by resource users?

A key component of public infrastructure is both statutory and customary law. Setting aside customary law for a moment, how does contemporary statutory law in South Africa support or compromise the utilisation of wetlands to achieve human well-being.

Wet-Legal (Armstrong, 2009), a handbook as part of the WRC Wetland Management Series, provides a detailed description of the legislation and conventions that apply to wetlands in South Africa. They range from Ramsar to specific provisions of the Conservation of Natural Resources Act (CARA) and the National Environmental Management Act (NEMA). Read individually and collectively a single consistent message emerges from all the legislation and conventions – keep out! Most direct use of a wetland in order to secure a livelihood benefit usually requires formal authorisation. Effectively, it is either discouraged or prohibited.

Let's take two pieces of legislation mentioned above and relate it back to our case-studies. CARA states, amongst its various provisions, that authorisation is required to:

- Drain or cultivate any vlei, marsh or water sponge
- Cultivate any land within the flood area of a water course or within 10 m outside the flood area of a water course

Paraphrasing NEMA, liability for an offence extends beyond the offender and includes those who have the authority to act to prevent the offence.

At Mbongolwane, Papenkuils and Craigieburn does cultivation and/or harvesting in the wetland take place? Yes. Are those cultivating and/or harvesting formally authorised to do so? No. Are they prosecuted? No. Are the officials who have the authority to prevent cultivation prosecuted? No. Do the cultivators/harvesters know they are breaking the law? Some do and some don't. It is the same situation at numerous other wetland systems in South Africa.

One might argue that the legislation is designed to protect indirect use – as an example, protection and conservation of the wetland will ensure good quality water for downstream users. But this raises the question; is 'keep out' the same as conservation and protection? One might argue that in a wetland significant biophysical impact is required for optimal ecological health.

Returning to the key question, current legislation (our social infrastructure) does not support the realisation of wetland-based wellbeing. To the contrary; if implemented in a technically correct manner it has the potential to compromise the well-being particularly of those who are most reliant on wetland natural resources. But, in some strange and perverse way, all is well. That is because both users and regulators appear to be ignoring the legislation. This might be for a number of reasons. Users might not know what the regulations are, some might know but act with impunity as there is no likelihood of prosecution and/or for some their survival might be dependent on ignoring it. Regulators might not know the regulations, or they might view them as impractical to implement, or they might simply be lazy or corrupt. But is it all well? Not really.

There are two fundamental problems. First, current legislation deprives many of the security of access to the resources upon which they rely. At any time, for sensible or perverse reasons, authorities can decide to enforce, compromising access and, with it, wellbeing. Lack of consistency reduces the resilience of the entire system. Second, contradictions occur that are difficult to reconcile. A very practical example of this is currently playing itself out at Mbongolwane. Cultivation of madumbes (taro) takes place in the wetland. In one area, immediately adjacent to this cultivation and within 10 m of the wetland edge, commercial sugar cane cultivation is taking place. The cane farmers are being advised, given the legislation, to pull back from the wetland edge but nobody is advising the madumbes farmers to stop cultivating in the wetland!

Customary law, in itself, is far more supportive of wetland use. It has evolved through an ongoing and participative process of negotiation between the users (local residents) and public infrastructure providers (the traditional authority). It is well understood, usually obeyed, and transgressors are sanctioned at the local level (tribal court).

The second component of public infrastructure is physical infrastructure which affects (either positively or negatively) the ability of the user to utilise the resource. Each wetland social-ecological system will have its own set but, in a well-being and livelihoods context, fundamental to each will be physical access. At a practical level, one needs to be able to access the system to cultivate, harvest or hunt; and to move raw materials, products and services in and out of the system.

In many instances we are dealing here with poorly resourced people in rural areas with limited ability to establish the physical infrastructure to create products and services, and access markets. If wetlands are to be sources of well-being going forward this infrastructure needs to be planned and established.

5.6 Who are the public infrastructure providers and what roles are they playing?

Some public infrastructure providers have been identified in Section 3.4. The cases identify five primary groups:

1. Traditional authority
2. Constitutional authority
3. Private authority
4. Support agencies (NGOs and Development Agencies)
5. Knowledge providers

Taking the first three, the cases illustrate contrasting settings depending on who is exercising power

At Craigieburn there is distinct tension between traditional and constitutional leadership. There is declining power within traditional leadership and local government is exercising power. This has created significant tension amongst user groups, and there is significant confusion which, in turn, breeds opportunism.

At Mbongolwane, traditional leadership remains a dominant authority but questions are being raised about its ability to influence what is occurring both within and particularly beyond its area of jurisdiction. Local government plays a limited role but it appears that provincial and national government are increasingly exerting their authority on land-use authorisations.

At Papenkuils there is no traditional authority as we define it and authority is exerted through numerous 'new' constitutional authorities. Interestingly, the water user association identified in the property rights case-study as an important intervention point at the local level, appears to be playing an important governance role.

Where there is private authority (the Mondi case-study) one would assume that property rights would be fairly simply defined but that is not the case. The reality is that, even here, there are bundles of rights depending on the specific relationship between the user (usually cattle grazers) and the owner (Mondi). Where land claims have been settled and Mondi leases back the land from the new owners, the rights appear to be well defined and respected. Amongst illegal or informal settlers on Mondi land the rights are poorly defined and tension exists.

With respect to support agencies and knowledge providers there appears to be a significant blurring of the distinction between the two. This is probably for two reasons: first, the provision of knowledge is seen as a significant support element, and second, knowledge providers increasingly engage in action research, providing support as they generate knowledge. At Craigieburn and Mbongolwane, AWARD and UKZN respectively have contributed significantly in the direct support of users. At both wetlands use has been made of local research capacity with mixed but generally positive results.

5.7 What is the relationship between the infrastructure service providers and the users?

This is a powerful theme emerging from the cases and one that reinforces the finding in Chapter 2. (*It engenders trust amongst stakeholders and stakeholder groupings*). Developing trust is an integral part of the establishment of relationships between individuals and groups. So, whatever process is being contemplated, at the outset significant time and effort needs to be invested in strengthening relationships and building trust.

But, practically, how does one do this? There are numerous methodologies but most are based on the following broad formula – iterative, face-to-face sharing within a non-confrontational environment of individual and group perspectives. This builds understanding of alternate perspectives and a collective understanding of the issue which, in turn, leads to collective action – in short, participative learning and strategic adaptive management.

In facilitating such interactions recognise that:

- It is often very time consuming but one has to invest the time to build trust.
- Amongst resource users and amongst public infrastructure providers and particularly between these two grouping there are usually significant power differentials. Those with knowledge, wealth and authority dominate those without. There needs to be a 'levelling of the playing field' so as to generate equity and build trust.
- There are sometimes individuals and groups who will attempt to pervert the process for private benefit. This destroys trust but preventing it is very difficult.
- Many users have, historically, been deprived of their rights to access and benefit from wetland resources. Redress is an important component of the process.

5.8 What are the external drivers influencing the system?

The cases indicate that wetland social-ecological systems are operating within a broader societal and biophysical context that is evolving rapidly, and fundamentally affecting what is happening within the system. Some are tangible and easily observed and others are more subtle. A major driver is changing societal choices exemplified in the Mbongolwane case. Hoes have been substituted with cell-phones and madumbes have been replaced by deep-fried fast-food chicken.

Generally it appears as if direct use is declining and indirect use is increasing – there is less harvesting and less cultivation but the importance of the wetland in generating clean and inexpensive water for downstream use is increasing. Where direct use is happening it is increasingly for private rather than communal benefit, and the ultimate beneficiary (the purchaser of madumbes at Woolworths) is often far removed from the wetland.

Another key external driver that is receiving increasing attention is climate change. The specific impact of climate change will largely be dependent on where the wetland is located. In western South Africa it will be drier, in the centre there is a high level of uncertainty and in the east it will be wetter (and rainfall events will be more intense). The long term change in rainfall patterns will fundamentally affect the supply of ecosystem services, not only from the wetland but from surrounding landscapes.

5.9 Resilience

Only the Papenkuils case explicitly engaged resilience as a key concept. Resilience is a goal – ultimately, in whatever we do, we are attempting to strengthen the resilience of wetland social-ecological system. Four questions are asked and should form a part of any process:

- What does the system need to be resilient to? i.e. what are the observed or anticipated impacts?
- What features/attributes of the system confer resilience?
- What affect do the relationships depicted in the Anderies et al (2002) framework have on the resilience of the system?

5.10 Some general comments

The fallacy of the single tool

At its inception it was intimated that this project's primary purpose was to strengthen the wetland management tool box through the addition of a tool. We have numerous wetland management tools that address rehabilitation, valuation, legislation, wise-use and numerous other facets but only that of Turpie (2009), *A Tool for the Assessment of the Livelihood Value of Wetlands*, directly addresses the link between wetlands and well-being. The reality is that at different times and in different circumstances we will require a wide variety of tools to engage effectively.

The analogy of a toolbox containing a set of tools is fairly appropriate. Trying to repair, change the settings, modify or simply service and maintain a motor vehicle with a single spanner is not going work. Equally, engaging in efforts to understand, be a part of, influence, change, fix or improve the social-ecological system that is a wetland cannot be done with one tool. It requires a set of frameworks, processes and systems to guide one systematically through the maze.

Taking this analogy to the next level, what tools are required is influenced by who you are in the system. A driver might require a simple set – a jack, wheel spanner, map and a pot of coffee – while, when something goes wrong, the mechanic will require a different and more sophisticated set. So, while researcher might require one set of tools, users and regulators will require different sets.

One of the fundamental differences between a motor vehicle and a wetland social-ecological system is the level of standardisation. For a range of motor vehicles one requires a single standard set of tools but each social-ecological system is unique and so every tool will require some form of customisation or adaptation to achieve the correct 'fit'. That leads to the next point. You don't want a tool that is so specialised that it can't be adapted to varying situations.

Requisite simplicity

Inherent in each component and each relationship arrow of the Anderies and others (2004) framework is complexity. Each of the cases implicitly or explicitly demonstrates high levels of complexity. This complexity has the potential to overwhelm and create 'paralysis'. We do nothing because whatever we do has unintended consequences. This has been recognised by Stirzacker and others (2010) who coined the phrase 'requisite simplicity'. In practical terms it means that whatever

process we design, it needs to achieve a certain level of focus which means that certain detail will inevitably be lost. Particularly important here is being able to sense what level of complexity and technical detail participants are able to cope with – too simplistic and you patronise; too complex and everyone gets lost! This strengthens the argument for participatory management.

Chapter 6: Wetlands and wellbeing: engaging practically (Appendix 7)

6.1 Introduction

At the project's inception it was agreed that a decision support system would be developed that would support the realization of improved wellbeing from wetland ecosystem services. What form this decision support system would take was not specified. There were numerous discussions amongst project team members, with the project reference group and amongst the broader 'wetland researcher and practitioner' community on design and content. Agreement was finally reached that the decision support system should comprise three elements:

- A handbook the overall purpose of which would be to, firstly, generate an appreciation and understanding of the contribution wetlands make to societal and individual well-being, and secondly, to expose the reader to the opportunities and issues related to achieving improved well-being from wetlands.
- Linked to this, a guide to the resource material available on this subject
- Also linked to this a technical tool that, with facilitation, would guide stakeholders in making better decisions about wetlands in a well-being context

The general audience for this handbook would be action-researchers, managers and practitioners operating in the water resource management domain.

6.2 Specific attributes

In terms of design the narrative of the handbook is simple and engaging, and it is liberally illustrated with appropriate photographs. Content is informed primarily by this research project. For the resource material, each document is summarised, where relevant a URL address is provided for it and, where it is in the public domain, a full copy of the document is included in an accompanying CD. The technical decision support system builds primarily on *Wet-Ecoservices: A Technique for rapidly assessing ecosystem services supplied by wetlands* (Kotze and others, 2009) and by the decision support system developed to support the estuary-based economic empowerment (Bowd and others, 2012). It comprises an explanatory text and an excel-based series of spread-sheets which allows one (in a desk-top or participatory process) to:

1. Assess the supply of ecosystem services for a particular wetland or group of wetlands
2. Explore how different use scenarios might affect the suite of ecosystem services supplied by a wetland
3. Assess the current demand and use of the services
4. Identify opportunities and threats to the ecosystem services
5. Assess the costs (dis-benefits) of the wetland, e.g. habitat for disease vectors

6. Identify opportunities for increasing the benefits and addressing risks/threats to the ecosystem services
7. Identify means of addressing the costs

It is important to be specific as to what this handbook does not do. It is recognised that each wetland social-ecological system is unique and is complex. So, to impose a simplistic recipe-based approach to improved well-being from wetlands is not possible; also it is undesirable. It is specifically not the intention to tell a wetland manager that if he or she does X,Y and Z at a wetland the result will be improved well-being options of user groups. What is its intention to empower a wetland manager so that he or she can engage with users groups and they learn together how wetlands contribute to and improve well-being opportunities? The user groups would in turn be empowered to realise these opportunities.

6.3 Summary of the handbook content

1. By way of an introduction it sets out the importance of wetlands to the livelihoods of rural South Africans and how the socio-economic context is evolving away from direct reliance on natural resources. It emphasises, in a South African context, the importance of wetlands to water security (Chapter 1).

2. It provides a general context relating how history has brought us to the present and summarising the key findings of research conducted over the last fifteen years. (Chapter 2)

3. It provides a user's perspective on wetlands and well-being focusing on practical examples of how we might get more out of wetlands (Chapter 3)

4. It describes the main attributes of a wetland social-ecological system (Chapter 4)

5. It explains the adaptive process that facilitates local-level wetland management that might be adopted and the key principles informing this process. In engaging this process it lists the key questions that participants should ask and answer to improve overall understanding of the system and its dynamics (Chapter 5)

6. It provides some concluding thoughts on how the relationship between people and wetlands might evolve to the benefit of both constituents. (Chapter 6)

7. It provides a guide to detailed literature and resource material that might be useful for specific applications (Appendix 1)

Chapter 7: Conclusion and recommendations for further research

7.1 Conclusion

When we set out on this journey of research it was in many of our minds that one of the major products – a culmination of the research – would be a further volume of the highly successful WRC sponsored Wetland Management Series. There would be a practical guide, like that for rehabilitation that a practitioner could read and then set to work.

What we have found is that it is not as simple as that – every context is different and every wetland social-ecological system is unique. One could not provide practitioners with a recipe book on how to improve the well-being of residents at a wetland and then send them on their way. The outcome would likely be disastrous.

What we did do through the handbook (narrative in Appendix 7), by way of example and guidance to other information, provides practitioners, government officials, users and researchers with ideas of how we might get more from our wetlands; how people might take opportunities and improve their wellbeing without compromising the integrity of a wetland social-ecological system.

Coincidentally, while we were in the latter stages of this research, Wood and others (2013) published their book on wetlands and livelihoods in Africa. Their conclusions on the direction we might be following are worth repeating:

- The adoption of socio-ecological systemic approach
- A reflexive and learning approach to adaptive wetland management
- Improving our understanding of and incentives for peoples' wetlands use
- Improving our understanding of required trade-offs
- Empowering local institutional arrangements for wetland management
- Influencing the policy debates on wetland use
- Demonstrations of evolving best practice

We would not assume to have engaged all these areas effectively but we have taken a few bold steps down this road.

7.2 Recommendations for further research

There are two specific areas where further research might be considered:

1. In the context of the WRC "Green Village" programme it appears, from the case-study, that Mbongolwane would be an appropriate site of action research and pilot application:
   - There is a body of research on which to build
   - With the wetland the area is strongly water-centered
   - Local resource users are willing to participate
   - There are major opportunities for partnerships and co-funding with government, non-government and private sector agencies
   - The area is relatively secure and safe.
2. Going forward in South Africa wetlands will be increasingly linked to and be agents of water security. It is important to establish a better understanding of water security and specifically how risks to water security might be effectively analysed

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On the CD

(Also included on the CD is an electronic copy of this report)

Appendix 1: Mbongolwane - an ongoing analysis of wetland-based natural resource use at the Mbongolwane Wetland in northern KwaZulu-Natal

Appendix 2: The Governance of Craigieburn – a meta-reflection on the governance of the Craigieburn Wetland in Mpumalanga

Appendix 3: The Waterblommetjies of Papenkuils – A social-ecological systems analysis of the Papenkuils Wetland in the Western Cape

Appendix 4: (Pongola) Property Rights, Ecosystem Services and Water Resources - An introduction to property rights and water resources with a focus on wetland and floodplain examples

Appendix 5: Mpenjati Estuary - Connecting supply and demand: a process for stakeholder learning about trade-offs in social-ecological systems

Appendix 6: Mondi – a social-ecological systems analysis of Mondi's approach to wetlands and livelihoods

Wetlands and Well-being: Getting more out of our wetlands (handbook and linked decision support system)