

Integrated Water Resource Management in South Africa

Marius Claassen

CSIR, PO Box 395, Pretoria 0001, RSA
E-mail: mclaasse@csir.co.za

IWRM operates within different ideologies, ranging from empiricism to postmodernism when describing thought; from neorealism to classic structuralism in political economy; and from rationalism to social constructivism in international relations. These ideologies manifest in political dogmas and in the way that society organizes governance, with the private good vs. public good paradigms and the institutional hierarchy vs. a network approaches being important for Integrated Water Resources Management. With the history of sustainable development spanning Rachel Carson's "Silent Spring" to Agenda 21, and beyond, IWRM emphasizes an enabling policy and regulating environment; institutional roles and responsibilities; and management instruments as prerequisites to deploying water resources to support social and economic development while ensuring sustainability of the resource. Water resource management in South Africa has moved from a focus on private good, with a strong role of the state and institutions to a greater emphasis on public good and a network approach. While this shift has brought about short term social and economic benefits, the sustainability of water resources has been compromised. The challenges in implementing progressive legislation is reflected in a shortage of skilled people, weaknesses in management instruments and difficulties in finding a balance between the role of the state and institutions and the effective function of networks to achieve development outcomes.

Keywords: IWRM, Water, South Africa, Sustainable development

1. Introduction

1.1. *Ideologies and Water Resources Management*

Integrated Water Resource Management (IWRM) is a holistic approach that seeks to integrate the management of the physical environment within the broader socio-economic and political framework (UNESCO, 2009). The implementation of IWRM is sensitive to different world views or ideologies, which are systems of values and beliefs regarding institutions and processes of society that is accepted as fact or truth by a group of people (Sargent, 2009). Ideologies about thought (Glicken and Fairbrother, 1998) include empiricism, which states that data can only be gathered through the senses, and that these data are the limit of thoughts. While empirical evidence is useful (even necessary) in IWRM, it does not sufficiently deal with the complexities inherent in transdisciplinary integration.

Modernism expands this view to include truth, thus enriching the data with logic, scientific laws and laws of nature, which allows ecosystems to be seen as individual units connected by energy flows. Rationalism provides for systems theory to be included in the thought process, suggesting that it is the essence of things that are important, rather than their attributes. These perspectives acknowledge both the value of elements in a system as well as the value of connectedness, thus promoting a holistic and integrated view. Postmodernism carries this view even further by advocating that the observer creates his or her perceptions through filters of personal history and experience, thus recognizing multiple views, particularly from political and societal actors.

In the context of political economy (Hobson and Seabrooke, 2007), neorealism reflects a view of the world as it really is and focuses on state actors, whereas neoliberalism places an emphasis on market mechanisms (Baldwin, 1993). The effective implementation of IWRM depends on a balance between the two, specifically understanding which mechanisms (or combinations of which) are required to achieve a specific result. Systematic constructivism suggests that international cooperation between states is more deeply entrenched than with neoliberalism, which is an important perspective for the transnational implementation of IWRM. Classic structuralism emphasizes the capitalist world economy and the unequal distribution of benefits, which is important in context (such as South Africa), where equitable distribution of benefits are paramount. In international relations constructivism focuses on individual constructs, which is seen as the middle ground between the divergent ideas of rationalism (systems theory) and reflectivism, where the world is understood through the interpretation of events (Smith, 2000; Du Plessis, 2001; Meissner, 2004; Nienaber, in press). The ideologies in international relations are of particular importance in transboundary basins.

Ideologies thus manifest in political dogmas (what we do) and in the way that society organizes governance (how we do it). Two characteristics that have significant implications for the integrated management of water resources are drawn from these manifestations and considered in the subsequent discussion of IWRM. The first characteristic reflects the resource ownership and the distribution of benefits, with water being regarded as either a private good or a public good. The second characteristic reflects the governance process, which is presented as a focus on institutional hierarchy as opposed to a network approach.

1.2. The Origins of Integrated Management of Water Resources

The need for sustainable development gained much public support with the publication of the book, *Silent Spring* (Carson, 1962). Carson reflected on the dangers of pesticides and painted a bleak future of ecosystems and mankind if the trajectories of use continued. The United Nations (UN) Conference on the Human Environment (UN, 1972) considered the need for a common outlook to inspire and guide the peoples in the preservation and enhancement of the human environment. The conference put forward 26 principles to address the need, which includes the safeguarding of natural resources for the benefit of present and future generations through careful planning or management and

a call on states for an integrated and coordinated approach to development planning. The World Commission on Environment and Development advanced these principles in their report: "Our Common Future", saying that the strategy for sustainable development aims to promote harmony among human beings and between humanity and nature (Brundtland, 1987). The report identifies common concerns and challenges and suggests common endeavors to secure sustainable development. The International Conference on Water and the Environment that took place in Dublin in 1992, resulted in four guiding principles being presented to the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992 (World Meteorological Organisation, 1992). These principles (commonly referred to as the Dublin principles) state that: Water should be regarded as a finite resource that has an economic value with significant social implications; That local communities must participate in all phases of water management; That water resource management must be developed within a comprehensive set of policies and That there is a need to recognize and actively support the role of rural populations with particular emphasis on women. These principles will be referred to in the subsequent discussion of IWRM.

The United Nations Conference on Environment and Development resulted in the Rio Declaration and Agenda 21 (UN, 1992). The declaration subsequently became the blueprint for sustainable development world-wide (Spangenberg et al., 2002), although challenges of measuring and achieving its implementation have been raised (Radif, 1999; Spangenberg et al., 2002). The Global Water Partnership (GWP) advanced the implementation of sustainable development in relation to water resources through the paper, entitled "Integrated Water Resources Management" (GWP, 2000), which defined Integrated Water Resources Management (IWRM), as "a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." The paper suggested an IWRM framework that constitutes three complementary elements, being the enabling environment (policies, legislation and regulations); institutional roles and functions; and management instruments. IWRM has subsequently been taken up in different geographies and contexts (Mylopoulos and Kolokytha, 2008; Swatuk, 2005). Participants in the 2007 World Water Week concluded that IWRM "is seen as a powerful means to conserve aquatic ecosystems that is compatible with sustained basin development", but that "most countries failed to deliver the integrated water resources management (IWRM) plans they committed to in Johannesburg in 2002" (SIWI, 2007). However, GWP and INBO (2009) maintains that the integrated approach coordinates water resources management across sectors, interest groups and scales; emphasises involvement in national policy and law making processes; establishes good governance; and creates effective institutional and regulatory arrangements as routes to more equitable and sustainable decisions.

The above approach is supported by the regional political sentiment, with the President of the African Minister Council on Water stating that "The effective utilization of the water resources as well as efficient and harmonious management of our trans-boundary waters will lead to greater food security, better harnessing of our energy sources,

creation of diversified transportation means including effective means of intra and inter socio-economic and political integration, peace and security, factors germane for more robust sustainable development” (Molewa, 2012a). While the principles and utility of integrated management of water have been established, there are wide-ranging views on the shared understanding thereof, with Muller et al. (2009) stating that there is something of a mystique surrounding IWRM, but that it is a relatively straightforward concept, while van der Zaag (2005) describes it as a relevant, yet elusive and fuzzy concept, and Jonker (2007) says it remains elusive because there is a lack of conceptual clarity about IWRM. Ultimately, IWRM seeks to integrate the quantity and quality of all sources of water within river basins with different user sectors within the broader framework of national development planning (Muller et al., 2009) and inspires a new generation of water managers and researchers to think outside the box and act creatively (van der Zaag, 2005).

2. The Theory and Practice of IWRM in South Africa

2.1. A Historical Perspective of Water Resources Management in South Africa

Water resources in southern Africa met the modest demands prior to the nineteenth century. Communities depending on rain-fed agriculture and livestock in the higher rainfall eastern areas and nomadic hunter-gatherer communities in the drier western regions adapted to the variable temporal and geographic patterns of rainfall (Turton et al., 2003). Following international trends associated with the green revolution, modern agricultural practices were introduced in the 20th century (Gleick, 1998). These monoculture methods were not only more intensive, but they also required vast amounts of water. This need was addressed through the construction of dams and irrigation schemes. Rapid population growth coupled with industrial and mining development put further demands on the finite resource. The government responded by promulgating the Irrigation and Conservation of Waters Act (Act 8 of 1912), which consolidated and amended the provincial laws in the Union of South Africa relating to the use of water from public streams for domestic, irrigation and industrial purposes. The Act provided for the establishment of facilities for irrigation and domestic use of water, but power and decision making was centralized in a “command and control” system, with little local empowerment. The key aspects of this Act were the distinction between public and private water and the establishment of riparian rights. The use of private water (defined as that which originated from private land) was not regulated, except for specified historically established uses, whereas public water (defined as natural streams) was subject to apportionment by riparian users (Tewari, 2009). The Act was set in a utilitarian paradigm, with the key objective being to supply specific users with sufficient water.

The Water Act (Act 54 of 1956) further regulated water use in 1956 by repealing the Irrigation and Conservation of Waters Act of 1912 and consolidating various other financial and irrigation acts that related to water. Although the Act provided for the control of water pollution and the more effective protection of the water resources, it was still

set in the paradigm of riparian rights (thus a private good). The 1956 Act was largely a response to industrialization, with the uniform effluent standard approach (DWA, 1986; van der Merwe and Grobler, 1990), the receiving water quality objectives (Neytzell-de Wilde, 1992), pollution prevention approach, and precautionary approach (DWA, 1995) being implemented to protect water resources. As with the 1912 act, the emphasis was on the role of the state and institutional structures to enforce legislation. These policies may have been effective in reducing pollution, but they were not effective for comparative evaluation of different uses (DWA, 1998).

The need for reliable supplies of water for expanding agriculture at the turn of the 19th century served as catalyst for the development of infrastructure to capture, store and distribute water. The subsequent expansion of mines, industries and urban areas created the demand for further infrastructure development. Figure 1 shows the cumulative storage capacity of the 3956 registered dams built in South Africa between 1900 and 2009. The storage capacity of the five largest dams (indicated in the graph) constitutes close to 50% of the total storage. The water supply to the economic heartland of Johannesburg and surrounds have been further secured through the Lesotho Highlands Water Project, which saw the completion of Katse Dam ($1.9 \text{ m}^3 \times 10^9$) in 1997 and the Mohale Dam ($0.9 \text{ m}^3 \times 10^9$) in 2002 (DWA, 2012b).

When the demand increased and the social and economic issues became increasingly complex in the 1990s, a shift in thinking was required. The global paradigm for water resource management was shifting from supply side engineering solutions to demand side management. Previous approaches used population growth and per capita water use to determine future demands and focused on capturing a larger portion of the hydrological cycle to meet these demands. As it became clear that engineering solutions to increase water supply were not sustainable, resource managers turned to efficiency improvements and demand management in a holistic strategy to meet future needs (Gleick, 1998). This

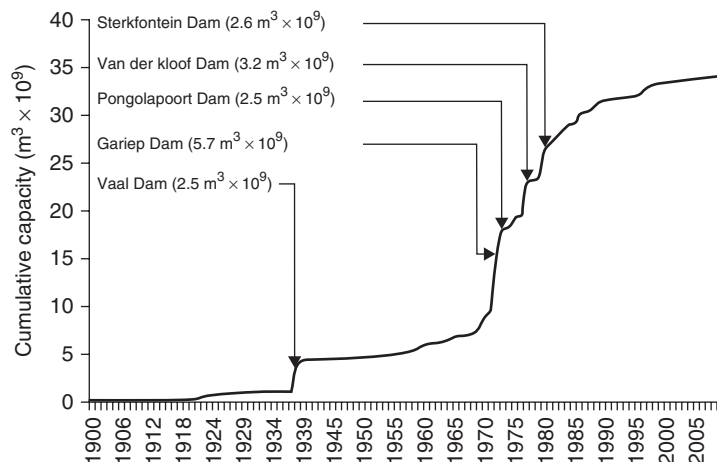


Figure 1. Cumulative capacity of dams built in South Africa from 1900 (data from DWA, 2012a).

coincided with a significant political change in South Africa, with the first democratic elections being held in 1994. The new government had a mandate and obligation to provide access to water for domestic and economic use to the majority of the population which didn't previously have access. The new policy on water resource management in South Africa (DWA, 1997) was drafted in this context. The consequent National Water Act (Act 36 of 1998) emphasized water management at national and catchment scales, made specific provisions for the protection of water resources and established mechanisms to ensure equitable and efficient water use. These mechanisms also placed a premium on participative management, thus supporting the Dublin Principles of social and economic benefit, community participation, a policy framework and the role of communities and women. While the Act does not explicitly mention IWRM, it does recognize "the need for the integrated management of all aspects of water resources and, where appropriate, the delegation of management functions to a regional or catchment level so as to enable everyone to participate". Importantly, the Act abolished private ownership of water and distinguished public and private benefits. The implementation of the Act has yielded mixed success. While there has been much progress in water infrastructure development for services (public benefit), the backlog in issuing water use licenses (unprocessed applications, mostly for private benefit) stood at 4 318 in 2011 (DWA, 2011a). The protection of water resources suffered under the drive for, and progress in, social and economic development, with South Africa ranked at 128 out of 132 countries in the Environmental Performance Index and also being listed within the lowest ten countries in the Trend Index Decliners (Emerson et al., 2012). This state and trend is supported by the National Freshwater Ecosystem Priority Areas report, which reports an ongoing deterioration over a period of 12 years and lists 65% of wetland ecosystem types and 57% of river ecosystem types as threatened (Nel et al., 2011). The Minister of Water and Environmental Affairs stated that she is aware of the challenges experienced in determining the Reserve (water required to protect ecosystems) for the significant water resources in the country, which include limited availability of skilled technical personnel and funds (PMG, 2012).

2.2. Regional Context

Water has been as a source of conflict and cooperation for centuries. Accounts of disputes can be traced to Sumeria around 2500 BC (Gleick, 1998), with religious animosities, ideological disputes, political borders and economic development mostly being at the root of such conflicts. In the last century, disputes over water led to 21 instances of military conflict (Gleick, 1998) and 37 instances of violent conflict (UNEP, 2002). The instances of cooperation over water, however, far outweigh the examples of conflict. Whereas the Sumerian conflict led to an agreement on water along the Tigris River (Wolf, 1998), there are more than 3 600 international water treaties dating from 805 BC and 295 international water agreements have been signed since 1948 (UNEP, 2002). Southern Africa is no stranger to conflicts and cooperation, with water resources being highly variable and unreliable. Rivers in the region often transect multiple countries or form the boundaries

between countries. Shared river basins such as the Orange (Botswana, Lesotho, South Africa and Namibia), Incomati (South Africa, Swaziland and Mozambique) and Limpopo (Botswana, Zimbabwe, South Africa and Mozambique) have led to disputes about entitlements to water, water abstraction, hydropower, water pollution and land ownership (Turton, et al., 2003), which includes the South African-Namibian border dispute, which has not been resolved. Conflict and cooperation are not mutually exclusive, since conflict can exist on one issue, while there is cooperation on another. The instances of cooperation outweigh the disputes, with South Africa having been party to 59 international freshwater agreements signed since 1910 (Ashton et al., 2006). Many of these agreements were driven by a need to ensure national water security to support agricultural and industrial development. It is therefore necessary to consider regional issues which looking at IWRM in South Africa.

2.3. *Institutional Structures*

The National Water Act (Act 36 of 1998) provides for a balance of responsibilities, ranging from the Minister and Director General at the national level, to Catchment Management Agencies (CMAs) at the basin level and Water User Associations (WUAs) at a sub-basin level. Advisory committees can also be established as well as bodies to implement international agreements. More than ten year after the promulgation of the Water Act, only two CMAs (out of the 19 intended) have been established, namely; the Inkomati and Breede-Overberg CMAs, whereas only 111 irrigation boards (out of the 279 that existed prior to the new legislation) have been transformed into 59 WUAs (DWA 2011b). This framework provides a spectrum of institutional structures, aimed at providing a balance between state control in the national interest and local participation towards equitable benefits (network approach). The decentralization of power has not reached the intended levels, with capacity constraints presenting an operational constraint and the national interest being a political driver.

The legal (enabling) framework is in place to support IWRM, but good governance supported by management and institutional capacity is needed to give effect to IWRM (Funke et al., 2007). This finding is underpinned by a case study on the Mhlathuze Catchment in South Africa, which found that IWRM is not fully realized and that internal institutional problems delayed acceptance of IWRM by water managers, that there is insufficient cooperation between sectors and policies, and that there are difficulties in the involvement of stakeholders in decision-making, all of which are hindering full implementation (Funke et al., 2007). South Africa also has sufficient legal instruments that promote interactive participation of rural people in the management of natural resources, but these are not matched by the practice on the ground, with a lack of capacity, experience and innovation underlying the absence of institutional culture for effective integration of rural people's needs into the management of protected natural resources (Holmes-Watts and Watts, 2008). The time required for effective engagement is often not planned into process and where engagement does take place, it is in the form of information sharing rather than incorporation of diverse views. Van der Zaag (2005) also state that IWRM should explicitly

deal with the fact that water tends to build asymmetrical relationships between people, communities and nations, and lists institutional capacity to integrate, and transparent and inclusive decision-making, as two other key elements for IWRM. In the South African context, the asymmetrical relationships between high volume water users and poor, low-volume water users is a legacy of the past, therefore demographic representation needs to be well anchored in the structure of a CMA and its accountability mechanisms (Shreiner and van Koppen, 2002). Empowerment of disempowered water users can be supported by pro-actively reaching out to poor communities, providing information and legal literacy in local languages via multiple media, building capacity, ensuring mobility, structuring long term effective representation, and by mediating in conflicts (Shreiner and van Koppen, 2002). In a Southern African context, Swatuk (2005) argues that IWRM requires states to fundamentally reconstitute how resource access, allocation and use decisions are made, which is a profoundly political act that challenges the power bases in many of these societies. These perspectives highlight the challenges in establishing strong institutions to give effect to the national interest and effective networks to ensure participation towards equitable benefits.

In reflecting on 40 years of research in the water sector, Green et al. (2011) finds that many hurdles have to be overcome to achieve full practical realization of cooperative governance for IWRM, with inadequate human and institutional capacity being one of the main factors limiting the efficient management of water resources in South Africa. This analysis is supported by data from DWA, with the National Department reporting to have had 4286 people in its employment as at September 2010, whereas 1155 posts were vacant at the time (DWA, 2011a). This translates to less than 80% capacity, which explains the difficulties in implementation. The failure to define water rights, to enforce monitoring, to interpret readily available information and to enforce compliance can be blamed on the “crumbling capacity” within the DWA (Herold, 2010). This is illustrated by the fact that DWA, which has an essentially technical function necessitating 250 engineering posts, had only 39% of these posts filled in 2008 (Herold, 2010). Furthermore, by March 2011, the Department of Water Affairs had a vacancy rate of 33% at senior management level (DWA, 2011a). IWRM is being entrenched in academic curricula in response to this need (Jonker, 2005), but this process will only build capacity for more effective implementation in the medium and long term.

There are also concerns regarding the monitoring and subsequent availability of hydrological data. Both rainfall and river flow measurement have exhibited a decline over recent years, with the rainfall monitoring network having declined from over 2000 stations in the 1970s to less than 1000 functional stations in 2005 and the flow gauging stations from more than 450 in 1987 to less than 350 in 2005 (Pitman, 2011).

2.4. Water and Development

The context for the use and management of water resources in South Africa has been reset in the Constitution (Act no. 108 of 1996). The Bill of Rights (Chapter 2 of the Constitution) specifies, amongst others, that every person shall have the right to an

environment which is not detrimental to his or her health or well-being and to have the environment protected, and have access to sufficient food and water. With the National Water Act (Act 36 of 1998) and the Water Services Act (Act 108 of 1997) providing the enabling legislative instruments to secure these rights. The National Water Act provides for both Resource Directed Measures to ensure the sustainable use of the resource as well as Source Directed Controls, which allows for the management of impacts. The Water Services Act addresses issues of universal, equitable access to water supply and sanitation services. The Water for Growth and Development Framework (DWAF, 2009) is a national programme that sets out practical steps to achieve socio-economic development objectives in accordance with the enabling environment established by the above legislation. The Water for Growth and Development Framework recommends action in eight areas to guide actions and decisions that will ensure water security in terms of quantity and of quality to support South Africa's requirements for economic growth and social development. These areas are the strengthening institutional capacity, mainstreaming water, diversifying the water mix, water conservation and demand management, maintaining water quality, water service backlogs, water use behaviour and behavioural changes towards the value of water. These areas cover three dimensions of water management towards a water secure world, being water management; safe water and basic sanitation; and water productivity (USAID, 2009).

In South Africa, developmental Catchment Management Agencies (CMAs) are required that stimulate poor people's water use, not only for drinking water purposes, but also for productive purposes in farming, livestock, forestry, fisheries, and small-scale industries in order to combat income poverty (Shreiner and van Koppen, 2002). These agencies are to be established for 19 Water Management Areas in accordance with the National Water Resources Strategy (DWAF, 2004). Twomlow et al. (2008) draws parallels between Integrated Natural Resource Management (INRM) and IWRM and points out that solutions may be compatible for blue water and formal irrigation systems, but are not generically applicable to smallholder rainfed systems, stating that a key difference between INRM and IWRM is that the former uses a unit with social boundaries (e.g. village or household) as the scale for analysis, whereas the latter focuses on the catchment as the basic unit of analysis.

The South African Minister of Water and Environment Affairs recently stated that water quality deterioration through pollution from agricultural, industrial and mining activities, and poor urban wastewater management, is arguably the most serious threat to the country's water resources (Molewa, 2012b). This view is supported by analysts, stating that the current status of water resources and water resource use in South Africa shows that that regulation is failing (Herold, 2010; Schreiner et al., 2011). Illegal water use also falls under the umbrella of poor regulation, with the example of the theft of about $175 \times 10^6 \text{ m}^3/\text{a}$ of irrigation water by farmers in the Upper Vaal Catchment (Herold, 2010). The draft National Water Resources Strategy (DWA, 2012) recognizes the challenges of impacts on water resources, but States that: ". . . it is necessary to reinterpret these principles [IWRM] within the context of a developmental state, [and that] . . . water plays a critical role in equitable social and economic development, and that the developmental state has a critical

role in ensuring that this takes place.” This emphasizes development rather than protection and emphasizes the need of the “development state” to ensure equitable development (water as a public good), rather than market mechanisms (water as a private good). A key challenge in managing and regulating water use in support of social and economic development is thus that the responsibilities for different activities lie with different agencies, both between departments and between tiers of government.

2.5. *Integration*

Integration in IWRM is multi-dimensional, with the background paper on IWRM (GWP, 2000) identifying the interactions between the natural and human system; freshwater and the coastal zone; land and water; green and blue water; surface and groundwater; water quality and quantity; and upstream and downstream interests as important interfaces related to the biophysical system. The paper further identifies the mainstreaming of water, cross-sectoral integration, macro-economic effects, integrated policy-making, economic sector decisions, stakeholders, and water and wastewater management as key elements to take into account when integrating the human systems related to water resources management. In the South African context, integration related to the biophysical system elements are supported by a strong legislative context, with the South African Constitution (Act no. 108 of 1996) establishing the basic rights mentioned above and also establishes mechanisms for cooperative governance, whereas the National Environmental Management Act (Act 107 of 1998) emphasizes an integrated approach by promoting “the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities” respectively. These provisions are supported in sector-specific legislation such as the National Water Act (Act 36 of 1998), which recognizes “the need for the integrated management of all aspects of water resources”. The deteriorating state of these resource are however testament to the goals of integrated protection and utilization not having been realized.

The road map in the National Development Plan (NPC, 2011) emphasizes specific intervention areas related to water, but the integration between these areas and other sectors could be improved in the following areas:

- Under drivers of change (p. 68), a compelling argument is presented for the importance of climate change and the document rates climate change as the biggest international risk, but the section on water resources and services does not address this important risk explicitly and comprehensively.
- While the section on Africa’s development (p. 8–9) states that “Securing adequate supplies of water and food must be looked at in a regional context.”, the section on water resources and services makes only scant reference to international obligations.
- With the expansion and shifts suggested in the energy sector (p. 140), the section on water resources and services should address the implications of these energy plans for water resources, as well as the risks and opportunities posed by the country’s water situation for energy production.

- The section on an integrated and inclusive rural economy (p. 195) identifies land reform, job creation and poverty alleviation as the main vehicles to achieve better integration of the country's rural areas, but the section on water resources and services makes no explicit mention of a need, strategy or actions to secure and deliver water to beneficiaries of the land reform process.

The ratification of the Southern African Development Community (SADC) revised protocol on shared watercourses (SADC, 2000) and establishment of various river basin organizations (RBOs) has played an important role in promoting cooperation and increasing the benefits from these basins. The Orange-Senqu River Commission was established to foster closer cooperation for judicious, sustainable and co-ordinated management, protection and utilization of shared watercourses and to advance the SADC agenda of regional integration and poverty alleviation (ORASECOM, 2000), whereas the IncoMaputo agreement (2002) set out to promote cooperation among the Parties to ensure the protection and sustainable utilization of the water resources of the Incomati and Maputo watercourses. The agreement for the establishment of the Limpopo Watercourse Commission was signed in 2003 and ratified in 2011 (LIMCOM, 2003; Limpopo RAK, 2012). While these basin commissions have advisory rather than executive functions, they have facilitated the commissioning and execution of significant technical work in support of the shared objectives (ORASECOM, 2012; LIMCOM 2012). One of the largest bilateral infrastructure development projects in Africa, the Lesotho Highlands Water Project (LHWP), is executed through a bilateral treaty (RSA and Lesotho, 1986). The Treaty entrenches the sovereignty of Lesotho and the benefits she derives from the project. In terms of the treaty, South Africa is responsible for all the water transfer costs and its financial interests are safeguarded by assured water delivery schedules, whereas Lesotho is responsible for all costs on the hydropower component and ancillary development related to the LHWP in Lesotho. INBO and GWP (2012) consolidated the experience from IWRM in transboundary basins, including Lenton and Muller (2009), and concluded that: IWRM should be organized at the basin level, with cooperation between riparian countries; Tangible results depend on strong political will, trust and solidarity; There should be clear and aligned legal frameworks; Transboundary water bodies facilitates dialogue, information exchange and joint implementation of actions; and Appropriate financial mechanisms should be developed. The dependence on strong political will, trust and solidarity is demonstrated by the long lead times for the conclusion of regional agreements, such as the SADC Protocol on Shared Watercourse Systems, which was drafted in 1995, but which only came into force in 2003 (ORASECOM, 2000).

Various approaches have been developed to support integrated management of water resources, including integrated hydrology-ecology-economic models (Blignaut et al., 2010), regional models (Gaiser et al., 2008), the integration of socio-economic and biophysical data (de Lange et al., 2010), ecosystem services assessments (Jewitt, 2002), payments for ecosystem services (Blignaut et al., 2010), combating alien invasive plants (Enright, 2000; van Wilgen et al., 2012), regulation (Schreiner et al., 2011), incentives and economic instruments (Blignaut and van Heerden, 2009), and learning-by-doing

management (GWP and INBO, 2009). The learning by doing approach has been adopted for implementation as an adaptive management cycle (consisting of Visioning, Strategy development, Planning, Decisions making, Actions, Monitoring and Review) by shared watercourse institutions in SADC (Claassen et al., 2009). Payments for ecosystem services in the form of restoration and management of natural capital can support rural development and a social equity (Blignaut et al., 2010), with an example of such an intervention being the Working for Water Programme (van Wilgen et al., 2012). Other requirements for integration include a supportive and integrated policy framework, as well as a systems approach, the development of partnerships (stakeholder participation, a common vision, collaborative planning) and adaptive management (Pollard, 2002).

Uncertainty about the rate and magnitude at which the impacts of climate change will play out is a significant obstacle to timely and effective climate-related decisions, with decision makers being unsure which path to take or using uncertainty as an excuse not to integrate climate risks into plans and policies (WRI et al., 2011). Various authors have suggested Bayesian networks to incorporate uncertainty in water resources management (Bromley et al., 2005; Hendriksen and Barlebo, 2008; Molina et al., 2010) and a Bayesian approach was also followed in evaluating management options for water allocation in South Africa (Claassen et al., 2006), but there is still a need to incorporate uncertainty in optimizing integrated water resources management (Liu et al., 2011).

3. Conclusion

IWRM is a useful and necessary model for emphasizing the systematic interconnectedness within river basins, but it needs to be complimented with reflexivity and self-criticism to include broader issues such as politics (Merrey, 2008). This paper reflects on the development and implementation of IWRM in a South African context, particularly the degree to which the principles of IWRM (derived from the Dublin principles) are adhered to. Of these principles, the finite nature of water is not fully appreciated, with water quality and quantity coming under increasing pressure. However, the social and economic value of water is entrenched in policy and practice. The need for local community participation is addressed in policies and plans, but the mechanisms and consequent implementation should be strengthened. The enabling environment (policies, legislation and regulations) that has been established in South Africa supports the third Dublin principle, whereas the role of rural populations and women should receive more attention. The implementation of institutional roles and functions has started to yield results, but is still some way from the transformation and capacity envisaged in the National Water Act (Act 36 of 1998). While some management instruments are in place, there is a need to address significant gaps, for instance in monitoring and decision support. These aspects are hampering efforts to benefit from the positive enabling environment, whereas there is a particularly need to in establish mechanisms to support a network approach. While institutions, such as ORASECOM are starting to address the regional challenges in IWRM, the asymmetry in resources and power renders these undertakings

quite delicate. Although people-centered processes are more time consuming, they are more likely to lead to sustainability in the longer term (Pollard, 2002). The issue of resource ownership has been addressed in policy and practice, with water being a public good, but the distribution of benefits should be reassessed to ensure that inequities in society are addressed. The implementation of a public good policy in an environment where a free market economy provides the resources is proving to be challenging. The progress in moving from a “command and control” governance process, which focuses on institutional hierarchy to a network approach, is also progressing slowly. Significant progress in implementing IWRM and realizing its benefits thus not only depends on the enabling legal environment, institutional roles and functions and management instruments, but substantial shifts in the hearts and minds of policy makers, managers, scientists and water users. This shift is enabled and constrained by world views or ideologies. While the intent of policy and legislation is rooted in rationalism (with the essence of things being important), the value of the approach is lost in implementation, with resources being regulated through an empirical approach (or modernist at best). Such linear arguments do not adequately take account of complexities inherent in integration. The reality of postmodernism, which recognizes multiple views, causes political and societal actors to often have different views on what is important and what the best choices are, which leads to conflict with the empirical regulatory system.

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