Chapter 6
The South African Water Sector: On its Way Towards Adaptive Water Governance?

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Abstract The African continent is likely to be highly affected by the consequences of climate change. The ensuing projected changes in the ecological system such as decreasing water availability and higher amplitudes of droughts and floods require responses from the social system, i.e. adaptation measures. Even though climate modelling is still plagued by high uncertainty, models suggest a reduction of precipitation and runoff for South Africa. This poses a major threat for South Africa, which depends heavily on surface water and whose water resources are already under stress. Adaptive governance has been proposed as an approach that provides a way to cope with rising uncertainty and environmental change. Against the background of decreasing water availability and in addition to technical solutions, adaptive water governance structures can serve as an important element for increasing water use efficiency, adaptive capacity and resilience of the water sector. The first part of the paper takes a conceptual approach towards adaptive water governance. It suggests characterizing adaptive water governance by referring to and merging elements of good governance, water governance and adaptive governance. In the second part of the paper, some of the elements of adaptive water governance are examined with regard to their relevance for South Africa's water governance reforms. The paper concludes that, on the one hand, progress can be attested with regard to (1) a high level of flexibility built in the national water legislation, especially the National Water Act, (2) the provision of buffer capacities regarding institutions for solving water conflicts (redundancy), (3) the high level of participation of stakeholders at many levels and (4) the provision of equitable access to water. On the other hand, some (unintended) negative implications of these developments are documented. Among them are (1)

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the time-consuming processes of elaborating procedures and guidelines in the process of implementation, (2) the potentially negative effects of functional overlaps of CMA and regional offices of DWA, (3) effectively involving relevant stakeholders and (4) the lacking long-term sustainability of water infrastructure due to lack of capacity and capital.

Keywords Adaptation · Adaptive governance · Water governance · Good governance · Resilience · South Africa

Introduction

On the African continent, climate change impacts are expected to be especially severe. The Intergovernmental Panel on Climate Change (IPCC) states that "warming [in Africa] is very likely to be larger than the global, annual mean warming throughout the continent and in all seasons, with drier subtropical regions warming more than the moister tropics" (Christensen et al. 2007, p. 850). For South Africa, climate change models suggest that the eastern part of the country is likely to receive more rain, while the western parts become even drier (Lumsden et al. 2009). Due to its close interconnectedness with the climate system, the hydrological system is very sensitive to changes in the climate. A 20% decrease in precipitation might lead to a decrease of up to 70% of the drainage in some parts of the Orange-Senqu river basin, which serves as a major water source for irrigation agriculture (De Wit and Stankiewicz 2006). However, modelling the consequences of climate change is still afflicted with considerable uncertainties, especially concerning local projections of climate change impacts. Furthermore, uncertainties arise since past experience may often no longer provide reliable guidance for the future, and governance of natural resources is confronted by unprecedented situations (Pahl-Wostl et al. 2007).

These developments of the ecological system and increased uncertainties put the social system under pressure to change and adapt.[1] Climate change threatens recent achievements in development, thus underlining the urgency of action, i.e. adaptation, especially in developing countries. Economic and social development has so far assumed environmental stability and relied upon relatively stable environmental conditions. In the past, the focus of natural resource use has been on managing and governing for stability and efficiency. This produced good results in the short term while in the long term it led to resource degradation and decreasing ecological resilience (Olsson et al. 2006). Faced with uncertainty, the results

[1] A social system is defined as all man-made structures, relations and objects and encompassing social and economic aspects, while an ecological system is a system of interrelated and dependent organisms or biological units (Anderies et al. 2004). Interlinked and interdependent social and ecological systems constitute a social-ecological system (SES; Berkes et al. 2003).

of these approaches have been surprise and ecological and economic losses (Holling and Gunderson 2002).

At the same time, in the context of climate change, natural resource governance needs to reflect and be able to deal with uncertainties as well as gradual and abrupt change, i.e. it needs to become adaptive. It needs to be in accordance with the requirements of sustainable development, ensuring a balance of social, economic and environmental needs, not only today but also in the future. Sustainable use of natural resources in a changing environment is more likely if resilience and adaptive change become integral parts of natural resource and especially water governance. In this sense, building resilience can be termed a sustainable response to climate change (Tompkins and Adger 2003). With a view to natural resource governance and especially institutions, the problems of fit and interplay have been highlighted as important realms on the way towards sustainable resource governance regimes (Young 2002). The requirement of fit between an institutional setting and the natural resource it is addressing becomes even more important in a changing environment, highlighting the need to adapt. The problem of interplay, i.e. the interaction and coherence of the various institutions at different levels or sectors of natural resource governance regimes is also gaining importance, since climate change is a cross-cutting issue, which needs to be addressed coherently across sectors and administrative levels.

The need for adaptation is especially high in the water sector, which will be especially affected by climate change through changes in precipitation patterns and river runoff, increased evaporation from water bodies and evapotranspiration of plants. Technical measures for adaptation only constitute part of the solution. Firstly, climate change is likely to produce an impact on livelihoods high above any extent of technical progress. Secondly, already available technical solutions are unlikely to be affordable by the people hit hardest by climate change. The social system and especially the water sector need to develop strategies and structures enabling it to cope with the challenges of climate change, i.e. it needs to increase its adaptive capacity and resilience. With decreasing water availability and increasing demand, the need for effective governance, enabling conflict management and water allocation with the consent of the majority of the population, increases. Adaptive governance has been proposed as an approach that provides the means to cope with rising uncertainty and environmental change (Dietz et al. 2003; Folke et al. 2005).

This paper aims at developing a concept of adaptive water governance and applying it to the water sector. In the following section, such a concept is derived by combining the concepts of good governance, water governance and adaptive governance. The elements of adaptive water governance reflect the dimensions of sustainable development, as well as addressing the problems of fit and interplay. The third section provides an application of this concept to the South African context of water governance reform. Finally, conclusions are drawn with respect to the adaptability of the South African water governance regime.

The paper builds upon findings from research on the transition towards adaptive water governance regimes in the context of climate change in South Africa

undertaken as part of the NeWater Project. It draws upon a literature review and several weeks of field research. The research was informed by a qualitative research paradigm. Empirical data on water governance reforms, governance structures and processes (especially regarding the elements of adaptive water governance described above) was mainly derived from 34 semi-structured interviews with policy-makers, water managers, stakeholders and scientists. Subsequently, data was updated and validated via contacts and discussions with colleagues from South Africa.

Towards a Concept for Adaptive Water Governance

A water governance regime that is able to cope with the challenges of climate change needs to, firstly, have a high level of resilience (Folke 2006). This includes flexibility to confront uncertainty and to react to surprise and changing climatic, hydrological and social conditions. It thus needs to be adaptive. Secondly, it should have the support and trust of the people and build upon a broad base of knowledge and experience. These issues are covered by the concept of good governance (Doornbos 2003). Finally, it should take the specific necessities of the water sector and the water cycle into account. This requirement is met by the concept of water governance (GWP 2003). A combination of adaptive governance, good governance and water governance is suggested as a way to capture the elements of adaptive water governance. In the following, the concepts are briefly outlined before they are merged to form a sustainable concept of adaptive water governance.

Adaptive Governance

"Adaptive governance is a process of creating adaptability and transformability in [social-ecological systems]" (Walker et al. 2004, p. 7).

Adaptive governance acknowledges that modern governance regimes increasingly face complexity, that governance resources change, and that surprise and new uncertainties are inevitable. However, the term remains ambiguous in the resilience literature (Jordan 2008). In this paper adaptive governance is defined as "the evolution of rules and norms that better promote the satisfaction of underlying human needs and preferences given changes in understanding, objectives, and the social, economic and environmental context" (Hatfield-Dodds et al. 2007, p. 4). Elements of adaptive governance most frequently mentioned in the literature are flexible and redundant institutions as well as multi-level, horizontal and polycentric governance structures (Folke et al. 2002; Folke et al. 2005; Olsson et al. 2006; Pahl-Wostl 2009).

At this point, the mutually reinforcing relationship between adaptive governance and adaptive management needs to be addressed. Adaptive management is an attempt to address uncertainties in everyday water resources management through the integration of feedback loops to accelerate learning, increased flexibility and perceiving policy as a set of controlled experiments (Mclain and Lee 1996; Folke et al. 2002). Adaptive management thus provides the basis for being able to take informed decisions on water allocation and distribution. Being a management tool for addressing uncertainties that remain in planning, it complements adaptive governance at the management level. Adaptive management relies on functioning institutions and institutional capacity and thus on adaptive governance (Medema and Jeffrey 2005). Water management takes place within and is influenced by the water governance system. It needs to be supplemented and facilitated by fitting (and possibly adaptive) governance structures that enable adaptive management of water resources.

Good Governance

"Good governance must underpin effective adaptation strategies" (AfDB et al. 2003, p. 24).

In the 1990s, international development agencies coined the term "good governance" as they found that shortcomings in development were linked to deficient governance structures and processes (Dolzer 2004). Good governance was identified as central to strong and equitable development and thus as a precondition for economic prosperity and political stability (World Bank 1992). Bad governance, on the contrary, often serves as a barrier to development, increases vulnerability and decreases the ability to react to change and adapt (GWP 2003). Good governance has a strong influence on social-ecological systems and their ability to react to disturbances (Walker et al. 2006, p. 7). In other words, good governance positively affects a system's ability to adapt to changing circumstances.

The aim of good governance is to improve the effectiveness and quality of governance processes, structures and outcomes, which is assumed to benefit the well-being of the citizens. "Governance can be seen as the exercise of economic, political and administrative authority to manage a country's affairs at all levels. It comprises the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences" (UNDP 1997). Frequently mentioned elements of good governance include participation, transparency, accountability, effectiveness and equity. It promotes the rule of law and "ensures that political, social and economic priorities are based on broad consensus in society and that the voices of the poorest and the most vulnerable are heard in decision-making over the allocation of development resources" (UNDP 1997).

Sustainable development and building resilience are often connected to trade-offs, e.g. ecological resilience versus social resilience, economic versus ecological sustainability (Lebel et al. 2006). Each society needs to decide what kind of resilience it seeks to establish and towards which threats it wants to build resilience. Good governance facilitates these kinds of processes. A good governance approach ensures an equitable and broadly based discourse. It thus helps finding a broadly based consensus on how to deal with trade-offs, define priorities and how to position a society within areas of conflict.

The concept of good governance mainly focuses on providing political stability and economic prosperity, while not explicitly referring to the third dimension of sustainable development, namely ecological sustainability. Among other things, the ecological dimension is supplemented in the concept of water governance.

Water Governance

"Water governance refers to the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society" (GWP 2003, p. 16).

Governance issues arise in almost all spheres of development and social life and thus also play an increasingly important role in formerly technically dominated spheres such as water management. In coherence with the principles of Integrated Water Resources Management (IWRM), water governance is defined as being (GWP 2003, pp. 27–29):

- *Open and transparent*: accessible and transparent policy formulation and implementation to increase confidence and trust in organizations and institutions of water allocation and distribution.
- *Inclusive and communicative*: enabling broad stakeholder participation to increase the quality and effectiveness of water policies, organizations and institutions.
- *Coherent and integrative*: inclusion of all users and uses and the coordination of related policies to adequately address problems of complex systems with a consistent, holistic and cross-cutting approach.
- *Equitable and ethical*: enforcement of justice, property rights and rule of law regarding access to and ownership of water to provide all citizens with equal opportunities to sustain their well-being.
- *Accountable*: ensure clear responsibilities and obligations as well as sanctions for the violation of rules.
- *Efficient*: apart from economic efficiency support social, political and environmental efficiency in water issues (e.g. minimize economic and environmental inefficiencies of water management such as over- or under-allocation or provide a socially accepted and affordable level of access to water resources and sanitation).

- *Responsive and sustainable*: orient policies and institutions on demand, the policies' impact and past experience. Implement these policies at the relevant level (principle of subsidiarity), keeping in mind present and future interests of water users.[2]

Water governance functions as a transmitter of impact from the social system to the ecological system and vice versa. Thus institutions as a basic component of water governance "link the society to nature, and have the potential to coordinate the human and natural systems in a complementary way for both ecological and human long-term objectives. They also have the potential to inhibit adaptive responses to ecosystem changes" (IHDP 1998). For example, water governance sets the incentives for the sustainable or unsustainable use of the water resources through the institutions of property rights. This function of water governance as interface implies that water governance and especially the institutional arrangement in the water sector is one of the spheres firstly coming under pressure of adaptation when changes of the ecological system occur. If water governance proves resistant to such adaptation pressure, the resulting (increased) mismatch between social and ecological systems is likely to exacerbate degradation and overuse of water resources.

Adaptive Water Governance

Based on the concepts of adaptive governance, good governance and water governance elements of adaptive water governance can be derived. These elements are grouped according to address the need for sustainable water governance and the problems of fit and interplay (cf. Fig. 1). The concept of adaptive water governance provides a point of reference for examining and assessing institutional change in water governance regimes.

The Problem of Interplay: Multi-Level and Horizontal Governance

The importance of vertical and horizontal interplay between institutions and organizations for sustainable and adaptive governance of natural resources has been frequently underlined (Young 2002; Folke 2006; Young 2006; Pahl-Wostl 2009). Horizontal interplay or governance refers to institutions that facilitate the cooperation and linkages (e.g. exchange of knowledge and information) among

[2] Water governance is, on the one hand, based on and significantly overlaps with good governance. On the other hand, it differs from good governance by not addressing issues of democratization, electoral systems and sovereignty (GWP 2003).

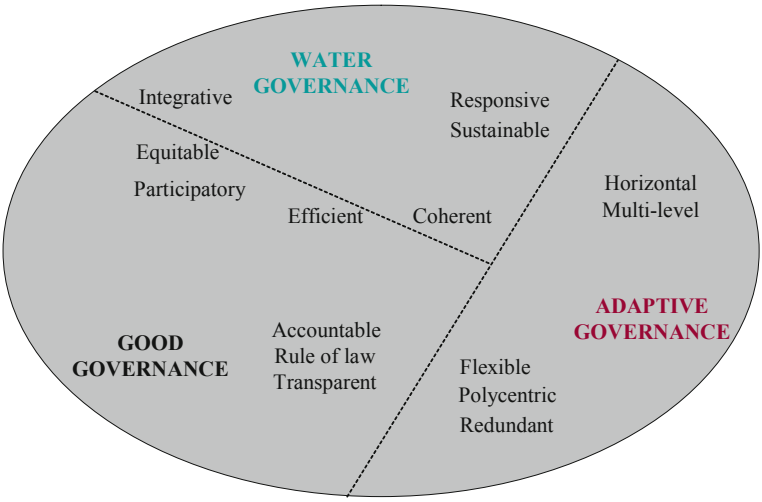

Fig. 1 Adaptive water governance. Source: own compilation

governance entities at the same level of administration (e.g. ministries, local water management organizations), as well as cross-sectoral and cross-disciplinary thinking (Hill 2005). It foresees that e.g. ministries concerned with water management tasks or local water management organizations, such as WUA, exchange information, thus allowing for new practices to spread quickly. This is increasingly important with regard to the transfer of responsibilities in decentralized governance systems. The newly empowered organizations need to cooperate to identify and share best practices.

The demand for *multi-level* or *vertical governance* structures within adaptive water governance (Folke et al. 2002; Pahl-Wostl 2009) originates from the observation that ecological systems rarely follow administrative boundaries and that ecosystems dispose of multiple levels. An effective resource management should thus mirror these multiple levels (Low et al. 2003) and possess governance mechanisms working across levels including state and non-state actors and integrating the local, provincial, national and international levels of governance and administration. Multi-level governance is based on the assumption that complex issues such as water governance can only be achieved through the integration, interaction and cooperation of the different levels of a governance system. However, multi-level governance does not necessarily imply the linear organization of administrative levels, which is more crisis-prone or susceptible to risk, since the failure of one element can break the system (Low et al. 2003).

The Problem of Fit: Polycentric, Flexible and Redundant Governance Structures

Adaptive water governance regimes should aim at improving the fit between the ecological and the social system (Young 2002). Evolving complex social-ecological systems (SES), which may be characterized by state changes and flips, require polycentric, flexible and redundant governance structures, management institutions and organizations in order to prevent mismatch and mismanagement.

Polycentric organizations and institutions "improve the fit between knowledge, action, and social-ecological contexts in ways that allow societies to respond more adaptively at appropriate levels" (Lebel et al. 2006, pp. 8–9). It is assumed that nonlinear polycentric governance structures are better geared to react to nonlinear ecological crisis if compared to linear governance structures (Low et al. 2003). For example, the impacts of climate change on water resources are likely to vary across a country, thus calling for individual adaptation measures in different regions. These are more likely to develop in the local context than within a hierarchical governance setting. Unlike strictly hierarchical systems polycentric governance structures dispose of multiple centres of power. "Polycentric governance systems can be characterized as complex, modular systems where differently sized governance units with different purpose, organization, spatial location interact to form together a largely self-organized governance regime. Polycentric governance systems are characterized by many degrees of freedom at different levels" (Pahl-Wostl 2009, p. 7). These degrees of freedom allow the development of locally appropriate institutions (Lebel et al. 2006).

Adaptive water governance requires *flexible institutions*, which offer mechanisms that provide for the adjustment of management procedures and management structures to new (environmental) conditions and new (scientific) knowledge (Folke et al. 2002). Flexible institutions permit and request feedback and monitor its implementation, i.e. they allow for learning from past experience, are able to quickly identify inefficient practices and rules and the need for changing them. However, too much flexibility may also turn out negatively. "Systems where change is not allowed will almost certainly generate surprise and crisis. Systems that allow too much change and novelty will suffer loss of memory" (Berkes et al. 2003, p. 376). On the one hand, the increasingly uncertain environment forces social systems and institutions to become more adaptive—that is, flexible and open to change. On the other hand, strong and reliable institutions are needed to establish and sustain a functioning water governance system. The task is therefore to find the appropriate balance between innovation and conservation.

The *redundancy* of institutions similarly requires finding such a balance. Redundancy influences system performance—under some conditions positively, under others negatively (Low et al. 2003). Contrary to mainstream economic thinking it is increasingly acknowledged that redundant structures do not necessarily lead to inefficiency but may even improve system performance—especially

if system performance is not measured in terms of short-term output but rather in terms of long-term capacity to deal with risk and uncertainty and adapt to change.

In ecosystems, redundancy of species guarantees ecosystem resilience and stability and prevents ecosystem failure (Naeem 1998). Redundant species are not primarily needed to provide ecosystem functioning and services because they provide similar functions to the ecosystem as other species. But they are able to replace other species once these fail or become extinct. Thus, redundancy resembles one of the core principles of evolution and can potentially ensure the survival of the system in times of crisis.

Applied to social systems, the overlap and redundancy of institutions may increase the capacity of a system to diverse responses to a problem (Walker and Salt 2006). This implies that one institution can provide the same (or similar) function as a second one and replace it once the second one became ineffective through crisis and change. Redundancy may refer to the overlap of institutions or functions of organizations or the prevalence of similar subsystems (Holling et al. 2002; Low et al. 2003). The doubling of institutions and a modest overlap of functions support the spreading of risks and help to absorb disturbance (Folke et al. 2005). Moreover, governance structures that mirror and thus fit ecosystem structures are more likely to identify system failure and adequately respond to it (Low et al. 2003). Redundant functions and organizations may thus not contribute to system functioning under normal conditions but may provide relevant functions and information during unpredictable events, i.e. when the system reorganizes.

Redundant subsystems need to operate independently to have positive effects. The administrative unit compensating for another unit's failure should not be affected by that failure (Low et al. 2003). However, since the doubling of functions and subsystems is costly, there is a need to identify the optimal level of redundancy (Low et al. 2003). Since it is often difficult to identify the kind of redundancy in advance that will generate positive effects in a crisis, redundancy should be limited to those cases where it can be achieved with low costs.

Social Sustainability: Equity, Integration and Participation

Broad stakeholder *participation* on the basis of *equity* is an essential element of making water governance regimes adaptive (Pahl-Wostl et al. 2005; Biermann et al. 2009). This refers both to the involvement of relevant stakeholders in decision-making processes at different levels of administration (e.g. in the development of a water use strategy) and the equitable access to and use of water resources. The *integration* of all users ensures that different interests within society and interactions of a topic with other issues come to light and are discussed. Participation gives underrepresented groups the chance to raise their issues and claim their rights. Through this process, trust and a shared understanding can be built and social learning be fostered (Lebel et al. 2006). Through participation, different kinds of knowledge on ecosystem functioning and management practices

(including local and traditional knowledge) can be integrated in management decisions.

Economic Sustainability: Efficiency and Coherence

The efficient use of natural, human and financial resources is a prerequisite of adaptive water resource governance, especially in the context of developing countries, which more often than not are not well endowed with any of them. One prerequisite for effective and *efficient* governance of resources is *coherent* decision-making (Sadoff and Muller 2009). This is especially important since water is a cross-cutting issue. Decisions at all levels and in many different spheres of governance affect the water resource. It is important, however, to keep in mind the inherent trade-offs between efficient governance, redundancy and an increased long-term vulnerability to uncertainty and surprise (Davidson-Hunt and Berkes 2003). This trade-off, which is related to what Walker has termed the difference between general and specific resilience (Walker et al. 2006), will be addressed in the section on synergies and trade-offs.

Political Sustainability: Rule of Law, Accountability and Transparency

Water governance organizations underlie the rules which have been formulated by legislature for the governance and management of water resources. Their actions should be authorized by law (García-Salmones 2009). Laws define their room of manoeuvre for managing water resources and the necessary cooperation with other state organs. The *rule of law* aims at preventing discretionary, ad hoc water resources governance. This is closely connected to upwards (towards superior bodies) and downwards (towards the public) *accountability*. Authorities that can be made responsible for their actions (and inaction) tend to pursue a more equitable distribution of benefits and thus enhance the adaptive capacity of a social system (Lebel et al. 2006).

Accountability is supported by *transparency*, i.e. the disclosure of organizational structures, water management procedures and strategies, as well as monitoring data (Young and Lipton 2006). Transparency, accountability and rule of law increase the predictability of system behaviour and create trust in the system and its functioning.

Ecological Sustainability and Responsiveness

Water governance should be organized with a view to the long-term *sustainability* of water use. This includes governing (surface water and groundwater) resources such that they are neither overused nor polluted and that enough water is provided to support ecosystems (so-called environmental flows). In a changing environment, *responsiveness*, i.e. the ability to recognize changes in the water system (e.g. decreasing water availability, overuse of groundwater resources or increasing water pollution), and taking timely and adequate measures to react to these changes gain importance. This includes measures of demand management rather than supply management.

Sustainable water governance should not only serve present water users but also take demands of future water users into account (GWP 2003). The emphasis on sustainability and responsiveness introduces the timescale to adaptive water governance. Past experience and current changes in the ecological system need to be monitored and taken into account. Long-term effects of present interventions need to be anticipated and (especially when this is not or not sufficiently possible) effects need to be monitored during implementation to be able to adjust measures, should they entail unintended negative effects.

Synergies and Trade-Offs Between the Elements of Adaptive Water Governance

Many of the elements of adaptive water governance described above are closely interlinked and difficult to examine in isolation. Some of the elements produce synergies, while trade-offs and tensions exist between others. For example polycentric governance may facilitate redundancy and experimenting because of a large number of independent units thus fostering resilience of the system (Warner et al. 2008; Huitema et al. 2009). Polycentric governance and redundancy in institutional set-up and structures, however, may come to the detriment of efficiency and coherence. Public participation on the one hand adds transparency for stakeholders, fosters social learning and improves water governance through knowledge exchange. On the other hand, it is often costly (in terms of human and financial resources), thus negatively affecting efficiency. Likewise, it might be difficult to arrange for participatory governance structures that allow for accountability (who is responsible for decisions taken with large involvement of stakeholders?) or to establish flexible institutions that remain sufficiently transparent.

From a short-term perspective, most of these tensions seem inevitable. With a longer-term perspective, which does not only take the functioning of the social but also of the ecological system into account, the elements of adaptive water governance are not necessarily mutually exclusive. The trade-off of participation and

efficiency may at least partly dissolve when taking a longer-term perspective. Participation helps to produce resilient solutions that take local context and knowledge into account, are supported by stakeholders and tend to be easier to implement and sustain than decisions taken in a top–down manner. Likewise, redundant institutions or structures may prove useful in times of crisis. The aim of adaptive water governance should therefore be to find ways how to achieve one goal while not negatively affecting the others. In those cases where this cannot be achieved, good governance should provide for a societal negotiation process on finding an acceptable level of negative effects. An example is the trade-off between participation and accountability or the increasing costs of cooperation and coordination with increasingly redundant structures.

Adaptive water governance should not be understood as a "one-size-fits-all" approach, but rather as one leaving room for composing the elements and adjusting them to local needs. The optimal amount of one or the other element will differ in different cultural, social, political and economic contexts. The respective contexts also determine the relevance of a certain set of elements, which might not be the same in two countries. In addition, different stages of development may require the emphasis of different sets of elements, i.e. the composition and accentuation of elements in a particular case may change over time. For example the creation of trust through rule of law, transparency and accountability may be a precondition for meaningful participation. However, it is assumed that—regardless of the socioeconomic situation—a certain level of each of these elements is required for constituting an adaptive regime and the building of resilience. For example, the provision of a certain level of flexibility of institutions should be provided in order to assure the ability to react to disturbance. The "optimal" level of this flexibility can differ in different contexts though and should be determined through good governance.

Adaptive Water Governance Applied to South African Water Governance Reforms

South Africa is a country undergoing comprehensive transformation since the end of the apartheid regime in 1994. After decades of economic sanctions, domestic markets and foreign trade were liberalized and a parliament was democratically elected. In addition to this transformation, the country is prospected to be highly affected by environmental change. The South African water system in particular is highly vulnerable to climate change (De Wit and Stankiewicz 2006). The country is characterized by a relatively low mean annual precipitation [495 mm in 2007 (FAO 2009)] and a low conversion rate of rainfall to runoff while being highly dependent on surface water. As a consequence, water resources are highly stressed in some parts of the country. In the past, increasing demand was met through increasing the water storage capacity by building a highly sophisticated system of

water transfer schemes and dams. Today, there are few adequate places left to build new dams (Muller 2002) and the variability of runoff is further increased through the impact of climate change, thus possibly rendering large, inflexible infrastructure less efficient. Apart from these economic limitations, several ecological objections exist against dams and water transfers. For example, the Greater Fish transfer scheme turned a previously seasonal river into a permanent one, providing excellent breeding conditions for the biting black fly. This insect turned from a seasonal occurrence into a pest, causing significant stock losses among cattle (Bohensky 2008). Thus, besides technical solutions, improvements of water governance regimes need to be explored. The prevailing structural engineering and supply management approach needs to be replaced by an approach which combines demand management and economic incentives for water saving (e.g. through pricing) with equitable access and ecological sustainability.

In the following, the elements of adaptive water governance are applied to the South African water sector. Even though adaptive water governance is no explicit goal of water governance reforms in South Africa, the current and future exposure of the country to climate change justifies the assessment of reforms using this concept. Examples are given that illustrate some elements of the concept without claiming to be exhaustive. The focus is on the problem of fit (especially flexible institutions and redundancy) and social sustainability (especially participation and equity), since most progress can be attested in these spheres.

Flexible Institutions: the National Water Act

Following the end of the apartheid regime, the South African social system has undergone paramount institutional change, beginning with a new constitution (Republic of South Africa 1996). In the water sector, the Water Services Act (Republic of South Africa 1997) and the National Water Act (Republic of South Africa 1998) that has been internationally praised for representing state-of-the-art water law (De Coning and Sherwill 2004) followed. The National Water Act foresees the transformation towards a holistic, decentralized and participatory approach to water management with the aim of increasing water use efficiency, securing equal access to water and sustainably using water resources.

Being conceptualized as a developing institution, the National Water Act provides several entry points for flexibility. Firstly, different parts of the legislation can be promulgated at different times. As a consequence, the National Water Act itself only provides a framework. Its concrete elaboration takes place during implementation and is authorized to the state administration in charge (in this case the Department of Water Affairs, DWA). Expressions such as “in a phased and progressive manner” allow for a phased implementation of the Act over time and space (Rowlston et al. 2000, p. 6). Thus, the largest part of the Act was promulgated in August 1998, but sensitive sections, such as the ones on licensing, the establishment of the Reserves and water use registration, were only promulgated in

October 1999 after they had been thoroughly designed, instruments had been developed and processes had been defined (De Lange 2004). With this approach it was acknowledged that the resources to implement comprehensive change in administrative and operational procedures were limited.

Secondly, several provisions of the Act include mechanisms allowing later adjustments. The Act itself and the National Water Resources Strategy are subject to reviews every five years. Likewise, water licences are reviewed every five years and may not be granted for a period longer than 40 years (Republic of South Africa 1998, Sect. 28). In the context of scarce water resources, the reallocation of water from relatively low productivity uses such as agriculture to uses with a higher productivity per unit of water such as industry are discussed in South Africa (Otieno and Ochieng 2004). Should there be political consensus on the issue, the flexibility of the water licensing procedure and the short term of water licences would allow for the implementation of such a change.

In the implementation process, however, the flexibility of the Act can also have negative repercussions. For example, the establishment of Catchment Management Agencies (Burt et al. 2008) was significantly delayed since the Act did not provide the necessary procedures, such as criteria for evaluating CMA proposals, which then had to be developed in the process. As a consequence, the assessment of the proposal for the Inkomati CMA was delayed for 18 months, thus alienating the involved stakeholders from the process (Brown and Woodhouse 2004; see also Herrfahrdt-Pähle 2010).

Redundancy: Functional Overlap of Institutions

In the South African context, institutions for solving water conflicts may serve as an example for potentially beneficial overlaps or redundancy. The National Water Act establishes a Water Tribunal as an "independent body with a mandate to hear and adjudicate appeals on a wide range of water-related issues, mainly against administrative decisions made by responsible authorities and water management institutions" (DWAF 2004b, p. 100). Appeals to the tribunal may relate to various aspects of water conflicts such as decisions on water allocation, licence applications, declarations of existing lawful water use or compensation for refused water rights.

Parallel to the Water Tribunal, another institution of conflict resolution has been acknowledged with the Traditional Courts Act (Republic of South Africa 2008). Traditional courts are foreseen to enhance "access to justice by providing a speedier, less formal and less expensive resolution of disputes" (Republic of South Africa 2008, p. 9). Thus traditional courts might serve as an alternative option to the Water Tribunal for solving water conflicts. In case of crisis, for example during a severe drought, traditional courts could serve as buffer capacity to unburden the Water Tribunal. It seems that the costs of the associated functional overlaps are relatively low since they are relatively inexpensive. The requirement of

independence of the two institutions is also given since they operate at different levels and within different sets of norms and structures.

Another example of a functional overlap of institutions is linked to the transition from administrative to hydrological water management. Until recently, water was managed by province offices of the Department of Water Affairs (DWA). The National Water Act inter alia calls for the transition from a water management system based on riparian rights and administrative boundaries towards licensing of water use and the management along hydrological boundaries (Seetal 2005). This includes the restructuring of the water management bodies of the DWA and the introduction of Catchment Management Agencies. Even though they will not be completely replaced by CMA, the role of the province offices of DWA is not adequately referred to in most water governance documents. Often reference is made to the changing role of the DWA from a regulating and implementing agency towards a provider of policies and strategies (DWAF 2004b). It remains unclear what this means for the province offices, which were mainly involved in policy implementation and operation and maintenance in the past. The parallel existence of both CMA and province offices of DWA may easily result in functional overlaps. In this case, however, overlaps rather seem to be connected to a number of disadvantages, since both organizations act simultaneously, at the same level and in the same sphere of governance. While it is not clear so far how exactly responsibilities and tasks will be delineated between the two bodies, it seems likely that their coexistence will be associated with higher costs than benefits. In any case, this form of redundancy will require good coordination to avoid excessive inefficiency and ineffectiveness.

Participation of Stakeholders: Top–Down Versus Bottom–Up

Since the end of the apartheid era, participation and participatory democracy range high in all spheres of government. Accordingly, the National Water Act foresees mechanisms for participation at all levels. For example, the formulation of a new strategy for the water sector needs to be informed by a comprehensive participation process. Stakeholder workshops are conducted at province and municipality level. Due to lacking capacities and skills at all levels of water administration, these consultation processes often take several years.

However, it seems that participatory mechanisms have so far mostly been implemented in a top–down approach by government agencies and that the initiative and major input generally comes from the central government. For example, the implementation process of the CMA seems to be initiated and organized either by DWA's province offices or the DWA headquarters, thus leaving little room for stakeholder participation in the sense of impact on the design of these new organizations or their procedures. There seems to be a bias

regarding participation. In strategically more important issues (such as the establishment of CMA, which touch upon the core of DWA competencies), participation seems to be less intensive than in others.

On the other hand, the dominant role of the government can be justified by the large imbalances that still exist between different stakeholder groups and which may cement inequality in water issues. Within Water User Associations (WUA), for example, the participation of previously disadvantaged persons is a topic of concern. They are often sidelined by white farmers and efforts need to be made to empower them to effectively take part in WUA decision-making (Karodia and Weston 2001). In this regard, it is the role of DWA to "level the playing field by stimulating information provision, social facilitation, dispute resolution, capacity building, etc". (Van Koppen et al. 2002, p. 15). The Minister has used her power several times and rejected proposals for CMA implementation processes because of the deficient representation of historically disadvantaged communities, small-holders and water users. "Only DWAF's [i.e. DWA's] strong, effective steering role in crafting CMAs that build upon local law can lead to inclusive, bottom–up river basin" (Van Koppen et al. 2002, p. 16). It will be difficult for DWA to determine the point in time when to withdraw from the process and to establish the necessary capacities with the underrepresented parts of the population. There is the risk that the domination of participatory processes through special interest groups (e.g. large-scale farmers) undermines the credibility of participatory mechanisms. De Villiers (2008) observes this trend and a resulting decline in participation with regard to ward committees.

Equity: Providing Equal Access to Water and Sanitation Services

Among the major concerns of the new political administration is the provision of the population with access to safe drinking water. Human and environmental water demand come first in the water law and there is a strong commitment to provide all citizens with access to drinking water under the slogan "some for all forever", which culminates in the constitutional right to water (Republic of South Africa 1996). To address the backlog in provision with access to water and sanitation from apartheid times, comprehensive programmes were put in place. Between 1994 and 2004, 13.4 million people received access to safe drinking water and 6.9 million people received access to basic sanitation (DWAF 2004a). Even though considerable progress was made by connecting large parts of the population to piped water in the 1990s, it has been stated that many of these infrastructure developments are inoperable today due to a lack of operational and maintenance capacity, inefficient cost recovery, the absence of institutional arrangements and vandalism (Mukheibir 2007).

The National Water Act foresees the implementation of the Reserve (consisting of a social and an ecological reserve) to prioritize human needs and environmental integrity of the system in relation to other water uses, e.g. by agriculture or industry. The "basic human needs reserve" guarantees a minimum of 25 l of water per person per day and the "ecological reserve" was established to assure sufficient provision of ecological flows (Hamann and O'Riordan 2000). Since 2001, the free basic water policy ensures that the basic human needs reserve is provided free of charge (to poor households). By 2007, more than 75% of the population received free basic water, which has contributed to achieving social equity (Muller 2008).

Conclusion

Governing water resources adaptively is becoming a crucial element of sustainable development because existing economic and social problems are increasingly exacerbated by the impact of climate change on water availability, especially in Africa. This paper sought to provide a way to characterize adaptive water governance in the context of sustainable development by referring to and merging elements of good governance, water governance and adaptive governance. Good governance is widely acknowledged as the basis for democratic and fair governance processes, both of which should also be guiding decision-making in the water sector. However, the concept of good governance appears not to be able to provide governance structures and processes with the resilience which is necessary regarding the challenges of a changing environment and especially climate change. Adaptive governance can complement good governance since it is geared towards increasing resilience, e.g. through flexible institutions. Both good governance and adaptive governance fall short of including the specific needs of the water sector. This element is provided by adding water governance, which among other things highlights the need for (ecological) sustainability in governing and managing water resources. Since the elements of adaptive water governance hold both synergies and trade-offs, the main challenge for future research will be finding ways of how to use synergies and minimize trade-offs.

In the second part of the paper, some elements of adaptive water governance were applied to the South African context of water governance reforms. The new water legislation and policy is largely in line with adaptive water governance. Elements such as ecological sustainability, institutional flexibility, participation and redundancy are addressed by the new water legislation through the provision for a social and ecological Reserve, CMA and the involvement of stakeholders. However, implementation of these ambitious legal frameworks is still weak. Little progress has been made with implementing ecological sustainability, e.g. by determining the demand for environmental flows. Similarly, the political will to curb water use and ensure sufficient environmental flows seems to be rather low. The examples on the flexibility of institutions, redundancy of institutional

structures, participation of stakeholders and equitable access to water likewise provided a mixed picture concerning implementation. On the one hand, progress can be attested with regard to (1) a high level of flexibility built in the national water legislation, especially the National Water Act, (2) the provision of buffer capacities regarding institutions for solving water conflicts (redundancy), (3) the high level of participation of stakeholders at many levels and (4) the provision of equitable access to water. On the other hand, some (unintended) negative implications of these developments are documented. Among them are (1) the time-consuming processes of elaborating procedures and guidelines in the process of implementation, (2) the potentially negative effects of functional overlaps of CMA and regional offices of DWA, (3) effectively involving relevant stakeholders and (4) the lacking long-term sustainability of water infrastructure due to lack of capacity and capital. This shows the close integration of the elements of adaptive water governance and their trade-offs as well as the difficulty to find an appropriate level of each of these elements. Thus, depending on the context, more participation does not necessarily increase adaptiveness and resilience (e.g. if it takes too much time to generate meaningful results due to lack of capacities).

Despite these caveats, progress has been made towards a more adaptive way of governing water resources in South Africa. The National Water Act and its flexibility provide an important place of departure for adaptive water governance. However, despite this good starting point, most drawbacks have to be attested regarding implementation. This shows the long way from conventional water governance approaches towards more adaptive approaches. Current limitations such as lack of political will, capacities and skills have to be overcome to facilitate timely and comprehensive implementation and thus increase the resilience of the water governance regime. With current water governance reforms in South Africa, significant first steps have been made but many more have to follow to establish adaptive water governance in practice and find sustainable solutions for increasing water scarcity and uncertainty.

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