# The Adaptation Capacity of African Water Resources Governance in Light of Environmental Change

## Mapping Determinants of Resilience across the Continent

Paper prepared for the 4th European Conference on African Studies, 15 June 2011, Uppsala, Sweden

Susanne Schmeier[1]

**Abstract**: Hydrological changes in transboundary river basins – may they occur in the form of extreme events like floods and droughts, changes in the river's flow due to infrastructure developments or changes in the river's ecosystem – lead to challenges of international nature. In order to address collective action problems related to the use of water resources by actors from several nation-states, River Basin Organizations (RBOs) have been established. However, their capacity to adapt to changes occurring in river basins varies highly, both across river basins and across issue-areas. This paper addresses the different potential determinants of adaptation capacity of RBOs. It aims at providing a common understanding of what triggers or impedes adaptation capacity in African River Basins, establishing a joint starting point for more case-specific papers presented in the course of the panel.

## 1 Introduction

The transboundary nature of many of the world's rivers and lakes implies the occurrence of collective action problems related to the fact that the use of the river and its resources by one actor necessarily affects the opportunities of other actors in the basin. While severe disputes over such collective action problems have largely been mitigated and conflicts prevented through the signature of International Water Treaties (IWTs) and the establishment of River Basin Organizations (RBOs), the emergence of new challenges can easily threaten the often fragile balance. Such new challenges most often come with change in a basin. Climate change, the development of large infrastructure schemes of changes in riparian states' populations, economic developments or political situations can all affect the river basin and its resources and trigger new collective action problems. In order to ensure long-term stable cooperation and the sustainable governance of shared watercourses, adaptation[2] needs to take place.

---

[1] Susanne Schmeier is a PhD Candidate at the Berlin School for Transnational Studies (BTS) at the Hertie School of Governance and the Free University of Berlin. Her research focuses on environmental politics and water resources governance. On these topics, she also worked for several implementing agencies such as the German Development Cooperation (GIZ), the Mekong River Commission (MRC) and the World Bank. The author can be contacted via schmeier@transnationalstudies.eu.

[2] First of all, it needs to be acknowledged that no consensus definition has been established on what is to be understood by 'adaptation', 'adaptive capacity' or 'resilience' (on the debate, refer to Gallopin 2006). Since it is not the aim of this paper to define the concepts and notions related to adaptation, we apply a very broad yet suitable definition of adaptation capacity, referring to the capacity of a natural entity, such as a river basin, to adapt to changes that occur within it – be they naturally caused or man-made. The state of great adaptation capacity is thereby often referred to as 'resilience'. More specifically, the adaptation capacity of an RBO refers to the capacity of the organization to develop, implement and coordinate measures leading to greater resilience in the entire river basin.

Adaptation can thereby be regarded as a process (see figure below): At a first stage, change occurs within the river basin, e.g. in the form of climate change consequences or the construction of a large irrigation scheme. This change can lead to specific events (triggers) that make states perceive the need to adapt. For example, climate change can trigger large floods that affect riparian populations' livelihoods and the overall development of riparian states. Similarly, droughts caused by water diversion or large hydropower dams behind which water is stored can convince states of the need for action. In order to mitigate the change perceived as threat, riparian states develop adaptation measures – in transboundary watercourses ideally through institutions that have been established to govern these shared water bodies. Successful adaptation then leads to strengthened resilience in the basin.

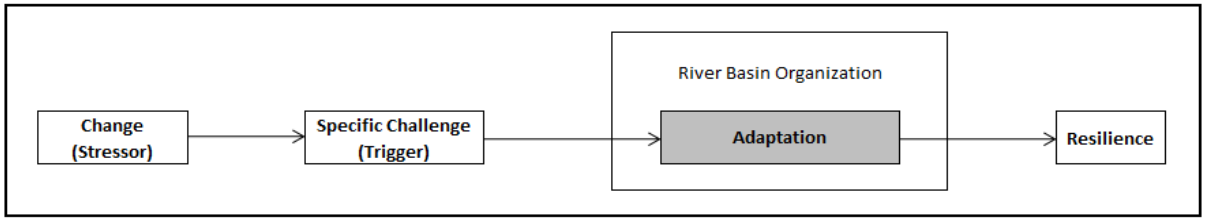


Figure I: The Adaptation Process

Whether adaptation is successful, however, depends on the joint institution and its capacity to mitigate change and related collective action problems. This capacity is call the institutional-adaptive capacity (IAC) of an RBO. This paper therefore investigates whether and to what extent African RBOs possess such institutional capacity to adapt to change. It aims at opening the black box of RBOs and studying the different institutional design characteristics of an RBO and their respective contributions to IAC.

The remainder of the paper is structured as follows: A first part briefly presents the different changes African watercourses are facing and thereby finds that there is an extremely high necessity to build adaptive capacity and strengthen resilience in order to ensure the long-term sustainable governance of African watercourses. The following part then provides an analytical framework for assessing the IAC of RBOs and applies it to a sample of 37 African RBOs, covering 25 rivers on the continent. It finds that the IAC of African RBOs is, across the continent, still very limited – especially in light of the tremendous changes watercourses and their riparian populations are currently facing and will face in the future.

## 2 Change in African Transboundary River Basins – The Need for Adaptation

In Africa, collective action problems caused by the use of water and related resources by various actors are intensified by the fact that a large number of rivers and lakes on the African continent transcend the borders of nation states: About 90% of the continent's surface water resources are located in river and lake basins that are shared by two or more countries, with a total of 60 river basins being international. Some of these basins, such as the Congo, Lake Chad, Niger, Nile and Zambezi Basins are shared by a particularly high number of riparians, further intensifying collective action problems.

Existing collective action problems have often been mitigated relatively successfully by establishing forms of institutionalized cooperation among riparians – either by signing International Water Treaties (IWTs) or by establishing River Basin Organizations (RBOs). However, their pure existence is

not sufficient for ensuring cooperation and the sustainable governance of the respective river basin on the long term. Instead, changes occurring in the respective basins can easily trigger new collective action problems.

Change thereby occurs in various forms: Climate change and its respective consequences (including temperature increase or changes in precipitation and evaporation rates) are certainly the type of change discussed most often in recent years. However, a number of other types of change can occur in river basins, triggered by developments as diverse as population growth, economic growth and development, political changes in riparian countries, infrastructure developments, or the construction of hydropower dams. All these developments affect watercourses on their various hydrological, biophysical and socioeconomic dimensions, including effects on the river's flow regime and thus water availability, on flood and drought patterns, on water availability and scarcity, on the river's sediment load, its ecosystem (fish as well as other species), the river's pollution load, as well as the different socioeconomic benefits all these river functions and characteristics provide. The interdependence of all of these basin characteristics further complicates the problem.

While it is not the aim of this paper to present the different effects of change on international watercourses in detail, the following sections provide a brief introduction into change-related challenges on the African continent. This underlines the need for these basins to build resilience and thus the need for African RBOs to enhance their capacity to adapt.

First and foremost, changes in a river basin affect the flow regime of the river and the overall water availability. This can be triggered by climate change as well as man-made developments. The former one, expected to lead to increases in temperatures in African at rates even higher than the global average , higher evaporation rates and decreasing rainfall at least in Northern and Southern Africa (Goulden et.al. 2008: 6), is likely to reduce the overall water availability on the African continent. The latter developments, mainly in the form of large infrastructure schemes such as water storage or diversion projects and hydropower dams, affect water availability in more ambiguous ways, possibly leading to more or to less water availability, but for sure to changes in the river's flow regime.

As a consequence of climate change, water availability is expected to decrease in a number of African states. The IPCC forecasts that nine African countries (Burundi, Cape Verde, Djibouti, Egypt, Kenya, Malawi, Rwanda, Somalia and South Africa) will suffer from water shortages of less than 1,000 $m^3$/person/year by 2025 (Bates et.al. 2008: 79). This is likely to lead to droughts all over the African continent – accompanied by various negative economic and social effects as well as implicit political consequences. A number of river basins already face significant drought risks and a share of 1/3 of the African population already now being affected by droughts (Bates et.al. 2008: 80 and Goulden et.al. 2008: 3, Krysanova et.al. 2008). These developments will increase the risks of water stress, being one of the main triggers of conflict identified by hydropolitics literature (Gleick 1993, Hensel et.al. 2006, Dinar 2009, Tir/Ackermann 2009).

Similar developments have already occurred and are likely to increase in the future as a consequence of man-made changes in river basins in the form of infrastructure developments and hydromorphological alterations. Especially the construction of large hydropower dams as they are currently ongoing or planned, for instance, in form of the Grand Inga Scheme on the Congo River in the DRC, by Namibia and Angola in form of the Bayes Dam on the Kunene River, along the Nile River in various riparian countries (such as Ethiopia, Uganda and Sudan), or the Mphanda Nkuwa Dam on the Zambezi in Mozambique, is likely to lead to various adverse effects in the respective basins. Such

effects include, similar to climate change, alterations in the river's flow regime and related drought risks. At the same time, hydropower schemes will be affected by climate change consequences, since increasing flow variability is likely to affect the opportunities for electricity generation and thus also the overall electricity availability for African states, already now depending highly on hydropower for their electricity supply (Bates et.al. 2008: 80)

Another consequence of climate change as well as of hydromorphological alterations and infrastructure developments as man-made changes in river basins is the occurrence of floods. Eastern and Central Africa have thereby been identified as the most flood prone areas, with the Congo and the Nile Basin and its tributaries already having experienced a high number of (transboundary) floods in recent years. In the 2002 floods in Kenya, for instance, 175,000 people were affected by direct flood consequences, leading to significant negative impacts on the country's social development prospects. Besides the direct effects of floods on people's lives and their property, floods come with a number of indirect and long-term effects such as reduced economic activities, the destruction of infrastructure, decreases in children's school attendance or the consequences of water-borne diseases.

Changes in river basins – caused by climate change through changes in river temperatures or flow regimes as well as by man-made alterations of the river in the form of dam construction, increased industrial uses, or the intrusion of pollutants – affects fish populations and thus fisheries as well. Since fisheries often provide an important source for both local and national food security and income to riparian populations and riparian economies, these developments affect the overall well-being of people in riparian countries. Countries with a particularly high dependence on fisheries, such as Uganda and Tanzania in the case of fisheries from the Lake Victoria and the Lake Tanganyika, are thereby particularly vulnerable.

Another effect of change in watercourses is related to water-borne diseases. Both climate change effects such as rising temperatures or increasing floods as well as consequences of dam construction and water storage in large reservoirs can lead to increase intensity of water-borne diseases and the proliferation of vector species and thus the diseases to new geographic ranges. Given the already high vulnerability of African populations to diseases such as rift valley fever, malaria or dengue fever, further increases can be expected to have devastating consequences on the overall social development in Africa.

In addition to changes in the river's flow regime and related flood and drought patterns with their respective ecological and socioeconomic consequences, climate change and, even more so, economic development accompanied by industrialization and urbanization affect African watercourses as well. The most obvious consequence is an increase in pollution, leading to a number of consequential effects on fish and other species, water use opportunities and riparian people's health. In the Okavango River Basin, for instance, the recovering of Angola from the civil war and the rapid economic growth the country enjoyed recently has led to a number of problems in the river basin, namely related to Angolan plans to divert water from the Okavango River in order to enhance water availability for the country and promote growth through industrial development and large infrastructure development.

All the aforementioned changes and their consequences on the river basins and their populations can lead to new collective action problems and conflicts and therefore require action by those institutions set up to sustainably and peacefully governing these watercourses. The sheer existence

of RBOs, however, is not sufficient for overcoming all these challenges. Continuous problems in a number of river basins in which RBOs have been established demonstrate this problem. Instead, the capacity of an RBO to adapt to changes and to successfully mitigate their negative effects matters. The next chapter focuses on this capacity of RBOs to contribute to adaptation and ultimately to resilience – the so-called institutional-adaptive capacity (IAC).

# 3 Determinants for Adaptive Capacity – Is Africa Prepared?

Whether and to what extent resilience to change can be established and improved in a river basin largely depends on two different components: The nature of the challenge and the complexity of the problem itself, thus being a truly exogenous variable, and the capacity of the RBO to internalize change and mitigate related collective action problems. The former – the nature of the challenge in the river basin – is assumed to be given in the basin and hard to change short or medium term. The capacity of an RBO to absorb change and mitigate related conflicts, on the other hand, can be altered through political action and is therefore the entry point for active resilience strengthening.

The capacity of an RBO to adapt to change is captured in this paper as IAC. It is defined as the capacity of an institution mandated to govern a shared watercourse to adapt itself and the basin it governs to changes occurring within the basin and thus creating greater resilience to change that ultimately benefits the watercourse and its riparian populations. It thus captures the RBO-internal characteristics that contribute to enabling the RBO as well as its member states to better deal with change.

Based on International Relations theory focusing on the institutional design of international institutions as well as hydropolitics, water law and IWRM analyses studying adaptation in international watercourses, a number of institutional design characteristics expected to determine the IAC of RBOs have been identified. They can be grouped into three categories:

1. **Treaty-based characteristics**, namely in the form of legal clauses and means to deal with variability as well as the implementation of principles of international water law
2. The **organizational set-up of RBOs** and thus the organizational framework of water resources governance (including the RBO's membership structure, its functional scope, its institutionalization level, its organizational structure and its financing modes)
3. **River basin governance mechanisms** provided by the RBO to its members for governing the basin (including data and information management means, dispute-resolution mechanisms and means for including stakeholders in the basin)

## 3.1 The Role of Agreements and Treaties – The Basis of Cooperation and Adaptation

The first step to institutionalizing cooperation over shared watercourses is the signature of an IWT. IWTs set the basis for long-term cooperation by defining the rights and obligations of member states with regard to various aspects of water resources governance. According to findings of the TFDD (Wolf et.al. 2003), more than 400 IWTs have been signed worldwide until today, a significant share of them between African countries. While earlier treaties most often cover navigation on African rivers (such as the 1885 General Act of the Conference of Berlin concerning the freedom of navigation on the Congo and the Niger Rivers), the non-navigational use of water resources was subsequently included, starting with the 1926 Agreement between South Africa and Portugal Regulating the Use of

the Water of the Cunene River or the 1959 Agreement between the Government of the United Arab Republic and the Government of Sudan concerning the allocation of Nile waters (Nile Waters Treaty).

With regard to adaptation and building resilience, treaties can provide a number of important functions: First of all, treaties include certain norms of how a specific river basin should be governed. The degree to which these norms match internationally recognized water law principles provides important insights into whether the governance of the watercourse and the adaptation to change will rely on what has been internationally agreed upon as "good" water governance.

Customary and increasingly codified international law provides a number of principles for water resources governance. Among them, the principal of equitable and sustainable use and the obligation not to cause significant harm can be regarded as the most important ones for regulating problems related to change in a river basin (Raadgever et.al. 2008, Eckstein 2010). The former one provides all states with the right to use a river's water resources as long as this is done in an equitable and sustainable way, that is, according to the general circumstances in the basin. The latter one requires states to avoid all activities that would harm any co-riparian, thus helping to prevent that the activities of one state reduce the benefits of other states.

While not sufficiently realized at the international level due to the continuous lack of ratification of the 1997 UN Convention on the Non-Navigational Use of International Watercourses, a number of RBOs include these principles in their agreements and river basin governance documents. Although the pure integration of these principles in an RBO's legal documents is not sufficient for sustainably governing the river basin, it provides important, clearly defined and internationally widely accepted guiding principles for how to deal with changes occurring in the basin and is therefore regarded as an important contribution to resilience.

Among African RBOs, some have incorporated the principle of equitable and sustainable use and the obligation not to cause significant harm explicitly – e.g. the Lake Victoria Basin Commission (LVBC) or in the Zambezi Watercourse Commission (ZAMCOM) – or implicitly by referring to more general water law codifications such as the 1997 UN Convention. The latter one is, for instance, the case with the Commission Internationale du Bassins Congo-Oubangui-Sangha (CICOS), the Limpopo Watercourse Commission (LIMCOM), the Organisation pour la Mise en Valeur du Fleuve Sénégal (OMVS) since its reform on the basis of the 2002 Water Charter, or the Orange-Senqu River Commission (ORASECOM). Others have incorporated one but not both of the principles: the Joint Water Commission (JWC) on the Ruvuma explicitly mentions the principle of equitable and sustainable use in its governance principles, though not the obligation not to cause significant harm, the same holds true for the Lake Chad Basin Commission (LCBC) and the Permanent Okavango River Basin Water Commission (OKACOM). The Lake Tanganyika Authority (LTA) – on the other hand – includes the obligation not to cause significant harm, but not the principle of equitable and sustainable use. Yet others, however, do not include any of the aforementioned water law principles. This is, for example, the case in the Autorité de Développement Integré de la Région du Liptako-Gourma (ALG), the Komati Basin Water Authority (KOBWA), the Mano River Union (MRU), the Niger Basin Authority (NBA), and the Zambezi River Authority (ZRA). Interestingly, the latter group of RBOs not including any water law principles is comprised of RBOs with a generally high level of institutionalization and an explicit focus on economic development on the basis of water resources exploitation, thus particularly highly vulnerable to change while often responsible for change themselves.

Besides their reliance on and their implementation of international water law principles, IWTs can make important contributions to adaptation by including explicit mechanisms for responding to change. Research has so far nearly exclusively focused on treaty-based mechanisms for responding to changes in water availability and analyzed provisions included in allocation-focused treaties for dealing with variability (Fischhendler 2004, Ansink/Ruijs 2008, Drieschova et.al. 2008, Colley et.al. 2009, DeStefano et.al. 2010, Dinar et.al. 2010). Generally, flexible allocation mechanisms are considered to be more adaptive than fixed allocation schemes since they allow for adjusting the allocation of water among riparians based on the actual flow of the river. Additional mechanisms for strengthening the adaptive capacity of treaties are the inclusion of escape clauses for times of water scarcity or regular treaty reviews and renegotiations.

In Africa, some IWTs allocating water between riparians indeed include such adaptive mechanisms: The Agreement on the Lesotho Highlands Water Project (LHWP) allows for a six month grace period allowing states to react flexibly to short-term water shortages without necessarily generally questioning joint management provision. The majority of African IWTs that deal with water allocation, however, does not include meaningful mechanisms for eventually occurring change in the river's flow. The Agreement Establishing the Vioolsdrift and Noordoewer Joint Irrigation Scheme between Namibia and South Africa (1992), concerning the Orange River, for instance, sets clear volumetric water allocation provision without including any measures for adjusting this distribution in times of change. Similarly, the Treaty on the Development and Utilization of the water resources of the Komati River Basin between Swaziland and South Africa (1992) sets clear shares for water allocation that cannot easily be altered. Given the particularly high vulnerability of Southern African river basins to both climate and man-made change, the contribution of IWT's to building resilience remains low. Some IWTs, however, assign specific institutions to deal with unforeseen developments. For example, the 1959 Nile Waters Treaty between Egypt and Sudan assigns the Permanent Joint Technical Commission on the Nile (NJTC) to work on means for dealing with low flow periods and to advice governments on measures to be taken.

The existence of IWTs can thus contribute to adaptive capacity in river basins but – as the example of African river basin shows – adaptation mechanisms are often insufficiently developed.

## 3.2 The Organizational Set-Up of RBOs – The Institutionalization of River Basin Governance

The organizational set-up of RBOs describes how structure of these organizations, including their legal basis for institutionalization, their geographical coverage of the basin, their mandate and tasks, and their financing mechanisms. Each of these features is expected to influence the RBO's capacity to adapt to change.

### 3.2.1 The Degree of Institutionalization – Providing the RBO with the Power to Adapt

In order to actively govern a shared river basin and to implement treaty provisions, RBOs require a certain degree of actor quality, allowing them to act independently in the international system. This actor quality of RBOs can be measured on the basis of their degree of institutionalization, described by their legal personality and the type of RBO they have been established as.

In international law, the actor quality of an institution is established on the basis of an institution's legal personality in implicit reference to the Vienna Convention on the Law of Treaties. The legal personality typically provides an organization with the right to enter into agreements with other

actors of the international system and thus to actively shape international politics. It can therefore be assumed that RBOs without legal personality find it harder to actively shape river basin governance, implement adaptation activities and thus build resilience.

Among African RBOs, the majority indeed possesses legal personality. Only very few RBOs do not possess such rights in the international system – among them the KOBWA, the Limpopo Basin Permanent Technical Committee (LPTC), the Nile Basin Initiative (NBI), given the continuous reluctance of member states to turn the initiative into a formal RBO, and the Tripartite Permanent Technical Committee (TPTC) on the Incomati and the Maputo. These RBOs indeed find it more difficult to actively govern the basin which will most likely reduce their effectiveness in introducing adaptation measures to the basin and their success in building resilience in the basin depends nearly entirely on the willingness of member states.

Another, RBO-specific dimension of the actor quality of an RBO is the level of institutionalization assigned to the RBO via its specific type of organization. It can thereby be distinguished between River Basin Committees, Commissions and Authorities, with increasing levels of autonomy and power vis-à-vis the respective RBO's member states. Similarly to the legal personality of RBOs, it can be assumed here that a higher level of institutionalization provides the RBO with more power and thus more capacity to implement river basin governance and adaptation activities – although to a certain threshold only, from which on additional gains in the level of institutionalization do not come with gains in adaptation effectiveness anymore.

Most RBOs in Africa are River Basin Commission, following the general international pattern of Commissions being the most common form of RBOs. However, Africa also possesses a very high share of Authorities among its RBOs (10 out of 37), especially in comparison to other regions of the world. Among the 10 Authorities are the ALG, the LTA, the NBA, the Organisation pour la Mise en Valeur du Fleuve Gambie (OMVG), the OMVS and the ZRA. In reality, however, a high level of institutionalization in the form of Authorities does not necessarily come with a better ability to govern the basin and to deal with newly emerging challenges. It can therefore be concluded that a certain level of institutionalization benefits the RBO by increasing its ability to implement river basin governance activities, but from a certain threshold on this ability does not increase anymore with increasing levels of institutionalization.

### 3.2.2 The Membership Structure – Ensuring Integrated Adaptation across All Riparians

RBOs are established to govern shared river basins and their adaptation activities focus change occurring within these river basins. One important determinant of adaptive capacity therefore concerns the geographical coverage of the basin by the RBO and in particular the question whether the RBO covers the entire river basin or only brings together a sub-set of riparians.

Hydropolitics literature generally argues that, in order to comply with IWRM requirements, RBOs must include all riparians to the basin in their management structures (GWP 2000, Kliot et.al. 2001, Mostert 2003, Gerlak/Grant 2009). If the governance of the river basin requires the inclusion of all actors concerned by and affecting the basin, the adaptation to change must necessarily fulfill similar requirements. This is illustrated by the following examples from the sample of African river basin studied here: In the Nile River Basin, the Nile Water Sharing Agreement between Egypt and Sudan lacks the participation of upstream states. These upstream states, however, move ahead in using and developing the river's resources through irrigation schemes, hydropower dams and water

abstraction for household and industrial use, thus challenging downstream water sharing agreements. Climate change and expected alterations of the river's flow regime and the precipitation in the basin are likely to further threaten the already fragile balance in the basin. Similar problems occurred on the Lake Chad within the management framework of the LCBC and on the Senegal within the OMVS before the Central African Republic and Guinea joined in 1994 and 2006 respectively.

Within the sample of 37 African RBOs, the membership structure is distributed relatively evenly, with 19 RBOs including all riparians to the basin and 18 including a subset only, thus being non-inclusive. Inclusive RBOs are, for instance, as the LTA, OMVG, and the OMVS. Non-inclusive RBOs, on the other hand, are the CICOS, the KOBWA, or the LCBC. Among 18 non-inclusive ones, three – the JWC on the Ruvuma River, the MRU, and ZAMCOM – can be considered as inclusive as well, given that the non-member state covers a very limited shared of the basin only and is thus of extremely limited influence on the river basin's resources and their development. In the ZAMCOM, for instance, the Democratic Republic of Congo only covers 0.08% of the river basin, significantly limiting its influence on the basin. It can therefore be considered as *de facto* inclusive. Based on the assumption that all relevant riparian need to be included in the RBO in order to be successful in governing the river basin, 22 RBOs can be considered as inclusive and 15 as non-inclusive.

The 15 non-inclusive RBOs thus continue to lack an important perquisite for adaptive capacity. Strengthening their ability to adapt to change and to do so in an effective manner will require their broadening across the basin – if not in the form of the inclusion of members so at least through improved mechanisms for coordination and collaboration with non-member states.

Although a higher number of actors involved potentially deceases the management efficiency of an RBO and delays joint decisions, the following has been found with regard to the influence of an RBO's membership structure on its IAC: Effective adaptation thus requires the inclusion of all riparian states that have an impact on the river basin due to their share of the basin and their use of the basin's resources and/or that are affected by other states' activities in the river basin, including activities that target change in the basin, that is, the inclusion of all 'relevant' riparians.

### 3.2.3 The Functional Scope of RBOs – Balancing IWRM Requirements for Adaptation

RBOs are mandated to govern the river basin in which they have been established. However, these mandates vary highly across RBOs, with some RBOs focusing on one specific issue only and other RBOs covering a very broad range of more or less interrelated issues. While dealing with one specific issue is often regarded as making governance easier and has therefore been promoted by some hydropolitics scholars (Bernauer 1997, Marty 2001), the fact that river basins face a number of interdependent challenges requires a holistic and integrated approach that has also been promoted by IWRM proponents (Kliot et.al. 2001, Dombrowsky 2007, Sadoff et.al. 2008).

The functional scope of African RBOs varies across all three categories and is distributed relatively equally with 10 single-issue RBOs, 16 few-issue RBOs and 11 multi-issue RBOs. Single-issue RBOs typically focus on infrastructure development, most often for the hydropower sector, such as in the cases of the Joint Operating Authority on the Kunene (JOA), the KOBWA, or the ZRA, or on water allocation (e.g. in the JWC between Joint Swaziland and Mozambique JWC, or the NJTC). They are, interestingly, most often found in Southern Africa. Multi-issue RBOs as found in the ALG, the Lesotho Highlands Water Commission (LHWC), or the OMVS, on the other hand, cover a very broad spectrum

of issues, most often related to the overall socioeconomic development of the river basin beyond water resources governance in the narrow sense. Such multi-issue RBOs are found most often in Western Africa. The geographical differences in the functional scope of RBOs indicate a different concept of water resources governance in the different parts of Africa, ranging from the narrow management of water resources in terms of quantity and use to the overall exploitation of river basins and their resources for economic development in the very broad sense.

The interdependent nature of change as described in section 2 requires that adaptation activities in RBOs, focusing on mitigating problems related to change in river basins, is based on integrated approaches as well. River basin governance and the mitigation of collective action problems related to hydropower developments, for instance, are likely to be affected by climate change consequences. The Zambezi River Basin and the work of the ZRA, exclusively focusing on hydropower development and management, illustrates this problem. An exclusive focus on hydropower management is thus likely to be insufficient for building resilience in the basin.

The inclusion of many issues into an RBO's scope can, however, also decrease its effectiveness. Especially due to limited technical, financial and human resources, many African RBOs of multi-issue nature already struggle with covering the issues they have been mandated to work on. The NBA and the OMVG, for example, have so far not managed to successfully implement programs and projects in the very broad and very different issue-areas they have been asked to work on and continuously struggle with developing and implementing activities at all. Introducing additional adaptation activities into their functional scope would therefore not increase their adaptive capacity and the overall resilience in the basin but rather deteriorate management efficiency and thus river basin governance and adaptation effectiveness. Overall, RBOs covering a sufficiently broad but still clearly defined and interrelated issue-scope tend to be the most successful ones in adapting to change.

### 3.2.4 Financing of RBOs – Who Pays for Adaptation?

In order to function properly, to fulfill the mandate assigned and to develop and implement river basin governance activities, RBOs rely on financial resources. Adaptation to change requires additional financial resources in order to study adaptation needs and measure and forecast change, raise the awareness among stakeholders, and develop and implement adaptation activities. The lack of financial resources is therefore an important impediment to an RBO's IAC and thus the overall resilience of the basin.

The influence of an RBO's funding structure on its IAC can be analyzed on the basis of three different mechanisms. First of all, the availability of financial resources presents a necessary condition for the overall functioning of the RBO and its IAC.

On the other hand, the sheer availability of financial resources does not necessarily lead to increased IAC within an RBO and to more sustainable water resources governance. Among the African RBOs, large infrastructures have often been prioritized that consume a large amount of financial resources but do not contribute to more sustainable water resources governance but, instead, have led to a adverse effects on the basin's environment and its populations. One of the most well-known examples is the work of the OMVS in constructing the Diama and Manantali Dams, with overall costs of more than US-$ 1 billion, largely funded by international donors, have caused various negative effects for the Senegal River Basin's environment and its populations.

The financial resources of an RBO can be provided by member states or by international donors (or any combination of those). Additional resources of income from which some water resources exploitation-oriented RBOs benefit are related to the provision of water-related services. The two additional dimensions for assessing an RBO's IAC with regard to its funding therefore focus on how contributions are shared among members and what consequences donor involvement has.

With regard to the first type of financing, African RBOs vary in how contributions from member states are defined: Some RBOs share costs equally among their member states and other RBOs apply some sort of cost-sharing mechanisms. Based on more general analyses on water resources governance and RBO financing, it can be assumed that equally shared costs ensure both the overall availability of funding and member states' ownership of and commitment to the respective RBO. The former mechanism is found, for example, in the ALG, the JWC between South Africa and Swaziland on the Incomati and the Maputo, the KOBWA, the LTA, the LIMCOM, the OKACOM or the ORASECOM. Key-based cost-sharing mechanisms, on the other hand, are applied in the CICOS, the LHWC, the NBA, or the Volta Basin Authority (VBA). Some RBOs combine both mechanisms by covering general administrative expenses through financial means provided on an equal basis and program or project-specific expenses on the basis of cost-sharing keys. The LCBC, for instance, shares costs for the ordinary budget of the RBO on an equal basis while contributions to the Fonds de Développement are shared based on a key of 1/1000 of each member state's annual budget, leaving Nigeria with the highest share of 52% of the overall budget of the Fonds. Similarly, expenses are differentiated within the OMVS into the general operating budget (shared equally among members) and costs for joint projects, shared on the basis of a cost-sharing key relying on the benefits each state generates from the respective project.

In Africa, all RBOs depend on external funding from donors – although to different degrees. In some RBOs, international donor agencies have played very active roles in initiating the RBO establishment and accompanying the RBO over several years with not only financial contributions but also the provision of expertise, technical and human capacity and management services. This is, most prominently, the case with the World Bank's support to the NBI. Other RBOs have received significant amounts of financial resources but depend less on non-financial contributions from international donors. This holds true, among others, for the LCBC (funded by the EU, France, Germany, UNDP, and the World Bank), or the OMVS (funded by Canada, the EU, France, Germany, the Islamic Development Bank, the Netherlands, the US and the World Bank). In some cases, funding also comes from non-state actors, most often in the form of large international NGOs. For instance, the LTA receives funding not only from the AfDB, the Nordic Development Fund, the FAO, the GEF, UNDP and UNEP GEF, but also from IUCN.

While donor contributions are of great importance for ensuring the availability of financial (as well as technical and human) resources and thus contribute to the establishment and the functioning of RBOs that would otherwise not be able to govern shared river basins, donor contributions come at certain costs. First of all, a high dependence on donor funding makes RBOs vulnerable to changes in donors' strategies and behavior. Furthermore, high levels of donor involvement are often related to problems of donor alignment and harmonization if several donors contribute to the same RBO but to different activities and/or on the basis of different strategies. Moreover, the funding of river basin governance – ultimately in the interest of riparian states – by external actors can significantly decrease these riparian states' ownership of the RBO. This is particularly problematic in the area of

adaptation, where donors and riparian states' perceptions of change and of the needs and the mechanisms to respond to it often vary considerably.

Various examples in Africa illustrate these problems: The expiring of a large GEF grant to the Lake Victoria Fisheries Organization (LVFO) in 2002 suddenly reduced the RBO's budget so drastically that river basin governance activities were nearly brought to a halt for some time. And in RBOs with a large number of different donors, various harmonization problems have occurred. In the NBA, for instance, funded by the AfDB, the African Water Facility, Canada, the ECOWAS, EU, Germany, the WAfDB and the World Bank, donors are very different in their overall approach to development aid and natural resources governance and therefore donor projects tend to lack coordination and a common approach to governing the Niger River Basin.

Ensuring financial sustainability as well as donor alignment and harmonization is thus an important step towards strengthening RBO's IAC and thus ultimately building resilience to change in shared watercourses.

## 3.3 River Basin Governance Mechanisms – Providing Means for Adaptation

It is not the pure existence of RBOs that helps governing a river basin and mitigating collective action problems related to the use of water and related resources but the mechanisms an RBO provides to its members and basin stakeholders for governing the basin. These include mechanisms for coming to joint decisions, instruments for managing data and information, dispute-resolution mechanisms as well as ways to include the different stakeholders in the basin. The following sections investigate each of these mechanisms' influence on the IAC of RBOs.

### 3.3.1 Data and Information Management – Knowing What to Adapt to

The governance of shared river basins and the adaptation to change occurring within these basins requires the availability of data and information on various aspects of the basin, including its hydrology, its flow regime, its environmental states, the use of the resources by different user groups as well as the socioeconomic development level in the basin. This has been emphasized by a number of hydropolitics scholars as well as policy-oriented analysis of adaptation (Chenoweth/Feitelson 2001, Raadgever et.al. 2008, Cooley et.al. 2009, Eckstein 2010). The provision of mechanisms for collecting, analyzing and sharing data and information is thus an important component of the IAC of RBOs.

In order to assess the needs for adaptation and to forecast the consequences of change for the river basin, to develop and implement adaptation measures and to monitor their progress, riparian actors and the RBO depend on data and information. The sheer availability of data and information is thereby the first prerequisite for successful adaptation. In addition, the level of data and information sharing significantly determines the IAC of an RBO. In river basins where data and information sharing relies on bilateral exchange, data availability is often insufficient and, moreover, cooperation problems related to information asymmetries and incentives for defection persist. It is therefore assumed that centralized RBO-level data and information management enhances the IAC of RBOs.

In African RBOs, the availability of data and information on the river basin in general and on adaptation needs in particular remains limited. As a consequence, much remains unknown regarding the current state of the respective river basins as well as the challenges ahead. Moreover, the dissemination of data and information often remains limited due to technical as well as political

impediments. Making data and information available to riparians has a high potential for improving the overall resilience of the basin to change. In the Orange Basin, for example, the ORASECOM provides member states with data and knowledge required for sustainably managing water resources and adapting management to changes ahead. Similarly, OKACOM member states have agreed on better sharing data on the basin. Based on Art. 3 of the 2007 OKACOM Agreement, a Protocol on Hydrological Data Sharing in May 2010, aiming at sharing information on the river basin that is then used, among other projects, to develop and early warning and information system that addresses the consequences of climate variability (OKACOM 2010, Art. 14).

Centralized data and information management is found, for instance, in the LTA, where parties exchange information and data through secretariat, in the LVBC, where the Secretariat has established a database and an information-exchange system, in the OKACOM, where the Secretariat has been assigned an important role in collecting, analyzing and disseminating information on the basin and in building a joint database, in the OMVS, where the High Commission manages the analysis and the dissemination of data and information on the basis of a joint database, and in the ZRA, which possesses a joint measurement network of 12 hydrological stations that survey the river's flow.

Such institutionalized RBO-level data and information sharing mechanisms indeed contribute to the overall IAC of the RBO and thus resilience in the basin: The development of a joint database within the OKACOM Secretariat, fed with information from the Transboundary Diagnostic Analysis (TDA), a largely donor-funded endeavor aiming at better understanding the hydrological and biophysical nature of the Okavango River Basin, has provided OKACOM member states with information on the basin they would otherwise not have had at hand. This has not only identified problems and challenges requiring adaptation, but has also contributed to a common understanding of these challenges among riparians and provided insights on how to cooperatively mitigate them (Schmeier/Schulze 2010).

Improving African RBOs' ability to collect, process and disseminate data and information on environmental change is therefore an important step towards building resilience in African river basins.

### 3.3.2 Dispute-Resolution Mechanisms – Overcoming Change-Induced Conflicts

New developments in international rivers basins – be they related to climate change consequences, the construction of new infrastructure schemes or change in riparian states' water use patterns – can easily lead to the (re-)emergence of (new) conflicts. An important means for ensuring long-term stable cooperation and the sustainable governance of river basins is therefore the provision of dispute-resolution mechanisms. This has also been emphasized by a number of hydropolitics scholars (Vinogradov/Langford 2001, Sohnle 2005, Fischhendler 2008, Tir/Stinnett 2011).

However, within the sample of 37 African RBOs studied, not all provide formalized and clearly defined dispute-resolution mechanisms to their members. The ALG and the NBI, for instance, do not establish any formalized mechanism for solving disputes among its members nor do their underlying legal documents even mention the need for and the form of solving disputes. Among RBOs that include formalized dispute-resolution mechanisms, it can be distinguished between bilateral negotiation (found, for example, in the JWC on the Limpopo, in the KOBWA, in the OKACOM) and institutionalized forms of dispute-resolution. The latter ones can be distinguished into RBO-based

dispute-resolution mechanisms such as RBO-internal tribunals (found, for instance, in the LTA, the LVFO) and external means such as regional tribunals or arbitrators (found, for instance in the LHWC which assigned the World Commission on Dams (WCD) as arbitrator of last resort, or the LIMCOM and the ZAMCOM, which refer to the SADC Tribunal). *De facto*, a number of RBOs that has once established external means for solving conflicts lack these means today since they rely on institutions that do not exist anymore. This concerns mainly RBOs such as the LCBC, the LVBC, the OMVG, the OMVS and the Organization for the Management and Development of the Kagera River Basin (ORKBO) that have assigned the Commission of Mediation, Conciliation and Arbitration of Organization of African Unity (OAU) with the resolution of conflicts which – since the OAU's replacement by the African Union (AU) does not exist anymore.

This distribution of conflict-resolution mechanisms across African RBOs indicates that a significant number of them still lacks sufficiently defined and formalized means for mitigating (newly) emerging conflicts in the river basin that are triggered by change. This is likely to significantly reduce their adaptive capacity and thus ultimately the river basin's resilience. Water allocation and hydropower benefit distribution among South Africa and Lesotho in the Orange Basin under the framework of the LHWC could, for instance, easily become contested once water availability of the river's flow regime change as a consequence of climate change. This is likely to lead to disputes between the two parties and would thus require an instrument for solving such disputes peacefully in order to maintain cooperation. Likewise, changes of the flow regime in the Senegal River can easily challenge existing benefit-sharing mechanisms for the Diama and the Manantali Dams and thus require the resolution of disputes among OMVS members over how to redistribute potentially decreasing benefits. Building IAC thus requires the formulation and establishment as well as the maintenance of means for solving disputes triggered by change in a clearly defined, efficient, institutionalized and binding way.

### 3.3.3 Stakeholder Involvement – Including Those that Cause and Suffer from Change

Changes in international watercourses are often at least implicitly caused by riparian populations (e.g. through irrigation and land use practices, infrastructure developments, water abstraction or pollution) and/or affect these populations, their livelihoods and their development opportunities. Moreover, the success of implementing adaptation measures highly depends on local populations. The inclusion of the public into river basin governance mechanisms has therefore been underlined by a number of hydropolitics scholars (Bruch et.al. 2005, Curton 2005, Kranz/Vorwerk 2007). In addition to local riparians, other stakeholders that influence both the need for and the success of include private companies (e.g. in the form of hydropower dam developers) and other regional institutions active in the respective river basin. A broad inclusion of stakeholders is thus an important component of IAC.

In African RBOs, the degree of stakeholder involvement varies highly: Some RBOs have largely ignored non-state actors in and beyond the river basin and have so far relied on purely inter-governmental river basin governance. This holds true, for instance, for the ALG, the KOBWA or the LCBC. Others have developed careful attempts of cooperating with NGOs and civil society actors, most often in the form of active information sharing. Such developments can, for example, be observed in the Lake Victoria for both the LVBC and the LVFO. The LVBC, for example, has developed various programs for information sharing with local communities in the lake basin and the Secretariat disseminates information on the RBO's decisions and projects among local stakeholders. Similarly, the NBI is closely cooperating with the Nile Basin Discourse, a civil society movement working on

disseminating knowledge on the river and its basin among local populations and beyond. Yet others have proven to be particularly open to non-state actors and have developed a number of means for including them into the river basin governance process. An example for such highly developed stakeholder involvement is the OKACOM and its Every River Has Its People Project, initiated by international donors and large international NGOs, aiming at including local water user communities into the water resources governance process. Especially in Southern Africa, public participation has experienced increasing importance among RBOs in the region, not least due to the fact that the SADC Protocol on Shared Watercourses includes several provisions for stakeholder involvement that apply to all RBOs established under the Protocol. Overall, the degree of public participation remains, however, low in African RBOs compared to other parts of the world. In order to build long-term resilience in these basins and to ensure the long-term sustainable use of the rivers and their resources to the benefit of riparian people, public participation needs to be further strengthened.

Similar findings hold true for the involvement of other stakeholders as well. Private companies such as dam developers have strong stakes in international river basins and therefore need to be included in both the assessment of the state of the basin and in the process of developing and implementing measures to adapt to change. This can, for example, be done in the form of environmental impact assessments for large infrastructure projects. In reality, however, the involvement of such stakeholders remains limited in all African basins.

Furthermore, the coordination of African RBOs with other regional institutions (be it more general ones or other RBOs working in the same basin – the case, for example in the Kunene River Basin where the Angola Namibian Joint Commission of Cooperation (JCO), the JOA and the Permanent Joint Technical Commission (PJTC) deal with water resources in the basin, or in the Lake Victoria Basin, where both the LVBC and the LVFO are mandated to govern the basin) remains limited, leading to a number of inefficiencies and thus deteriorating IAC.

The coordination between a more general regional institution and river basin specific RBOs works relatively well in Southern Africa with RBOs established in the context of the SADC Protocol of Shared Watercourses. In other regions of Africa, links are less well established: In East Africa in the Lake Chad and the Lake Victoria, river basin governance is linked to more general regional cooperation processes in the context of the EAC. Links between the RBOs and the EAC nevertheless remain limited – in spite of the formal subsidiary links between the LCBC and the LVBC and the EAC.

Of similar importance are links between different RBOs in the same basin: In the Orange River Basin, for example, four institutions are mandated to deal with water resources governance: the JIA, the LHWC, the ORASECOM, and the PWC, as well as the TPTC, which covers – among other basins – the Orange River Basin. This has necessarily led to overlaps in the management of the basin and is likely to affect the adaptation capacity of each of these institutions and thus the overall resilience of the basin as well.

## 4 Conclusion

The capacity of an RBO to contribute to adaptation in a river basin is of great importance for the overall sustainable governance of shared watercourses. As the analysis has shown, this IAC varies highly across African river basins and RBOs. Moreover, different components of an RBO's institutional design affect the overall IAC of an RBO differently. The table below summarizes these preliminary finding on the IAC of RBOs.

| Institutional Design Variable | Influence of the RBO's IAC and Resilience in the Basin |
|---|---|
| Legal Provisions/Treaties/ Water Law | Importance of water law principles; inclusion of provisions for dealing with water variability (ideally beyond allocation) |
| Membership Structure | Inclusion of all relevant riparians affecting the river basin and/or being affected by change and adaptation |
| Functional Scope | Need to include all interdependent water-related collective action problems, but risk of overstretching the RBO |
| Legalization and Institutionalization | Legal personality and certain level of institutionalization (Commission-level) required for implementation of activities; but no further increase in IAC beyond certain level |
| Financing and Cost-Sharing | Availability of financial resources crucial; equal cost-sharing more conducive to commitment; donor contributions often required by linked to alignment and harmonization challenges |
| Data and Information Management | Availability of data and information precondition for adaptation and IAC; centralized RBO-level databases contribute to IAC |
| Dispute-Resolution | Existence of well-defined, institutionalized and binding mechanisms important for ensuring long-term stable cooperation |
| Stakeholder Involvement | Inclusion of affected communities important for adaptation development and implementation; coordination with other regional institutions important contribution to resilience |

Figure II: The Institutional-Adaptive Capacity of RBOs – Determinants

With regard to the African RBOs studied in this paper, it can be concluded that their IAC is limited in various respects and on different dimensions, with only very few RBOs fulfilling the institutional requirements for successfully contributing to the adaptation to change in their respective river basins. However, the analysis of the different determinants for the IAC of African RBOs has also shown that there is considerable room for improvement, with some changes being relatively easy to introduce (e.g. the establishment of a joint data and information sharing platform or the development of mechanisms to better coordinate with other institutions in the basin) but having a high positive effect on the IAC of the respective RBO and thus the overall resilience in the basin.

## References

Ansink, E. & Ruijs, A. (2008): Climate change and the stability of water allocation agreements, *Environmental Resource Economics*, 41, 2, 249-266.

Bates, B.C., Kundzewicz, Z.W., Wu, S. & Palutikof, J.P. (eds.) (2008): *Climate Change and Water*, Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva.

Bernauer, T. (1997): Managing international rivers, Young, Oran R. (ed.): *Global Governance. Drawing insights from the environmental experience*, Cambridge/MA, 155-195.

Bruch, C., Jansky, L., Nakayama, M. & Salewicz, K. (2005): *Public participation in the governance of international freshwater resources*, Tokyo: United Nations University Press.

Chenoweth, J. & Feitelson, E. (2001): Analysis of factors influencing data and information exchange in international river basins: Can such exchanges be used to build confidence in cooperative management?, *Water international*, 26, 4, 499-512.

Conway, D. (2005): From headwater tributaries to international river: Observing and adapting to climate change variability and change in the Nile Basin, *Global Environmental Change*, 15, 99-114.

Cooley, H., Christian-Smith, J., Gleick, P., Allen, L. & Cohen, M. (2009): *Understanding and Reducing the Risks of Climate Change for Transboundary Waters*, Pacific Institute Working Paper, December 2009.

Curton, F. (2005): Emerging trends in water resources conflict prevention: Public participation and the role of civil society, Wirkus, L. (ed.): *Water development and cooperation – Comparative perspective: Euphrates-Tigris and Southern Africa*, Bonn: Bonn International Center for Conversion, 33-54.

DeStefano, L., Duncan, J., Dinar, S., Stahl, K., Strzepek, K. & Wolf, Aaron T. (2010): *Mapping the Resilience of International River Basins to Future Climate Change-induced Water Variability*, The World Bank: Water Sector Board Discussion Papers, No. 15, 3/2010.

Dinar, S. (2009): Scarcity and cooperation along international rivers, *Global Environmental Politics*, 9, 1, 109-135.

Dinar, A., Blankespoor, B., Dinar, S. & Kulukurasuriya, P. (2010): *The Impact of Water Supply Variability on Treaty Cooperation among International Bilateral River Basin Riparian States*, Paper presented at the International Studies Association (ISA) workshop "Water and Security" at the ISA 51st Annual Conventions, February 16, 2010, New Orleans.

Dombrowsky, I. (2007): *Conflict, cooperation and institutions in international water management: an economic analysis*, Cheltenham.

Drieschova, A., Giordano, M. & Fischhendler, I. (2008): Governance mechanisms to address flow variability in water treaties, *Global Environmental Governance*, 18, 2, 285-295.

Eckstein, G. (2010): Water Scarcity, Conflict, and Security in a Climate Change World: Challenges and Opportunities for International Law and Policy, *Wisconsin International Law Journal*, 27, 3, 409-461.

Fischhendler, I. (2004): Legal and institutional adaptation to climate uncertainty: a study of international rivers, Water Policy, 6, 4, 2004, 281-302.

Fischhendler, I. (2008): Ambiguity in transboundary environmental dispute resolution: The Israeli-Jordanian water agreement, *Journal of Peace Research*, 45, 1, 91-110.

Gallopin, G. (2006): Linkages between vulnerability, resilience, and adaptive capacity, *Global Environmental Change*, 16, 293-303.

Gerlak, A. K. & Grant, K. A. (2009): The emergence of cooperative institutions around transboundary waters, Volgy, T. J., Zabic, Z., Roter, P. & Gerlak, A. (eds.): *Mapping the new world order*, Wiley, 114-147.

Gleick, P. H. (1993): Water and conflict. Fresh water resources and international security, *International Security*, 18, 1, 79-112.

Global Water Partnership (GWP) (2000): *Integrated Water Resources Management*, Stockholm: GWP TAC Background Papers No. 4.

Goulden, M., Conway, D. & Persechino, A. (2008): *Adaptation to climate change in international river basins in Africa: A review*, Tyndall Centre for Climate Change Research, Working Paper No. 127, December 2008.

Hensel, P. R., McLaughlin Mitchell, S. & Sowers II, T. E. (2006): Conflict management of riparian disputes, *Political Geography*, 25, 383-411.

Kistin, E. & Ashton, P. (2008): Adapting to Change in Transboundary Rivers: An Analysis of Treaty Flexibility on the Orange-Senqu River Basin, *Water Resources Development*, 24, 3, 385-400.

Kliot, N., Shmueli, D. F. & Shamir, U. (2001): Institutions for management of transboundary water resources: their nature, characteristics and shortcomings, *Water Policy*, 3, 229-255.

Kranz, N. & Vorwerk, A. (2007): *Public Participation in Transboundary Water Management*, Paper presented at the 2007 Amsterdam Conference on the Human Dimensions of Global Environmental Change, 30 March 2007.

Krysanova, V., Buiteveld, H., Haase, D., HAttermann, F., Van Niekerk, K., Roest, K. Martinez-Santos, P. & Schlüter, M. (2008): Practices and Lessons Learned in Coping with Climatic Hazards at the River-Basin Scale: Floods and Droughts, Ecology and Society, 13, 2, 32.

Marty, F. (2001): *Managing international rivers. Problems, politics and institutions*, Bern.

Mostert, E. (2003): *Conflict and co-operation in international freshwater management: A global review*, UNESCO IHP Technical Documents in Hydrology No. 19, Paris.

Permanent Okavango River Basin Water Commission (OKACOM) (2007): *Agreement between the Governments of the Republic of Angola, the Republic of Botswana, and the Republic of Namibia on the Establishment of a Permanent Okavango River Basin Water Commission (OKACOM Agreement)*, signed 15 September 1994, Windhoek, Namibia.

Permanent Okavango River Basin Water Commission (OKACOM) (2010): *OKACOM Protocol on Hydrological Data Sharing for the Okavango River Basin*, signed 26 May 2010, Gaborone, Botswana.

Raadgever, G., Mostert, E., Kranz, N., Interviews, E. & Timmerman, J. (2008): Assessing the Management Regimes in Transboundary River Basins: Do They Support Adaptive Management?, Ecology and Society, 13, 1, 24.

Sadoff, C., Greiber, T., Smith, M. & Bergkamp, G. (2008): *Share. Managing water across boundaries*, Gland: International Union for Conservation of Nature and Natural Resources

Schmeier, S. & Schulze, S. (2010): *Governing Environmental Change in International River Basins. The Role of River Basin Organizations*, Paper presented at the 2010 Berlin Conference on the Human Dimensions of Global Environmental Change, 8 October 2010, Berlin, Germany.

Sohnle, J. (2005): Nouvelles tendances en matière de règlement pacifique des différends relatifs aux ressources en eau douce internationales, Boisson de Chazournes, L. & Salman, S. (eds.): *Les resources en eau et le droit international*, Leiden, 389-426.

Tir, J. & Ackermann, J. T. (2009): Politics of formalized river cooperation, *Journal of Peace Research*, 46, 5, 623-640.

Tir, J. & Stinnett, D. (2011): *Weathering the Storm of Climate Change: International Institutions as Strategies for Mitigating Militarized International Conflict over Water*, Paper presented at the Annual Meeting of the International Studies Association 16-19 March 2011, Quebec, Canada.

Transboundary Freshwater Dispute Database (TFDD): *Transboundary Freshwater Spatial Database*, http://www.transboundarywaters.orst.edu/database/transfreshspatdata.html.

Vinogradov, S. & Langford, V. (2001): Managing transboundary water resources in the Aral Sea Basin: In search of a solution, *International Journal of Global Environmental Issues*, 1, 3-4, 345-362.

## Abbreviations

| | |
|---|---|
| AfDB | African Development Bank |
| ALG | Autorité de Développement Integré de la Région du Liptako-Gourma |
| CICOS | Commission Internationale du Bassins Congo-Oubangui-Sangha |
| EAC | Eastern African Community |
| ECOWAS | Economic Community of West African States |
| EU | European Union |
| IAC | Institutional-adaptive Capacity |
| JCO | Angola Namibian Joint Commission of Cooperation |
| JOA | Joint Operating Authority on the Kunene |
| IWT | International Water Treaty |
| JWC | Joint Water Commission |
| KOBWA | Komati Basin Water Authority |
| LCBC | Lake Chad Basin Commission |
| LHWC | Lesotho Highlands Water Commission |
| LHWP | Lesotho Highlands Water Project |
| LIMCOM | Limpopo Watercourse Commission |
| LPTC | Limpopo Basin Permanent Technical Committee |
| LTA | Lake Tanganyika Authority |
| LVBC | Lake Victoria Basin Commission |
| LVFO | Lake Victoria Fisheries Organization |
| MRU | Mano River Union |
| NBA | Niger Basin Authority |
| NBI | Nile Basin Initiative |
| NJTC | Permanent Joint Technical Commission on the Nile |
| OKACOM | Permanent Okavango River Basin Water Commission |
| ORKBO | Organization for the Management of the Development of the Kagera River Basin |
| OMVG | Organisation pour la Mise en Valeur du Fleuve Gambie |
| OMVS | Organisation pour la Mise en Valeur du Fleuve Sénégal |
| ORASECOM | Orange Senqu River Commission |
| PJTC | Permanent Joint Technical Commission |
| RBO | River Basin Organizations |
| SADC | Southern African Development Community |
| TDA | Transboundary Diagnostic Analysis |
| TPTC | Tripartite Permanent Technical Committee |
| VBA | Volta Basin Authority |
| WAfDB | West African Development Bank |
| WCD | World Commission on Dams |
| ZAMCOM | Zambezi Watercourse Commission |
| ZRA | Zambezi River Authority |

## Annex: African RBOs Studied

| RBO Code | RBO | River |
|---|---|---|
| ALGX | Autorité de Développement Integré de la Région du Liptako-Gourma | Volta, Niger |
| CICO | Commission Internationale du Bassins Congo-Oubangui-Sangha (CICOS) | Congo |
| JCOC | Angola Namibian Joint Commission of Cooperation | Kunene |
| JIAX | Joint Irrigation Authority | Orange |
| JOAX | Joint Operating Authority on the Kunene | Kunene |
| JPTC | Joint Permanent Technical Committee | Limpopo |
| JPWC | Joint Permanent Water Commission for the Chobe-Linyanti Sub-Basin | Okavango |
| JWC1 | Joint Water Commission between South Africa and Swaziland | Incomati, Maputo |
| JWC2 | Joint Water Commission between Swaziland and Mozambique | Incomati |
| JWC5 | Joint Water Commission on the Limpopo | Limpopo |
| JWC6 | Joint Water Commission on the Ruvuma | Ruvuma |
| JWC7 | Joint Water Commission between Mozambique and Zimbabwe | Pungwe, Buzi, Save/Sabi |
| KBWA | Komati Basin Water Authority (KOBWA) | Incomati |
| LCBC | Lake Chad Basin Commission | Lake Chad |
| LHWC | Lesotho Highlands Development Authority (LHDA), later renamed Lesotho Highlands Water Commission (LHWC) | Orange |
| LPTC | Limpopo Basin Permanent Technical Committee | Limpopo |
| LTAX | Lake Tanganyika Authority (LTA) | Lake Tanganyika |
| LVBC | Lake Victoria Basin Commission | Lake Victoria |
| LVFO | Lake Victoria Fisheries Organization | Lake Victoria |
| LWCX | Limpopo Watercourse Commission (LIMCOM) | Limpopo |
| MRUX | Mano River Union | Mano-Morro |
| NBAX | Niger Basin Authority (NBA) | Niger |
| NBIX | Nile Basin Initiative (NBI) | Nile |
| NJTC | Permanent Joint Technical Commission on the Nile | Nile |
| NNJC | Nigeria-Niger Joint Commission for Cooperation Cooperation | Niger |
| OKAC | Okavango River Basin Water Commission (OKACOM) | Okavango |
| OMVG | Organisation pour la Mise en Valeur du Fleuve Gambie | Gambia, Corubal, Geba |
| OMVS | Organisation pour la Mise en Valeur du Fleuve Senegal | Senegal |
| ORAS | Orange Senqu River Commission (ORASECOM) | Orange |
| ORKB | Organization for the Management of the Development of the Kagera River Basin (OKRBO) | Kagera |
| PJTC | Permanent Joint Technical Commission | Kunene |
| PWCO | Permanent Water Commission for the Lower Orange Sub-Basin | Orange |
| TPTC | Tripartite Permanent Technical Committee | Incomati, Maputo |
| TPUR | Tripartite Permanent Technical Committee of the Umbeluzi River | Umbeluzi |
| VBAX | Volta Basin Authority (VBA) | Volta |
| ZAMC | Zambezi Watercouse Commission (ZAMCOM) | Zambezi |
| ZRAX | Zambezi River Authority (ZRA) | Zambezi |