Adapting to Change on Transboundary Rivers: An Analysis of Treaty Flexibility on the Orange-Senqu River Basin

Elizabeth J. Kistin [1] and Peter J. Ashton [2]

1: Department of International Development, St. John's College, Oxford University, Oxford OX1 3JP, United Kingdom. Elizabeth.Kistin@sjc.ox.ac.uk

2: CSIR – Natural Resources and the Environment, P.O. Box 395, Pretoria 0001, South Africa. PAshton@csir.co.za

ABSTRACT

Continuously changing patterns of water flow and utilization in the Orange-Senqu River basin hamper effective management of shared water resources, and the international agreements and institutions established for this basin must be equipped to recognize and respond to such changes. A review of international agreements and in-depth interviews with water managers throughout the Orange-Senqu basin, reveal a variety of flexibility mechanisms embedded within the existing treaties. Key to the process of adaptation are the broad institutional mandates that enable existing Commissions to recognize the need for change over time and advise the parties to adapt accordingly. While the existing institutions in the basin are young and have not been fully tested, the treaties do not restrict the adaptive capacity of the parties to manage water resources in the Orange-Senqu basin.

KEYWORDS

Adaptation; Cooperation; International agreements; Southern Africa; Water law

INTRODUCTION

International agreements over shared water resources establish rules, regulations and decision-making procedures that help to stabilize state expectations regarding water deliveries, utilization and demand (McCaffrey, 2003; Fischhendler, 2004). The complexity of establishing and implementing international water agreements is compounded by the series of continuous changes over time that characterizes patterns of water flow and use in transboundary basins (McCaffrey, 2003). River and groundwater flows are affected by seasonal and inter-annual climatic variation, as well as longer-term cyclical patterns of change and the effects of global climate processes (de Wit & Stankiewicz, 2006). Changes in water utilization are driven by population growth, economic development, and evolving management practices (de Sherbinin & Dompka, 1998; Rothert, 2000; Kistin & Phillips, 2007).

Worldwide, existing freshwater agreements are often ill-equipped for the changes that characterize the social and ecological systems they aim to address (Goldenman 1990; Kilgour & Dinar, 1995; Miller et al., 1997; Dellapenna, 1999). While seasonal variability is normally anticipated in water treaties, inter-annual variations, extreme events and the consequences of climate change are often omitted (McCaffrey, 2003). Similarly, demographic fluctuations, varied rates of growth and changes to the overall resource volume are seldom accounted for (Kistin & Phillips, 2007). The omission of mechanisms for dealing with such changes has serious implications for current and future management in transboundary river basins, because agreements that lock in rigid rules and procedures can impede, rather than promote, effective water management (Kistin, 2006). Recognizing that existing agreements are not always appropriately flexible is a first step towards understanding and improving the effectiveness of transboundary cooperation.

Drawing on existing literature and in-depth interviews with water managers from the four riparian countries of the Orange-Senqu basin, this paper focuses on existing international water agreements and the embedded mechanisms that enable parties to respond to short- and long-term changes. First, we examine the important climatic, demographic, socio-economic and ecological changes taking place in the Orange-Senqu Basin and their importance for transboundary water management. This is followed by an evaluation of the flexibility mechanisms embedded in four key water treaties pertaining to the basin, and their influence on the capacity of riparian states and water managers to adapt to changes over time.

CHANGING CIRCUMSTANCES IN THE ORANGE-SENQU BASIN

The Orange-Senqu River is shared between four countries: Botswana, Lesotho, Namibia and South Africa. Rising in the Maluti Mountains of Lesotho, the Orange-Senqu River flows through central and western South Africa – receiving inflows from several important tributaries - before flowing along the border between Namibia and South Africa and entering the Atlantic Ocean (**Figure 1**). The dynamic patterns of water flow and utilization in the basin are driven by a range of factors including the climatic characteristics of the region, population growth, economic development and changing resource management practices.

Climatic Template

The Orange-Senqu basin experiences substantial seasonal and spatial variation in precipitation and has a low conversion of rainfall to runoff (Conley & van Niekerk, 2000; Earle et al., 2005). At the source of the river, some 3,300 m above sea level, annual precipitation averages 1,800 mm with annual evaporation averaging roughly 1,100 mm. In contrast, annual precipitation in the lower reaches of the river averages 50 mm and average annual evaporation rates exceed 3,000 mm (DWAF, 2004b). The uneven spatial distribution of rainfall coupled with erratic summer precipitation patterns throughout the region render the runoff from the Orange-Senqu seasonal in nature and highly variable from year to year (Conley & van Niekerk, 2000; Smakhtin *et al*., 2001; Heyns, 2004). Forecasts suggest that the existing variability will likely be compounded by the effects of climate change in the region, as precipitation is likely to decline in the western portion of the basin while increasing towards the river's source (de Wit & Stankiewicz, 2006).

Demographic Changes

The four riparian states occupying the Orange-Senqu basin have widely different national and within-basin populations. For example, the 2001 census results showed that South Africa's population was 44.8 million in 2001 (STATS-SA, 2007). Current estimates suggest that this population had grown to 47.1 million in 2006 (World Bank, 2007), approximately eight times larger than the combined populations of Botswana, Lesotho and Namibia. No precise figures exist for the size of the combined population living within the basin, but recent studies suggest that over 11 million people were present in the South African segment of Orange-Senqu basin in 2000 (DWAF, 2004b; Ashton et al., in press). The proportion of each country's national population located within the Orange-Senqu basin and relying on its water supplies varies widely among the states. At the one extreme, the entire population of Lesotho lives within the basin and relies on the river for all water supplies. This contrasts with the small Botswana population living within the basin, which has no direct territorial access to perennial flows in the Orange River and meet their water requirements instead through groundwater and some surface runoff from the ephemeral Molopo-Nossob system (Heyns, 2003). In Namibia, the within-basin population is relatively small and is expected to decline gradually over the next 25 years as a result of trends in urbanization (PWC, 2005; Lange *et al*., 2007).

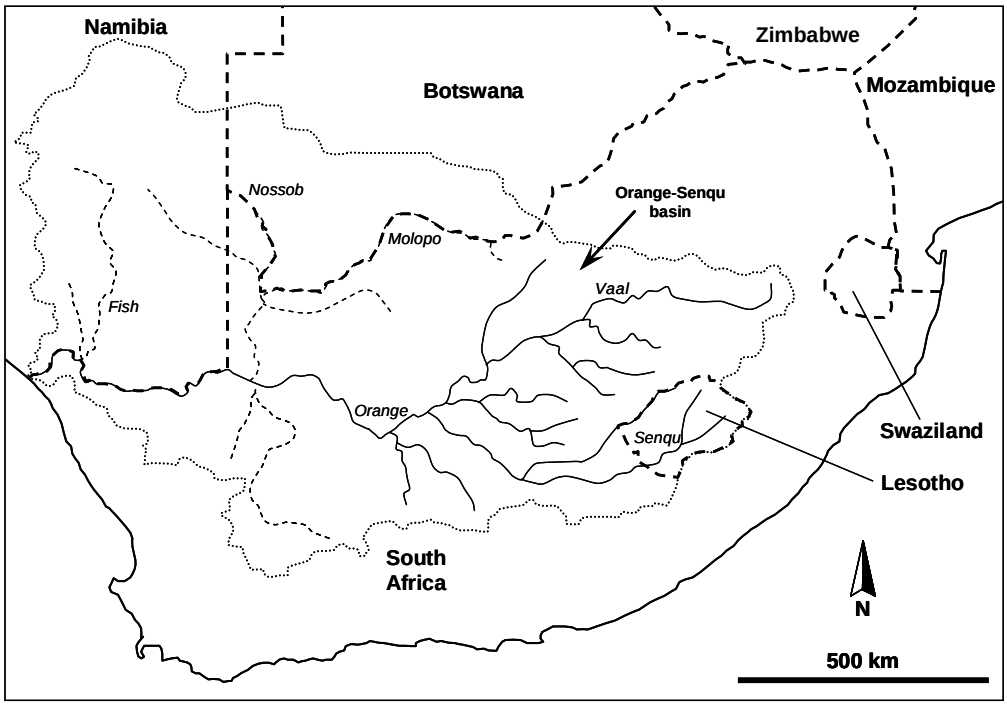

Figure 1. Map showing the location and extent of the Orange-Senqu River basin and the major tributaries in the basin.

Expectations for the annual rate of population growth in the four riparian states vary widely, with some statistical sources anticipating negative population growth rates as a result of the high HIV/AIDS prevalence in the region (CIA, 2007). Clearly, this devastating pandemic has already reduced population growth rates and will continue to influence water use patterns throughout the region (Ashton & Ramsar, 2002; Rascher *et al*., in press). Yet, even with these estimates of diminished population growth rates, for planning purposes, the South African Department of Water Affairs and Forestry (DWAF) anticipates that the South African population will grow at an annual rate of between 1.1 and 2.2 percent through 2025 and expects water use will continue to rise three times faster than the rate of population increase (DWAF, 2004b). The gradual rise in population throughout the basin, coupled with increasing migration to urban centres in the Gauteng Province and increased industrialization, will contribute to increasing water demands over time (DWAF, 2004a).

Socio-economic Changes

In addition to the trajectories of demographic change in the basin, the economic growth and development aspirations in riparian states will increase current patterns of water utilization. According to 2006 estimates, annual GDP growth rates for the riparian states were 6.2 percent in Lesotho, 5.4 percent in Botswana, 5 percent in South Africa and 2.9 percent in Namibia (CIA, 2007) (**Table 1**). As these countries continue to grow, their demands for water from the Orange-Senqu (and other international and national rivers) are likely to increase (**Table 2**).

Currently, South Africa dominates water use patterns in the Orange-Senqu basin to sustain key mining, industrial and agricultural activities. However, South African water use within the basin is expected to increase only marginally by 2025 with the principal increase allocated for irrigation on the 12 000 ha that have been allotted for resource-poor farmers (DWAF, 2004b; PWC, 2005). Elsewhere in the basin, urban and industrial development in the rapidly growing lowlands of Lesotho is expected to contribute to marginal increases in water demand (PWC,

2005; Government of Lesotho, 2004) (**Table 2**). New developments in southern Namibia that will require water from the Orange-Senqu include the Haib copper mine and the Skorpion lead and zinc mine (Heyns, 2003; PWC, 2005). Proposals for new communal and commercial irrigation projects along the common border area are also under consideration and are linked to proposals for the construction of a new dam on the lower reaches of the Orange-Senqu River (PWC, 2005; Heyns *et al*., this volume). The fourth riparian state, Botswana, uses surface water runoff from the ephemeral Molopo-Nossob river system but has never received water from the Orange River and has not, to date, made any such request (Conley & van Niekerk, 2000). While there is a slight potential that this could change in the future, Botswana's use of surface water from the Orange River is expected to remain at zero through 2025 (DWAF, 2004b; PWC, 2004).

Table 1. Gross domestic product (GDP) and annual growth rates by country for all basin states sharing the Orange-Senqu basin. All figures reflect 2006 estimates from CIA (2007).

Country	Real GDP growth rate (%)	GDP per capita (PPP $)	GDP Composition by sector (%)		
			Agriculture	Industry	Services
Lesotho	6.2	2,700	16.1	43.0	40.9
South Africa	5	13,300	2.6	30.3	67.1
Botswana	5.4	10,900	2.4	46.9	50.7
Namibia	2.9	7,500	11.8	30.2	58.1

Table 2. Current (2005) and projected (2025) surface water needs by sector for all riparian states in the Orange-Senqu basin (Source: PWC, 2005).

Riparian state	Sectoral Water Needs (Mm^3 / year)		
	Urban, industrial, mining	Irrigation	Total
2005			
Lesotho	11	9	20
South Africa	2115	3273	5388
Botswana	0	0	0
Namibia	16	60	76
Total:	2142	3342	5484
2025			
Lesotho	17	9	26
South Africa	2487	3381	5868
Botswana	0	0	0
Namibia	48	227	275
Total:	2472	3617	6169

Management Practices

A final key factor influencing water utilization patterns in the basin is the potential for changes in the volume of available water resources in the basin. As Kistin and Phillips (2007) note, this may occur where new sources of water are discovered or created (e.g. by desalination, increased water re-use, or bulk importation and inter-basin transfers); or as the result of changes to water management practices (e.g. through new estimates of the sustainable yield of an aquifer or the designation of a certain quantity of water for in-stream flows).

While there are some efforts underway in the basin states for water conservation, re-use and desalination (Rothert, 2000; Smakhtin *et al.*, 2001), the largest changes likely in the Orange-Senqu basin over the medium-term will come from intra- and inter-basin water transfers and changes in the practice of calculating requirements for in-stream, or environmental, flows (Heyns, 2003; PWC, 2005). Currently, several South African inter-basin transfer schemes

affect the amount of water available in the Orange-Senqu basin (**Figure 2**). As water demand grows in the region, South Africa is considering the augmentation of existing transfers and the creation of additional schemes to further augment water supplies in the basin beyond 2025 (DWAF, 2004b). One possibility for augmenting the availability in the Orange River through intra-basin transfer is the development of Phase 2 of the Lesotho Highlands Water Project (Heyns, 2003). Additional transfers into the basin from the Thukela River (Heyns, 2003) and possibly the Mzimvubu River are under consideration (DWAF, 2004a, b). Future inter-basin water transfers from the Zambezi and the Congo rivers have also been tabled as additional options to relieve water stress elsewhere in the region (Smakhtin *et al*., 2001).

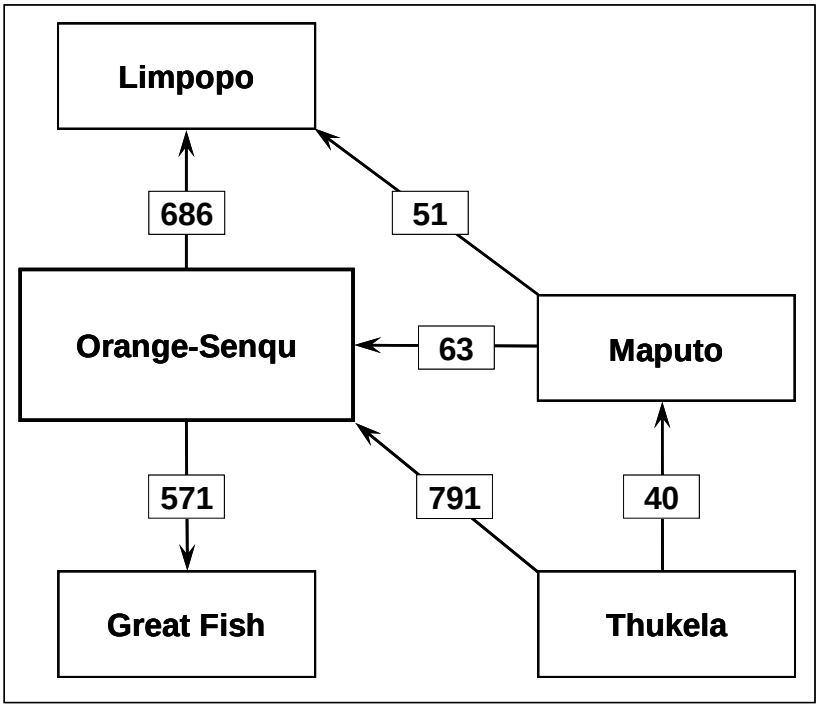

Figure 2. Inter-basin water transfers affecting the Orange-Senqu basin. (All water transfers are given in Mm^3/year; data adapted from DWAF (2003a-e)).

In addition to the future expansion of inter-basin transfers, recent changes in the practice of determining in-stream flow requirements and water quality standards adopted by Lesotho and South Africa will affect the amount of water that is (or can be) allocated for the environment and, consequently, the quantity available for use by the riparian states. For example, the Lower Orange River Management Study indicates that maintaining the estuary at the mouth of the river (a designated Ramsar site) in a category C management class (DWAF, 1996) will lead to a 500 Mm^3 water deficit by 2025 (PWC, 2005).

This brief overview of the climatic, demographic, socio-economic and ecological features that characterize patterns of water flow and utilization highlights the importance of adaptive management systems which can both recognize and respond to the range of changes impacting the basin over time. It suggests that to remain effective over time, transboundary water agreements must consider the potential of seasonal and inter-annual variations in the natural flow rate, climate change impacts, population growth, economic development and changes to overall resource volume. The following section examines the content of existing agreements on the Orange-Senqu basin and their contribution to enabling such adaptation.

TREATY FLEXIBILITY

Flexible water treaties, which anticipate the possibility of gradual and sudden changes in shared basins and incorporate mechanisms to allow parties to adjust management practices based on changing circumstances, are regarded as one of many important components for enabling effective and adaptive management (McCaffrey, 2003; Eakin & Lemos, 2005). Identifying whether or not the existing agreements on the Orange-Senqu River basin are properly equipped for guiding water management in the context of continuous change provides the foundation for evaluating the influence of existing treaties - and the flexibility mechanisms embedded within them - on the adaptive capacity of riparian states and basin commissions.

Following the recommendations of McCaffrey (2003) and Fischhendler (2004), international agreements can be evaluated against five sets of mechanisms for enhancing treaty flexibility:

- Allocation strategies;
- Drought response provisions;
- Amendment and review processes;
- Revocation clauses; and
- Institutional responsibilities.

The term “allocation strategies” refers to mechanisms that divide resources, not necessarily on the basis of fixed volumetric allocations, but according to alternative measures such as the percentage of flow contributed by each party and the timing and duration of river flows (Fischhendler, 2004; Dlamini et al., 2007; Pott & Hallowes, this volume). Drought response provisions include allowances for diminished water deliveries in exceptional circumstances to allow states time to respond to crises while keeping the existing agreement intact (McCaffrey, 2003). Mechanisms for amendment and review provide parties with an opportunity to establish guidelines for unforeseen circumstances and resynchronize national and basin-wide strategies with new knowledge and changing circumstances (Susskind, 1994). Revocation clauses allow countries to terminate their involvement with the treaty in order to renegotiate rules and regulations that are better suited to present and future scenarios. The term “institutional responsibilities” refers to the powers and jurisdiction conferred upon joint institutions by the cooperating parties to undertake and adjust management practices as necessary (Feitelson & Haddad, 1999).

Introduction to International Agreements on the Orange-Senqu River

The institutional arrangements pertaining to the Orange-Senqu basin have evolved over time and reflect the changing political, economic and social transformations that have occurred in southern Africa (**Figure 3**). In addition to the two regional water protocols signed in 1995 and 2000, the four riparian states in the Orange-Senqu basin have established six bilateral agreements and one basin-wide treaty (**Table 3)**. Four of these agreements—the 1986 treaty providing the framework for the Lesotho Highlands Water Project (LHWP) and the establishment of a Joint Permanent Technical Commission (JPWC), the 1992 agreement establishing the Vioolsdrift and Noordoewer Joint Irrigation Scheme (VNJIS), the 1992 agreement creating the Permanent Water Commission (PWC) and the 2000 agreement establishing the basin-wide Orange-Senqu River Commission (ORASECOM)—are particularly relevant to the current management of the Orange-Senqu River basin. The 1986 LHWP treaty and the 1992 VNJIS agreement both focus on the planning, operation and maintenance of joint projects in the basin while the agreements establishing the PWC and ORASECOM focus on creating joint institutions that are equipped to advise parties on the development and utilization of shared waters. Emerging over the last two decades, these four agreements were developed at different times and for different purposes and vary in the regulations, decision-making procedures and flexibility mechanisms that they embody.

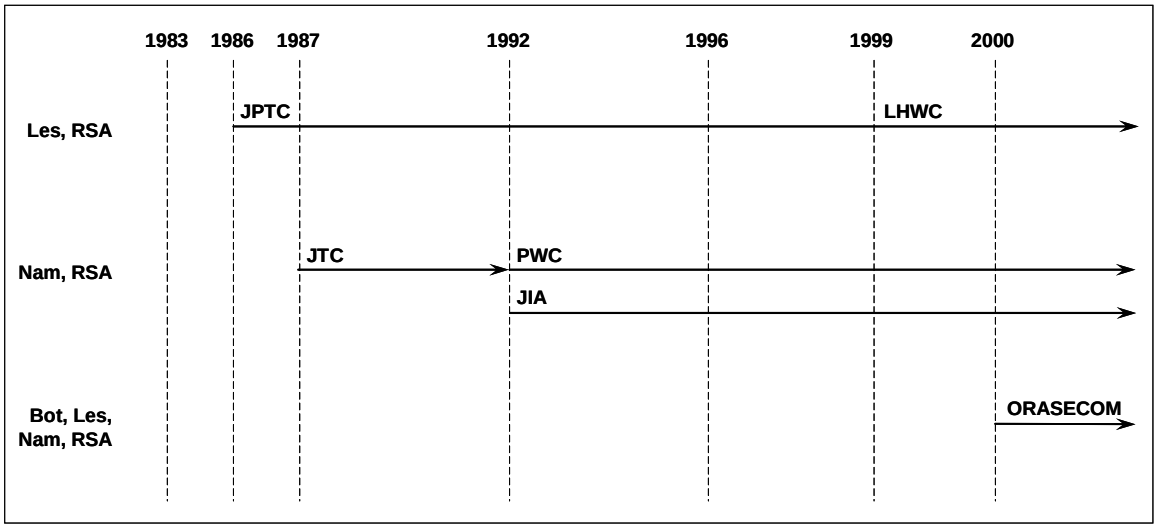

Figure 3. Schematic timeline depicting the emergence of water management institutions in the Orange-Senqu basin over time (Adapted from Turton 2003, pp. 207).

Table 3. Agreements and institutions established between the basin states of the Orange-Senqu River.

Year	Parties	Agreement	Institution
1983	Botswana, South Africa	Agreement between the Government of the Republic of South Africa and the Government of the Republic of Botswana establishing the Joint Permanent Technical Committee	Joint Permanent Technical Committee (JPTC)
1986	Lesotho, South Africa	Treaty on the Lesotho Highlands Water Project	Joint Permanent Technical Commission (JPTC), replaced in 1999 by the Lesotho Highlands Water Commission (LHWC) Trans-Caledon Tunnel Authority (TCTA) Lesotho Highlands Development Authority (LHDA)
1987	South West Africa, South Africa	Agreement between the Republic of South Africa and the Interim Government of the National entity of Southwest-Africa/Namibia concerning the control development and utilization of the water of the Orange River	Joint Technical Commission (JTC), replaced in 1992 by the Permanent Water Commission (PWC)
1990	Botswana Namibia	Agreement on the Establishment of a Joint Permanent Water Committee	Joint Permanent Water Committee (JPWC)
1992	Namibia, South Africa	Agreement on the Establishment of a Permanent Water Commission	Permanent Water Commission (PWC)
1992	Namibia, South Africa	Agreement on the Vioolsdrift and Noordoewer Joint Irrigation Scheme	Joint Irrigation Authority (JIA)
1999	Namibia, South Africa	Agreement on Water Related Matters Pertaining to the Incorporation of Walvis Bay in the Territory of the Republic of Namibia	
2000	Botswana Lesotho, Namibia, South Africa	Agreement on the Establishment of the Orange-Senqu River Commission	Orange-Senqu River Commission (ORASECOM)

Allocation Strategies

Water allocations are specified in only two of the four agreements (**Table 4**). In both cases volumetric allocations are used, but the level of prescribed flexibility differs. The VNJIS agreement dedicates 20 Mm^3 of water annually to the scheme as a whole, with 11 Mm^3 allocated for farmers in South Africa and 9 Mm^3 designated for those in Namibia. By itself, this fixed volumetric allocation provides water managers with no guidelines for adjusting the allocations to each country over time. The agreement does not eliminate the possibility of adapting the apportionment of the existing total allocation to each country over time, but leaves the issue to the two bilateral institutions—the Joint Irrigation Authority (JIA) and the Permanent Water Commission (PWC)—for investigation, negotiation, and recommendation to parties. Within the last few years, a reduction in the demand in the South African component of the scheme has prompted discussions within the respective water ministries and amongst representatives to the PWC and JIA about a range of options for changing the current allocation structure. The possibilities of selling the excess water to other users in South Africa or selling it to Namibian farmers within the scheme have both been raised as potential options (Biggs, personal communication, 2007).

Table 4. Flexibility mechanisms embedded in Orange-Senqu basin water agreements.

Flexibility Mechanisms	**Relevant annexures, articles, and protocols from Orange-Senqu Agreements**			
	2000	**1992 (PWC)**	**1992 (VNJIS)**	**1986**
Allocation				Art. 7(2) Annexure 2
Drought Provisions		Art. 3	Art. 3(5)	Art. 7(2) Art. 9 (19) Art. 14(1)
Amendments/Review	Art. 11	Art. 5	Art. 14	Art. 6
Revoking Clause	Art. 9	Art. 5	Art. 14	Art. 9(7, 8)
Institutional Responsibilities	Art. 1 [ORASECOM]	Art. 1 [PWC]	Art. 5 [JIA]	Art. 9 [JPTC] Protocol 6 [LHWC] Art. 7 [LHDA] Art. 8 [TCTA]

In contrast, the 1986 treaty couples progressive volumetric allocation with a clause that allows future modifications to this. The agreement specifies the amount of water to be delivered annually between 1995 and 2020 (see Annexure II), and provides for gradual increases in the quantities of water over time as each phase of the project is completed. The treaty also provides for the future modification of specified quantities pending changes in the projected water requirements in South Africa (see Article 7, section 2). This system of allocation provides more flexibility than simple fixed volumetric allocations and has allowed the joint commissions to alter the original schedule of delivery to respond to changing levels of water demand in South Africa (Hiddema, personal communication, 2007).

Outside of these two project-oriented agreements, water allocations and flow regimes have not yet been determined for the basin as a whole. This contributes to persistent uncertainty with regard to Namibia's entitlement to water abstractions in the basin (DWAF, 2004b; PWC, 2005). As South Africa strains to meet growing water needs and Namibia strives to expand economic activity in the basin, the clarification of flexible allocation entitlements will be crucial for enabling national planning and project development to take place (see Heyns, this volume; Potts & Hallowes, this volume). Recognizing the importance of developing a mutually acceptable method to determine equitable and reasonable utilization of shared waters, the parties granted both the PWC and the ORASECOM the power to advise parties

on the criteria to be adopted in the allocation and utilization of common water resources. The parties continue to undertake studies and exchange information to determine the long-term safe yield and projected levels of demand, but no action has been taken to specify basin-wide allocations.

Drought Response Provisions

Drought conditions are acknowledged in all four of the basin agreements. The 1992 agreement establishing the PWC grants the commission power to advise the parties on measures to alleviate short-term problems resulting from water shortages during periods of drought (See Article 3, section 1f). Similarly, the 2000 agreement tasks the ORASECOM with advising the riparian parties on contingency plans for responding to drought situations (see Article 5, section 2.7).

The project-focussed agreements establish more specific procedures for responding to drought events. In the case of extreme events, a classification into which drought and armed insurrection both fall (see Article 14, section 1), the 1986 treaty calls for parties to take the necessary measures of "palliation and restoration…and subsequently agree on joint action". This vaguely-worded provision is coupled with a more detailed procedure for dealing with shortfalls in annual water delivery. According to the agreement, Lesotho is required to recoup the amount of water through excess deliveries in the six months following the shortfall year (See Article 7, section 2; Article 9, section 19). In contrast, the VNJIS agreement contains no specific stipulations for responding to the impacts of droughts. However, the parties do acknowledge that, in the event of drought conditions in the lower basin, the diversion and abstraction of water within the scheme may be subject to restrictions imposed by the PWC.

To date, neither of these mechanisms for drought response has been invoked (Hiddema, personal communication, 2007; Liebenberg, personal communication, 2007). Nevertheless, the six-month grace period and repayment mechanism established for the Lesotho Highlands Water Project gives parties the flexibility to cope with short-term changes while keeping intact both the delivery schedule and wider agreement. In both the 1992 agreements, the drought references themselves do little to guide the parties in their response or adaptation. Instead, the joint institutions are relied upon to analyze the situation, consider the need for curtailments, advise the parties and implement subsequent decisions.

Amendment and Review Processes

All four agreements include basic provisions for future amendments to the treaty. However, unlike the other agreements, the 1986 treaty contains three additional mechanisms for reviewing and amending the original agreement. The first is a requirement for parties to review the treaty at twelve-year intervals (see Article 18, section 1). The second is the phased framework in which the parties outline five potential phases of the joint project, but only bind themselves, under the original agreement, to the implementation of the first phase. This structure provides parties with the opportunity to reassess objectives and opportunities before proceeding with subsequent phases. It is notable, however, that the flexibility provided by this phased framework is tempered by monetary penalties imposed if one or both parties withdraw before the completion of Phase 5. These penalties were included in the 1986 agreement in recognition of the financial commitments made by both parties and the anticipated need to recover the investments over the lifetime of the project. The third mechanism, a procedure for amending the original agreement through mutually agreed protocols, allows parties to create or alter rules to address any unforeseen or changing circumstances related to the project (**Table 5**). Protocol VI, for example, refines the institutional responsibilities and mandates to reflect the Project's transition from the construction to the management stage (Mwakalumbwa, personal communication, 2007). The parties used this amendment to replace the Joint Permanent Technical Committee (JPTC), established under the original agreement to oversee the development and implementation of the project, with the Lesotho Highlands Water Commission (LHWC), an

institution designed to extend beyond the technical aspects of the project to address the social, environmental and economic issues involved in maintaining the scheme.

Table 5. Protocols to the 1986 Treaty for the Lesotho Highlands Water Project.

Date	Protocol	Scope
1988	I: Royalty Manual	Elaborates the methodology for calculating the net benefit of the project and related royalty payments
1988	II: SACU Study	Examines the Lesotho's share in the common revenue pool of the Customs Union (between South Africa, Botswana, Lesotho and Swaziland) and specifies the advance payment to Lesotho as a fixed percentage of the present value of the total cost of initial development
1988	III: Apportionment of the Liability for the Costs of Phase 1A Project Works	Clarifies the responsibility of payment by country for the construction costs of water delivery and hydropower infrastructure
1991	IV: Supplementary Arrangements Regarding Phase 1A	Establishes processes and expectations regarding Cost Allocation Reports, royalty payments, reimbursement, loans, and insurance
1992	V: Supplementary Arrangements with Regard to Project Related Income Tax and Dues and Charges Levied in the Kingdom of Lesotho in respect of Phases 1A and 1B of the project	Examines the different types of water-related contracts issued in Lesotho and the need to track the amount of income tax paid; Specifies provisions to regard income tax as project costs.
1999	VI: Supplementary Arrangement Regarding the System of Governance for the Project	Redefines the functions and responsibilities of the Board of Directors of the LHDA, the Board of Directors of the TCTA and the JPTC; JPTC renamed Lesotho Highlands Water Commission (LHWC); Redefines hierarchical relations between the LHDA, TCTA and LHWC, and between the LHWC and parties.

Revocation Clauses

All five agreements contain clauses that allow the parties to terminate or withdraw from the treaty. Under the 2000 agreement, basin parties are permitted to withdraw from the agreement but no sooner than three years after the agreement has entered into force. Once written notice has been supplied to the other parties, a withdrawal is permitted after 12 months. This time period is included to prevent parties from absconding before complying with existing commitments. In the 1992 agreements, termination of the treaty requires the exchange of written notices between parties and termination will be enacted six months after the request. The 1986 treaty also includes cancellation clauses, though parties may be deterred from choosing this option due to the monetary penalties imposed for cancellations before the completion of phase five (see Article 6, section 1; Article 12, sections 7-8). To date, no riparian state has ever requested the termination of a joint water treaty in the Orange-Senqu Basin, though in extreme cases, where the terms of an agreement are no longer adequate for meeting changing needs, these clauses could provide parties with options for ending their involvement with the agreement and options for renegotiating rules and regulations which reflect present circumstances.

Institutional Responsibilities

Each of the four key agreements pertaining to the Orange-Senqu River basin establishes joint institutions with varied responsibilities and jurisdictions (**Table 6**). The project-related

institutions, the LHWC and the JIA, are both granted substantial powers to design and implement policies and procedures. The other two commissions - PWC and ORASECOM - serve as advisory bodies whose mandates are wider in scope than the project authorities. These joint institutions were designed to advise the parties on a wide range of topics related the development and utilization of shared waters. In addition to the list of priority matters on which the Commissions are expected to advise (**Table 7**), both agreements include clauses granting the joint bodies to advise on "such other matters as may be determined" by the parties of the Commissions. The broad and flexible mandates assigned by the parties to these joint bodies allow the existing institutions considerable scope for recognizing the need for management changes and advising the parties accordingly.

Table 6. Composition and mandate of joint institutions for water management in the Orange-Senqu basin.

Institution	Composition	Mandate
ORASECOM	The Council consists of 3 delegates from each of the riparian states and is supported by a Technical Task Team comprising specialists drawn from each country. A permanent secretariat for the Commission was established in October 2007.	To serve as a technical advisor to the Parties on matters relating to the development, utilization and conservation of water resources
PWC	3 delegates from each party	To serve as a technical advisor to parties on matters relating to the development and utilization of shared waters; monitor and advise the JIA
JIA	4 delegates from each party, at least three of which must be landowners within the district. The fourth space in each delegation is currently filled by a representative from the respective Departments of Water and Agriculture who also serves as liaison to the PWC	To operate and maintain the Irrigation Scheme and control the abstraction of water from the Orange River
LHWC	3 delegates from each party	To be responsible and accountable for the project; monitor, advise, and audit the LHDA and TCTA; determine appropriate policies, procedures and expenditure limits

According to the 2000 treaty, the ORASECOM has no formal oversight, advisory or coordinating powers with respect to the pre-existing bilateral commissions (see Article 1, section 3). While the agreement states that basin commissions which come into existence after 2000 will be made subordinate to ORASECOM (Article 1, section 4), previously established institutions (i.e. the LHWC, PWC and JIA) continue to operate as separate entities. With multiple institutions at work simultaneously in the basin, the bilateral institutions are expected to liaise with the basin-wide body (**Figure 4**). The 2000 agreement articulates a formal expectation that the bilateral institutions will provide reports and information on any activities that might have the potential to affect other parties. On a less formal level, communication between the various commissions is also facilitated by the fact that the same few individuals often represent their country on both the bilateral and basin-wide organizations.

Table 7. Powers and functions granted to the advisory institutions in the Orange-Senqu basin.

Issue	Permanent Water Commission	Orange-Senqu River Commission
	To advise parties on…	
Water Availability	Measures and arrangements to determine the potential of the water resources available from rivers of common interest	Measures and arrangements to determine the long-term safe yield of the water resources in the River System
Demand and Utilization	The reasonable demand for water from common resources	The equitable and reasonable utilization of the water resources in the River System to support sustainable development in the territory of each Party
	The criteria to be adopted in the allocation and utilization of common water resources	
Investigations, operation and maintenance	Investigations, separately or jointly by the Parties, related to the development of any water resource of common interest including the construction, operation and maintenance of any water works in connection therewith	Investigations and studies conducted separately or jointly by the Parties, with regard to the development of the River System, including any project of the construction, operation and maintenance of any water works
Pollution Control	The prevention of and control over the pollution of common water resources and soil erosion affecting such resources	The prevention of the pollution of water resources and the control over aquatic weeds in the River System
Drought and Emergency Provisions	Measures that can be implemented by either or both Parties to alleviate short-term problems resulting from water shortages in any river of common interest to the Parties during periods of drought, taking into consideration the availability of stored water and the water requirements within the territories of the respective parties	Contingency plans and measures for responding to emergency situation or harmful conditions resulting from natural causes such as droughts and floods, or from human conduct such as industrial accidents
Public Participation		The extent to which the inhabitants in the territory or each Party concerned shall participate in respect of the planning, development, utilization, protection and conservation of the River System, as well as the harmonization of policies in that regard and the possible impact on the social, cultural, economic and natural environment
Data/Info Collection and Exchange		The regular exchange of information and consultation on the possible effects of planned measures
		The standardized form of collecting, processing and disseminating data or information with regard to all aspects of the River System
Dispute Resolution		Measures with a view to arriving at a settlement of a dispute between two or more of the parties
Everything else	Such other matters as may be determined by the commission	Such other matters as may be determined by the Parties

This constellation of institutional responsibilities means that the planning for major infrastructure developments, such as Phase 2 of the LHWP and the proposed dam on the lower Orange, continues to take place in bilateral contexts (Biggs, personal communication, 2007). Recently, Namibian representatives expressed interest in becoming more involved with the feasibility study for Phase 2 of the LHWP (Heyns, personal communication, 2007). As Conley and van Niekerk (2000, 138) noted, the downstream state has a justifiable concern about the expansion of the Lesotho Highlands Water Project and its potential impact on the quantity of water that is available further downstream. However, the delegations from both South Africa and Lesotho remain reluctant to alter current protocols for communication and information sharing between basin commissions (Heyns, personal communication,

2007). The reasons cited for this bilateral preference include the efficiency of bilateral partnerships for project implementation (Mwakalumbwa, personal communication, 2007), the complexities of including additional states (Lesoma, personal communication, 2007), and the belief that the current levels of communication and interaction with ORASECOM provide sufficient opportunities for involvement of downstream states (Dlamini, personal communication, 2007). As efforts to develop the upper and lower reaches of the river continue, the parties will have to build upon the existing guidelines for information and data sharing and prior notification to calibrate the levels and mechanisms for communication so that all parties are content with the way the planning and development of future projects are handled.

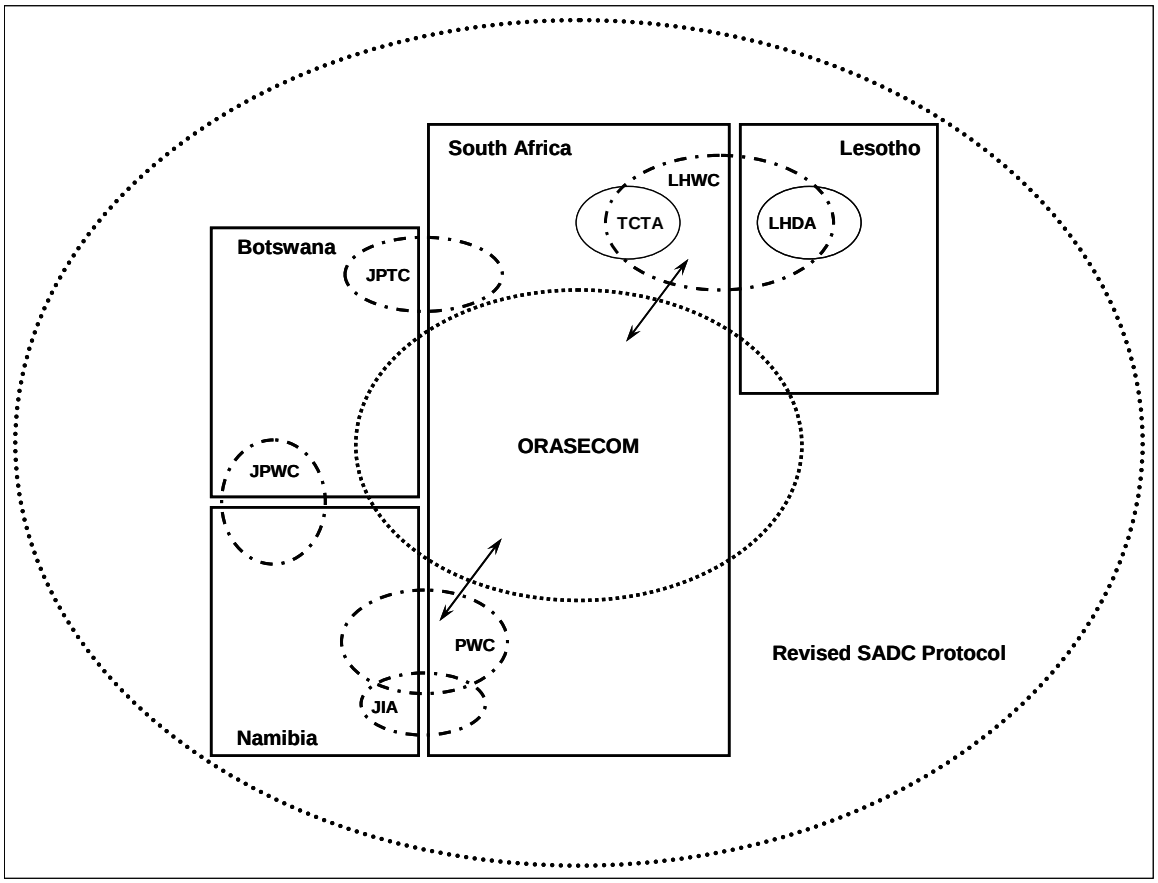

Figure 4. Landscape of international water agreements and management institutions pertaining to the Orange-Senqu basin.

As this analysis shows, the existing agreements that pertain to the Orange-Senqu River basin contain a variety of flexibility mechanisms. Some of mechanisms that are present in the four key agreements have not yet been needed or utilized by the parties. Others – such as the progressive allocation and protocol amendment strategies adopted for the LHWP – provide specific guidelines that may help parties to adapt to changing circumstances by requiring management policies and procedures to be reviewed, and if necessary, modified over time. Overall, the institutions that have been established to oversee basin projects and advise parties are enabled by the existing agreements to help drive the adaptive process. In particular, the broad mandates of the PWC and the ORASECOM to advise parties on a whole list of issues plus 'any other matter arising' allows these institutions to recognize the need for change and advise the parties to take action.

CONCLUSION

The patterns of water flow and utilization in the Orange-Senqu River basin have been characterized by a variety of seasonal, inter-annual and long-term changes and it is anticipated that the trends of change in water use patterns within each basin state will continue in the future. As a result, the systems for trans-boundary water management must be able to respond appropriately to all of the political, geographic, climatic, social, economic and environmental factors that alter the availability of water resources in the basin.

This review of flexibility mechanisms embedded in the basin-wide and bilateral agreements for the Orange-Senqu basin demonstrates the varied content of existing agreements. The four key basin treaties include some mechanisms which specify procedures for reviewing, and if necessary revising, management procedures. Overall, however, the most crucial mechanisms for allowing adaptation over time are the institutional structures and mandates articulated in the agreements. This analysis has shown that the existing treaties do not restrict the adaptive capacity of the parties to manage water resources in the Orange-Basin. Additional research is required, however, to understand how other factors (beyond the established agreements) influence the ability of joint institutions to recognize the need for change and to advise the parties accordingly, and the capacity of the parties to decide upon and implement the necessary changes.

ACKNOWLEDGEMENTS

The authors thank the numerous policy-makers, academics and practitioners who generously took time to share their experience and opinions regarding the complexities and effects of transboundary water cooperation in the region.

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