RESEARCH REPORT 6

Governance of Africa's Resources Programme

February 2010

New Thinking on the Governance of Water and River Basins in Africa:

Lessons from the SADC Region

Anthony Turton

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FOREWORD

The Southern African Development Community (SADC) region offers useful lessons about governance in transboundary river basins. Given the high number of rivers that cross international political boundaries in the region, combined with the fact that the SADC Water Protocol provides a regional legal framework around which to develop robust water resources governance systems, this report shows how institutions grow incrementally over time. The global norm is that most transboundary rivers that have more than two riparians are governed by a regime that does not include all riparian states. The SADC case is the opposite, where all of the transboundary rivers that were identified as being 'at risk' in a major study by Aaron Wolf and his team in fact have regimes that include all riparian states. This case study also shows that while instrumentalism leads to experimentation and failure on occasion, it also provides for the necessary adaptation needed to eventually produce a robust governance structure.

The report discusses a number of water governance lacunae in the region and concludes by making specific policy recommendations to enhance the effectiveness of water governance in the SADC region, but which may also hold applicability to other regions of Africa.

ABBREVIATIONS AND ACRONYMS

ANJCC	Angolan–Namibian Joint Commission of Co-operation
CSIR	Council for Scientific and Industrial Research
DRC	Democratic Republic of Congo
DWAF	Department of Water Affairs and Forestry
ENWC	Eastern National Water Carrier
EU	European Union
GGP	gross geographic product
IBT	inter-basin transfer
ICJ	International Court of Justice
JCC	Joint Commission of Co-operation
JIA	Joint Irrigation Authority
JOA	Joint Operating Authority
JPCC	Joint Permanent Commission of Co-operation
JPTC	Joint Permanent Technical Committee
JPTWC	Joint Permanent Technical Water Commission
JPWC	Joint Permanent Water Commission
JTC	Joint Technical Committee
JWC	Joint Water Commission
KOBWA	Komati Basin Water Authority
LBPTC	Limpopo Basin Permanent Technical Committee
LHDA	Lesotho Highlands Development Authority
LHWC	Lesotho Highlands Water Commission
LHWP	Lesotho Highlands Water Project
LWC	Limpopo Watercourse Commission
MAP	mean annual precipitation
MAR	mean annual runoff
NPA	Nkomati Peace Accord
OKACOM	(Permanent) Okavango River Basin Water Commission
ORASECOM	Orange–Senqu River Commission
PCC	Permanent Commission of Co-operation
PJCC	Permanent Joint Commission of Co-operation
PJTC	Permanent Joint Technical Commission
PNA	parallel national action
PWC	Permanent Water Commission
RBO	river basin organisation
SADC	Southern African Development Community
SADC FP	SADC Founding Protocol
SADSC TCM	SADC Protocol on Transport, Communications and Meteorology

SADC WP	SADC Water Protocol
SAHPC	Southern African Hydropolitical Complex
SARCCUS	Southern African Regional Commission for the Conservation and Utilisation of the Soil
SIWI	Stockholm International Water Institute
TCTA	Trans-Caledon Tunnel Authority
TPTC	Tripartite Permanent Technical Committee
TWO	Transboundary Water Opportunity
UNEP	UN Environment Programme
VNJIS	Vioolsdrift and Noordoewer Joint Irrigation Scheme
WRC	Water Research Commission
ZACPLAN	Zambezi Action Plan
ZAMCOM	Zambezi Water Commission
ZRA	Zambezi River Authority

CHAPTER 1

INTRODUCTION

While Africa is well endowed with mineral resources, water remains a fundamental constraint to future economic growth and development. This report presents the current state of the art with respect to our knowledge of these complex linkages. It summarises a large quantity of diverse work and is presented in a way that is designed to help the reader who is a non-technical specialist to understand the need for joint management of the continent's shared water resources. Given the wide variety of historic, social, cultural, climatic and biophysical differences that collectively exist across the continent of Africa, the Southern African Development Community (SADC) region will be used as a case study. This does not imply that other regions of the continent are less important. The SADC region has a rich history of river basin management from which many lessons can be distilled and it is for this reason alone that it has been selected. The most comprehensive work has been presented in two unpublished reports.[1]

The objective of this thematic commissioned report is to make well-grounded policy recommendations leading to the enhanced development of Africa's natural resource endowment. This is biassed specifically towards the avoidance of conflict and the maximisation of utilisation of the shared resource to the collective benefit of the citizens of the continent.

CHAPTER 2

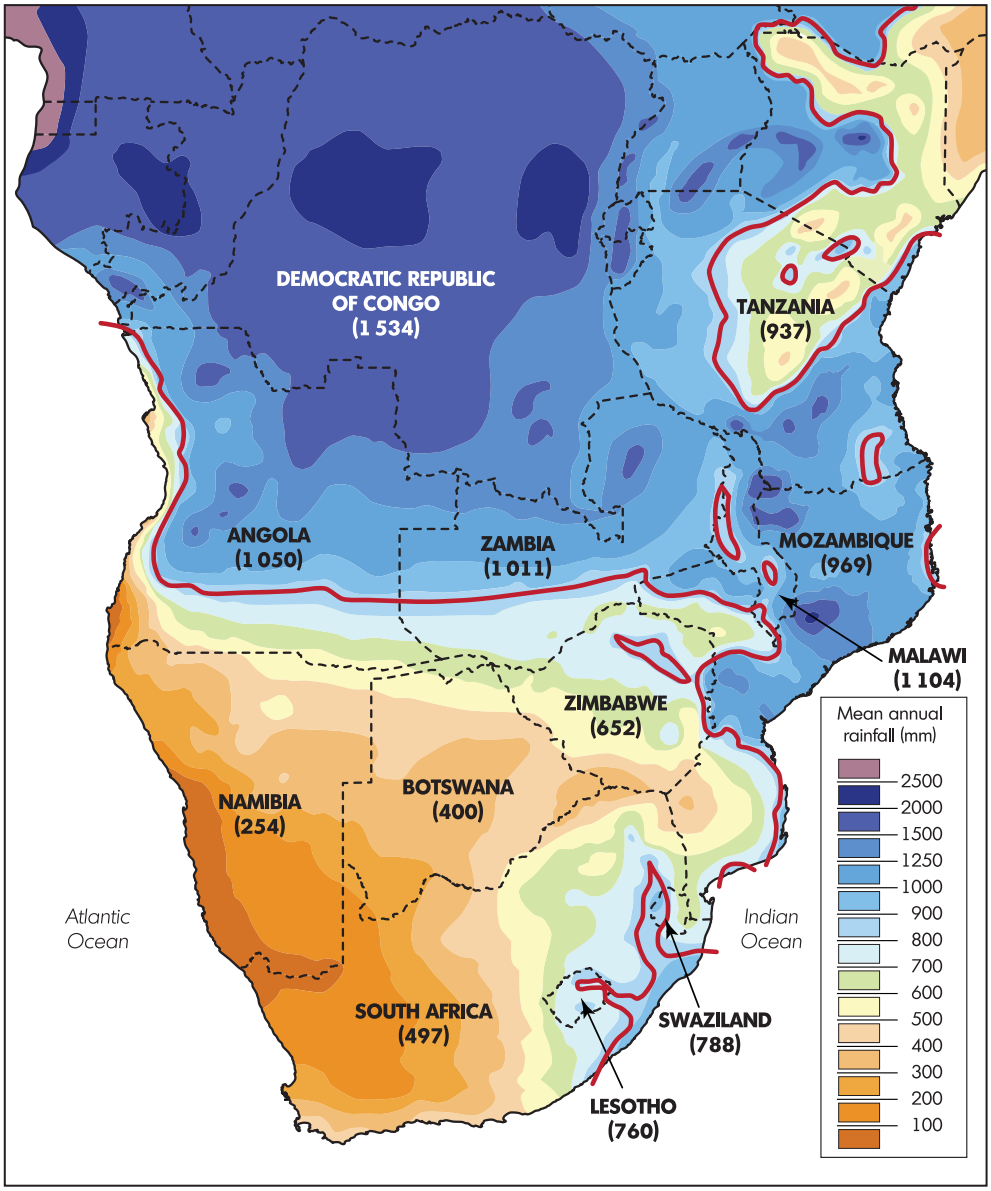
BRIEF SUMMARY OF TRANSBOUNDARY WATER RESOURCES IN THE SADC REGION

The SADC region covers 14 sovereign states, two of which are islands. The 12 mainland African states are linked by 21 river basins that cross international political borders, 15 of which are considered to be the most important in terms of socio-economic development.[2] The SADC region is characterised by a specific hydrological regime, made more complex by the fact that the majority of the area lies between the Inter-Tropical Convergence Zone and the Southern Ocean, both of which drive different patterns of weather and precipitation. This biophysical characteristic is superimposed onto a set of diverse countries, each with different developmental trajectories, different political histories, differing legal systems that reflect previous colonial legacies and diverse natural resource endowments. The ending of the Cold War has resulted in an attenuation of localised theatres of political instability, which in turn has meant that the SADC region is now set to grow economically into a more integrated regional grouping, possibly along similar lines to that of the European Union (EU).[3]

The economic development potential of the SADC region is defined by the availability of water. The primary source of water is precipitation, which is highly skewed across the region, as shown by the map in figure 1 on page 9. The precipitation patterns are characterised by steep gradients from north to south and from east to west, with the most currently economically diverse countries being on the 'wrong side' of the global average of 860 mm/yr^{-1}. The data presented in figure 1 shows these precipitation-related facts in a dramatic way, with the red line representing the global average isohyet of 860 mm/y^{-1} and the number stated in brackets beneath each country's name representing the annual average precipitation for that country in millimetres.

Arising from these precipitation patterns, the SADC region has a very specific drainage system.[4] As a result of the colonial legacy, international political borders seldom reflect hydrological management units, which in terms of 21st-century thinking are the river basin, defined as the area within the physical boundary delineating the surface drainage area. At the continental level, Africa has 64 river basins that cross international political borders (the 63 noted by Ashton, Turton and Jacobs,[5] plus Lake Chilwa, presented in this report in figure 5 on page 14 and figure 6 on page 16). It is significant that 11 of these African basins are endorheic, which are a specific type of river basin that drains inland rather than flowing into the sea.[6] The largest of these African endorheic systems is the Lake Chad basin, with the largest in the SADC region being the Okavango/Makgadikgadi, leaving the Cuvelai basin a close second (see figures 5 and 6). Nowhere else in the world is there a continental-level situation where 15% of the river basins (expressed by number and not geographic size or magnitude of the hydrological flow) do not flow into the sea. This fact complicates the management of transboundary river basins in Africa. The implication of this simple fact is that all rivers are not equal and cannot be managed in a

Figure 1: Rainfall patterns across the SADC region, characterised by a steep gradient from north to south



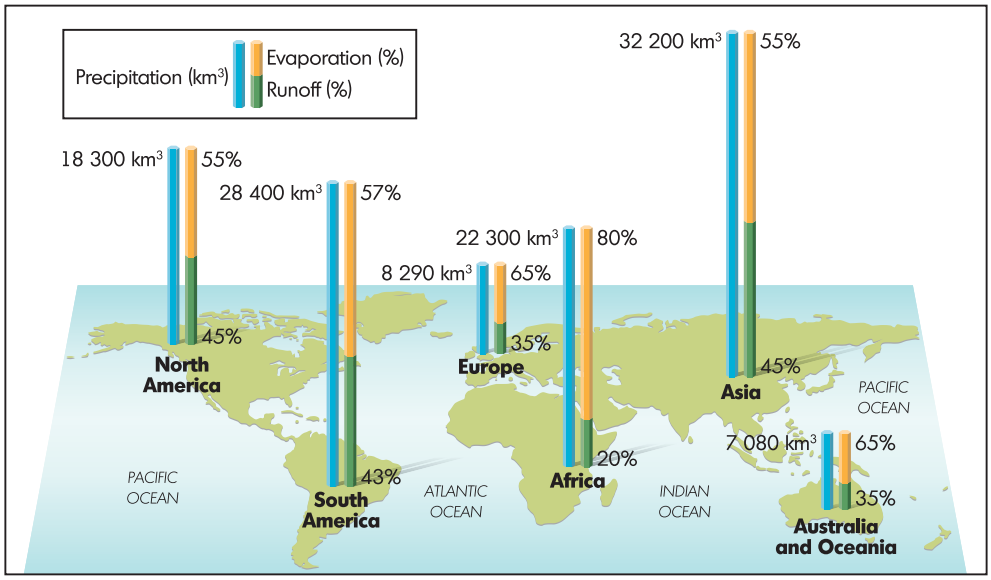
Source: PJ Ashton, Aquatic Ecosystems and Human Research Group, Natural Resources and the Environment Unit, CSIR, Pretoria.

simplistic manner by taking a 'one-size-fits-all' approach, because while these ephemeral and/or endorheic systems have relatively small volumes of water, they tend to sustain relatively large livelihood flows, making their management extremely important.[7] Africa has the lowest conversion ratio of mean annual precipitation (MAP) to mean annual runoff (MAR) in the world (as shown in figure 2 on page 10), which poses a fundamental development challenge.[8]

The coexistence of endorheic (rivers that do not end in the sea), ephemeral (rivers that flow only episodically) and perennial river systems (rivers that flow permanently) in Africa

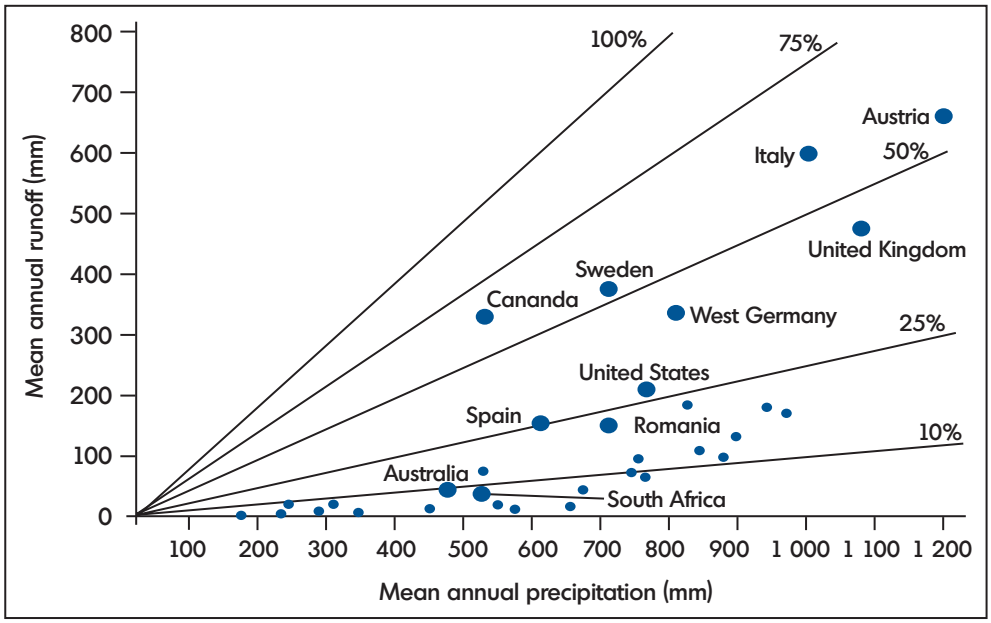
is the result of another climatic condition that constrains the economic development of the SADC region.[9] This constraint arises from the conversion of water that falls as rainfall (MAP) to water flowing in rivers and thus useful in an economic sense (MAR). Figure 2 shows rather dramatically that Africa converts only 20% of its MAP into MAR, the

Figure 2: The world's surface water: Precipitation, evaporation and runoff by region



Source: Gleick PH, *Water in Crisis*. New York: Oxford University Press, 1993.

Figure 3: Conversion ratios of MAP to MAR in the SADC region



Adapted from O'Keeffe J, Uys M & MN Bruton, *op. cit*.

rest (80%) being lost rather quickly after a rainfall event as evaporation. This MAP:MAR conversion ratio means that, in general, the SADC region has a low assurance of supply. In the interim, the relevance of this MAP:MAR conversion ratio is reflected in the flow regime of rivers draining the African continent (see figure 3 on page 10).

Figure 3 shows the MAP:MAR conversion ratio for the 21 transboundary river basins in the SADC region. The horizontal axis represents MAP, with the vertical axis showing MAR. The small dots on the graph represent individual river basins in the SADC region, with the larger dots representing specific countries by way of comparison. It is immediately evident that while the river basins in the SADC region differ in terms of volumetric flow, they are mostly clustered along or below the 10th percentile.[10] This should be interpreted against the data presented in figure 2, because it shows that while the continental average MAP:MAR conversion is 20%, the SADC conversion ratio is considerably less, being in most cases half of that (10%), often from a low precipitation base. It is this set of factors — a combination of climatic and hydrological — that represent a fundamental developmental constraint in the SADC region.[11]

Table 1: Known transboundary aquifer systems in the SADC region

Aquifer / Riparian state	Cunene coastal	Cuvelai	Congo coastal	Congo intra-cratonic	Gariep coastal	Incomati coastal	Kagera	Kalahari	Karoo sedimentary	Kenya-Tanzania coastal	Kilimanjaro	Limpopo granulite-gneiss belt	Nata-Gwai	Okavango	Okavango-Epukiro	Pafuri alluvial	Pomfret-Vergelegen dolomitic	Ramotswa dolomite	Rovuma coastal	Shire valley alluvial	Tuli-Shashe	Upper Rovuma	**Shared aquifers**
Angola	X	X	X	X										X									**5**
Botswana								X				X	X	X	X		X	X			X		**8**
DRC			X	X																			**2**
Lesotho									X														**1**
Madagascar																							**0**
Malawi																				X			**1**
Mauritius																							**0**
Mozambique						X										X			X	X		X	**5**
Namibia	X	X			X			X						X	X								**6**
South Africa					X	X		X	X			X				X	X	X			X		**9**
Swaziland						X																	**1**
Tanzania							X			X	X								X			X	**5**
Zambia				X									X	X									**3**
Zimbabwe												X	X			X					X		**4**
States sharing	**2**	**2**	**2**	**3**	**2**	**3**	**1**	**3**	**2**	**1**	**1**	**3**	**3**	**4**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	

Source: Turton AR, Ashton PJ & I Jacobs, *op. cit.*; Turton AR *et al.*, 2006, *op. cit.*; Turton AR *et al.*, 2007, *op. cit.*

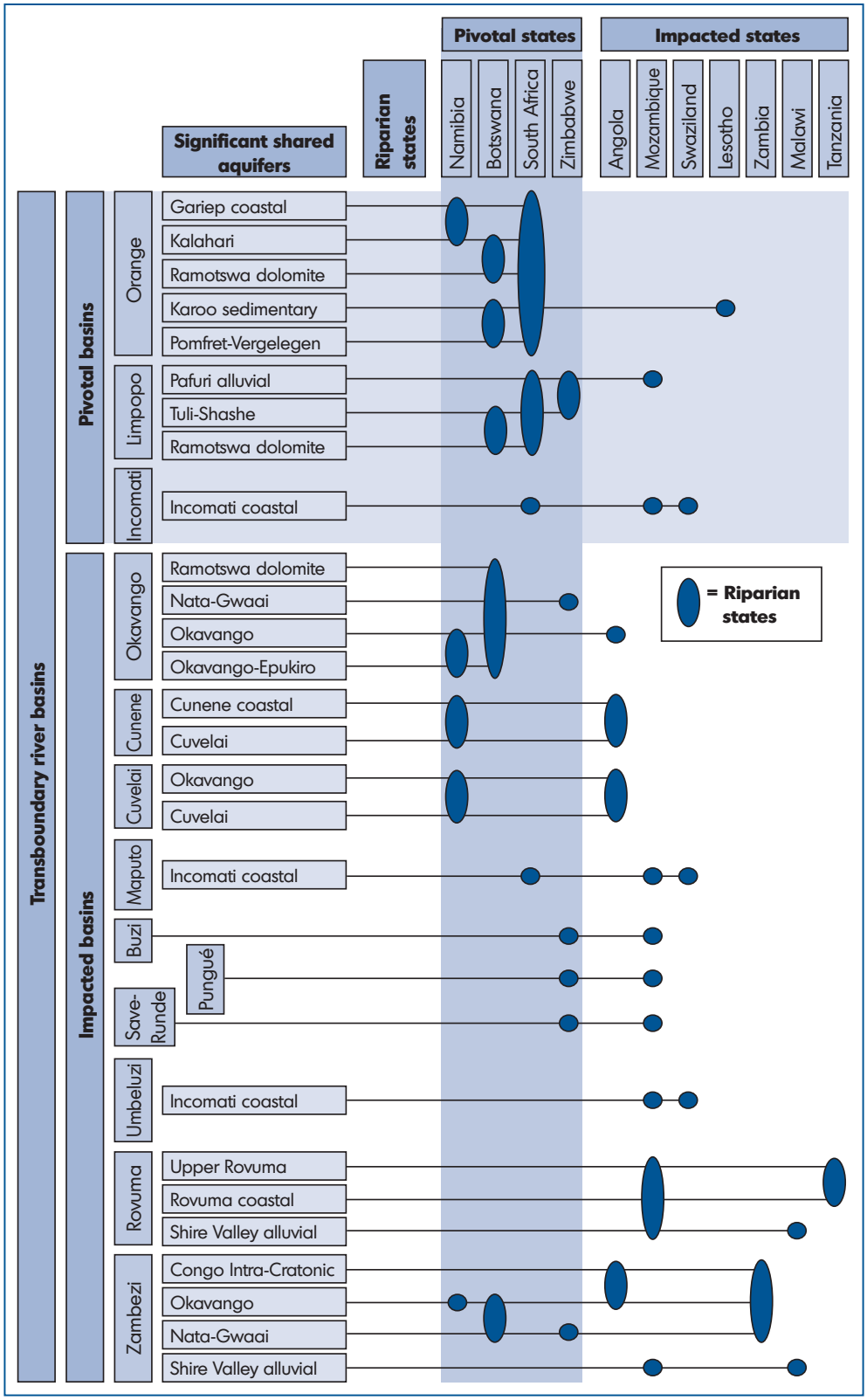
While surface water is important, the significance of groundwater should not be forgotten. Groundwater in the SADC region is a vital resource, often used by rural communities as their only reliable source of drinking water.[12] The livelihood flows derived from groundwater are thus extremely important, specifically in terms of poverty eradication. Table 1 on page 11 lists the 22 known transboundary aquifer systems within the SADC region along with their respective riparian states.[13] The column on the right shows how many shared aquifers are in each country and the bottom row shows how many riparians lie within each shared aquifer system. The word 'riparian' derives from the Latin '*rivus*', which means to share a common water source such as a river or an aquifer. Significantly, it is also the basis of the word '*rivalus*', from which the modern concept of rivalry is derived.

If one superimposes the surface and groundwater resources available across the SADC region, then an interesting pattern of distribution occurs. Figure 4 on page 13 shows a schematic representation of the distribution of water resources, both surface and groundwater, across the Southern African Hydropolitical Complex (SAHPC). A hydropolitical complex exists when patterns of interstate amity (co-operation) and enmity (conflict) converge around the co-dependence on a specific shared water resource, with the overall pattern of convergence tending towards co-operation rather than conflict.[14] This is the pattern in the SADC region, so it is prudent to call the SADC region the SAHPC when referring to interstate relations regarding water, specifically because of the convergence around co-operation rather than conflict.[15] It is significant to note that the four most water-constrained countries that are on the 'wrong side' of the global average isohyet of 860 mm/yr^{-1} (see figure 1 on page 9) — Botswana (400 mm/yr^{-1}), Namibia (254 mm/yr^{-1}), South Africa (497 mm/yr^{-1}) and Zimbabwe (652 mm/yr^{-1}) — are also the countries that share the largest number of transboundary aquifers (see table 1 on page 11) — Botswana (8), Namibia (6), South Africa (9) and Zimbabwe (4). These four countries are called pivotal states, and the three transboundary surface water basins that they depend on for strategic supplies of water, and which have already been fully — or almost fully — allocated (Incomati, Limpopo, Orange/Senqu), are called pivotal basins. This unique pattern of distribution has a number of ramifications that are absent from the current literature.

It becomes instructive to see where the main transboundary aquifers are. Maps to this effect are scarce and, where they are found, are extremely inaccurate by virtue of the paucity of knowledge about the full geographic extent of the aquifer systems. Recent work by Cobbing and his team[16] has generated a map that is potentially useful. Unfortunately, this work deals only with transboundary aquifers to which South Africa is riparian, but given that these are shared with six other SADC member states — Botswana, Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe — it still gives some insight at a regional level. This is presented as figure 5 on page 14.

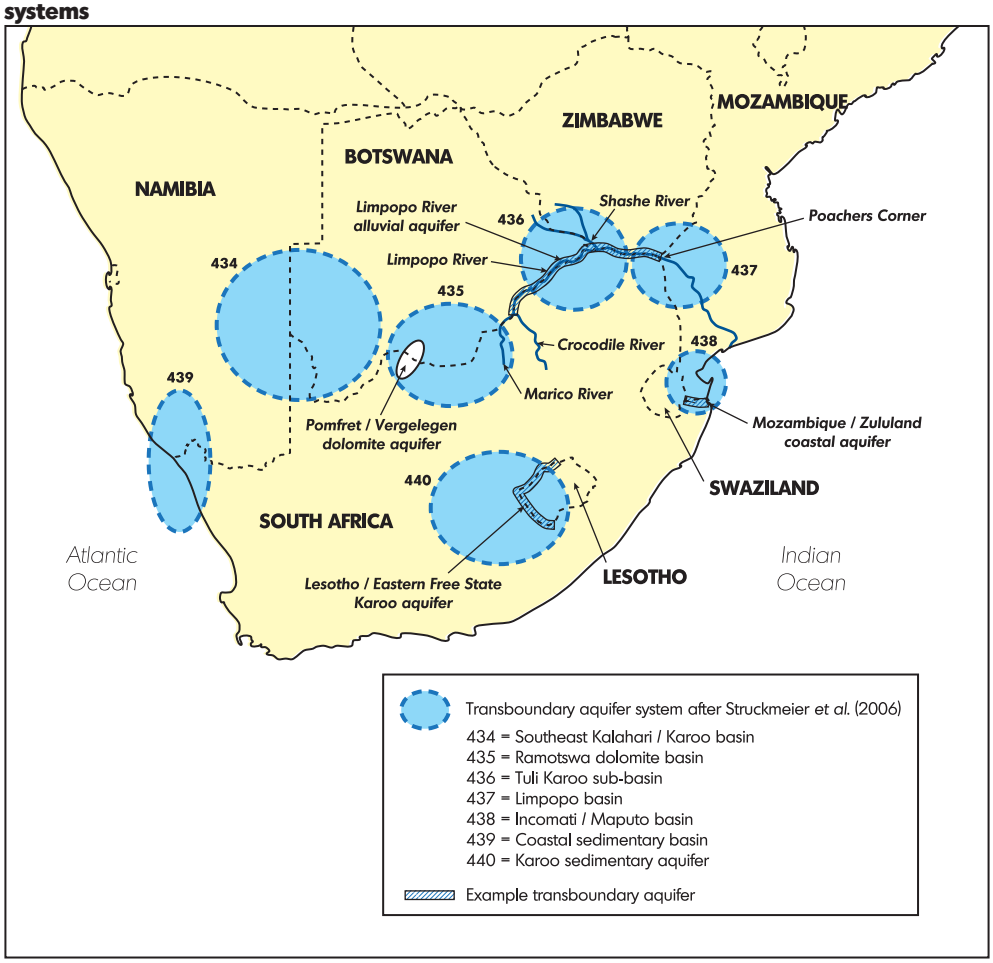
With this as a background, it now becomes possible to examine each of the transboundary rivers in the SADC region with a view to determining what needs to be done to unlock the latent potential each has for sustaining national economic development and regional integration. The 21 transboundary river basins in SADC are shown in table 2 on page 15, which also indicates the existence of an interstate agreement, the names of the respective riparian states and the classification in terms of being either perennial (permanently flowing) or endorheic (draining inland rather than into the sea).

Figure 4: Schematic representation of the relationship between significant water resources and various units of management in the SADC region



Source: Turton AR, Ashton PJ & I Jacobs, *op. cit.*

Figure 5: The approximate locations of seven Southern African transboundary aquifer systems



Source: Cobbing JE *et al.*, *op. cit.*

The 21 transboundary river basins to which a SADC member state is riparian are shown in figure 6 on page 16. From this map, it is evident that there are three broad categories of transboundary rivers. Category 1 consists of those transboundary rivers where not all of the riparians are members of SADC. This means that the SADC Water Protocol (SADC WP)[17] is not necessarily applicable to the management of that specific river basin, but it could become the foundation for management in the future. The SADC WP, known officially as the Protocol on Shared Watercourse Systems, was the first regional agreement signed by all SADC member states after South Africa joined that grouping. It was strongly influenced by aspects of international water law that were then in existence, such as the Helsinki Rules, the Dublin Principles and Agenda 21, and as such it represents a regional consensus over core principles enshrined in these various legal threads. The SADC WP was amended in 2000 when it was aligned with the UN Convention on the Law of the Non-Navigational Uses of Shared Watercourses.[18] The SADC WP contains a number of specific principles, including respect for the sovereignty of member states in the utilisation of shared watercourses; the application of rules of general or customary international law, community of interest, and equitable utilisation; the need to maintain a balance

Table 2: Transboundary river basins to which a SADC member state is riparian

Basin name	Agreement	Type	Riparian states
Buzi	No	Perennial	Mozambique, Zimbabwe
Chiloango	No	Perennial	Angola, Democratic Republic of Congo (DRC)
Congo	Yes	Perennial	Angola, Tanzania, Zambia
Cunene	Yes	Perennial	Angola, Namibia
Cuvelai	Yes (no RBO[a])	Endorheic	Angola, Namibia
Incomati	Yes	Perennial	Mozambique, South Africa, Swaziland
Lake Chilwa	No	Endorheic	Malawi, Mozambique
Lake Natron	No	Endorheic	Kenya, Tanzania
Limpopo	Yes	Perennial	Botswana, Mozambique, South Africa, Zimbabwe
Maputo	Yes	Perennial	Mozambique, South Africa, Swaziland
Nile	Yes	Perennial	DRC, Kenya, Tanzania
Okavango/ Makgadikgadi	Yes	Endorheic	Angola, Botswana, Namibia
Orange/Senqu	Yes	Perennial	Botswana, Lesotho, Namibia, South Africa
Pagani	No	Perennial	Kenya, Tanzania
Pungué	No	Perennial	Mozambique, Zimbabwe
Rovuma	Yes (no RBO[a])	Perennial	Mozambique, Tanzania
Savé–Runde	No	Perennial	Mozambique, Zimbabwe
Thukela	No	Perennial	Lesotho, South Africa
Umba	No	Perennial	Kenya, Tanzania
Umbeluzi	Yes	Perennial	Mozambique, South Africa, Swaziland
Zambezi	Yes	Perennial	Angola, Botswana, Malawi, Mozambique, Namibia, Zambia, Zimbabwe

a RBO = river basin organisation

Source: Turton AR, Ashton PJ & I Jacobs, *op. cit*.

between economic development and environmental protection in shared watercourse systems; co-operation in joint projects and studies relevant to shared watercourse systems; commitment to sharing data among riparian states; the equitable and reasonable utilisation of shared watercourse systems (which runs contrary to the older Harmon Doctrine,[19] which claimed rights by virtue of first use); the need for discharge and abstraction permits for all users; and the obligation to notify all riparians about emergency situations. The SADC WP is widely regarded as being one of the most significant examples of regional co-operation over water and, as such, it might provide a blueprint for how to manage rivers shared

Figure 6: Geographic distribution of the 21 rivers to which one or more SADC member states are riparian[20]

between SADC and non-SADC member states by virtue of shared experience. Included in this category are the Chiloango, Congo, Lake Natron, Nile, Pagani and Umba basins.

Category 2 consists of those transboundary rivers where all riparians are members

of SADC, so the management of these systems is subject to the SADC WP. This consists of two distinct subsets. Category 2a consists of rivers that have significant portions of their basin in each riparian state, so joint management is vital. This subset consists of the Cunene, Incomati, Limpopo, Maputo, Okavango/Makgadikgadi, Orange/Senqu, Rovuma, Savé–Runde, Umbeluzi and the Zambezi basins. Category 2b consists of rivers that are fully within SADC territory and thus under the jurisdiction of the SADC WP, but are characterised by basins where the largest proportion of the resource lies in one country. As a result, joint management is not critical and might even be impractical. This subset includes the Buzi, Pungué and Thukela basins.

Category 3 consists of rivers that have specific hydrological regimes that are not conducive to the construction of large dams, mostly being endorheic in nature, but sometimes also ephemeral and thus linked closely to groundwater. This means that a disproportionately large number of livelihoods are dependent on a water supply that is often highly irregular and erratic, and where the management of these systems is very complex, often linked to endemic poverty and mostly under-funded. Included in this category are the Cuvelai and Lake Chilwa basins. These 21 transboundary river basins are shown in figure 6 on page 16.

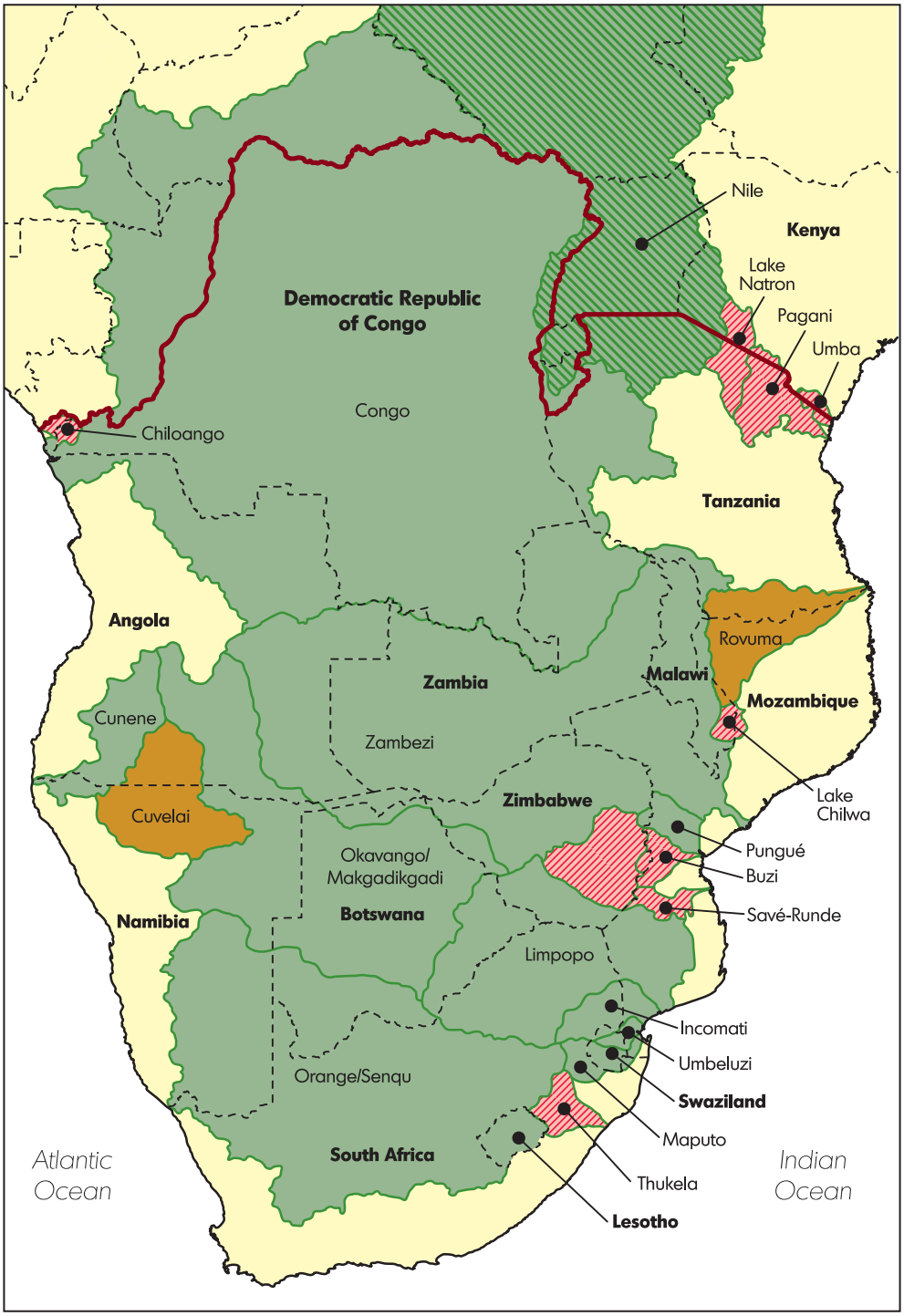
The analysis thus far gives a highly textured and nuanced view of the water resources of the SADC region. It is therefore instructive to advance this analysis a step further by determining which of these transboundary river basins are covered by some type of formal international agreement, known technically as a regime.[21] Figure 7 on page 18 shows the 21 transboundary river basins in the SADC region that are covered by both a treaty and a river basin organisation (RBO) (green) or a treaty, but without an RBO (orange), indicating that eight basins are not being managed directly in terms of the SADC WP (hatched red), with the Nile (hatched green) falling under a separate regime (this is not a qualitative analysis at all, merely a crude quantitative indication).

It is evident that of the 21 transboundary rivers in the SADC region, nine have no treaty or RBO to manage them. When analysed in terms of the categorisation presented above, they are separated out as follows:

- Category 1 (transboundary rivers of which not all of the riparians are SADC member states): Chiloango, Lake Natron, Pagani and Umba River basins;
- Category 2a (rivers that have significant portions of their basin in each riparian state, so joint management is vital): Savé–Runde;
- Category 2b (rivers that are fully within SADC territory and thus under the jurisdiction of the SADC WP, but by virtue of the fact that the significant portion of the resource lies in one country, joint management is not critical and might even be impractical): Buzi, Pungué and Thukela; and
- Category 3 (rivers that have specific hydrological regimes, which are not conducive to the construction of large dams, mostly being endorheic in nature, but sometimes also ephemeral and thus linked to groundwater): Lake Chilwa.

Figure 8 on page 19 shows the three transboundary rivers in the SADC region that are closed, or approaching closure, because their water resources are fully, or almost fully, allocated; these are shown as hatched red.[22] These are called pivotal basins in the SAHPC based on two criteria — being fully allocated, but also being strategically important to the

Figure 7: Agreements relating to transboundary river basins in the SADC region

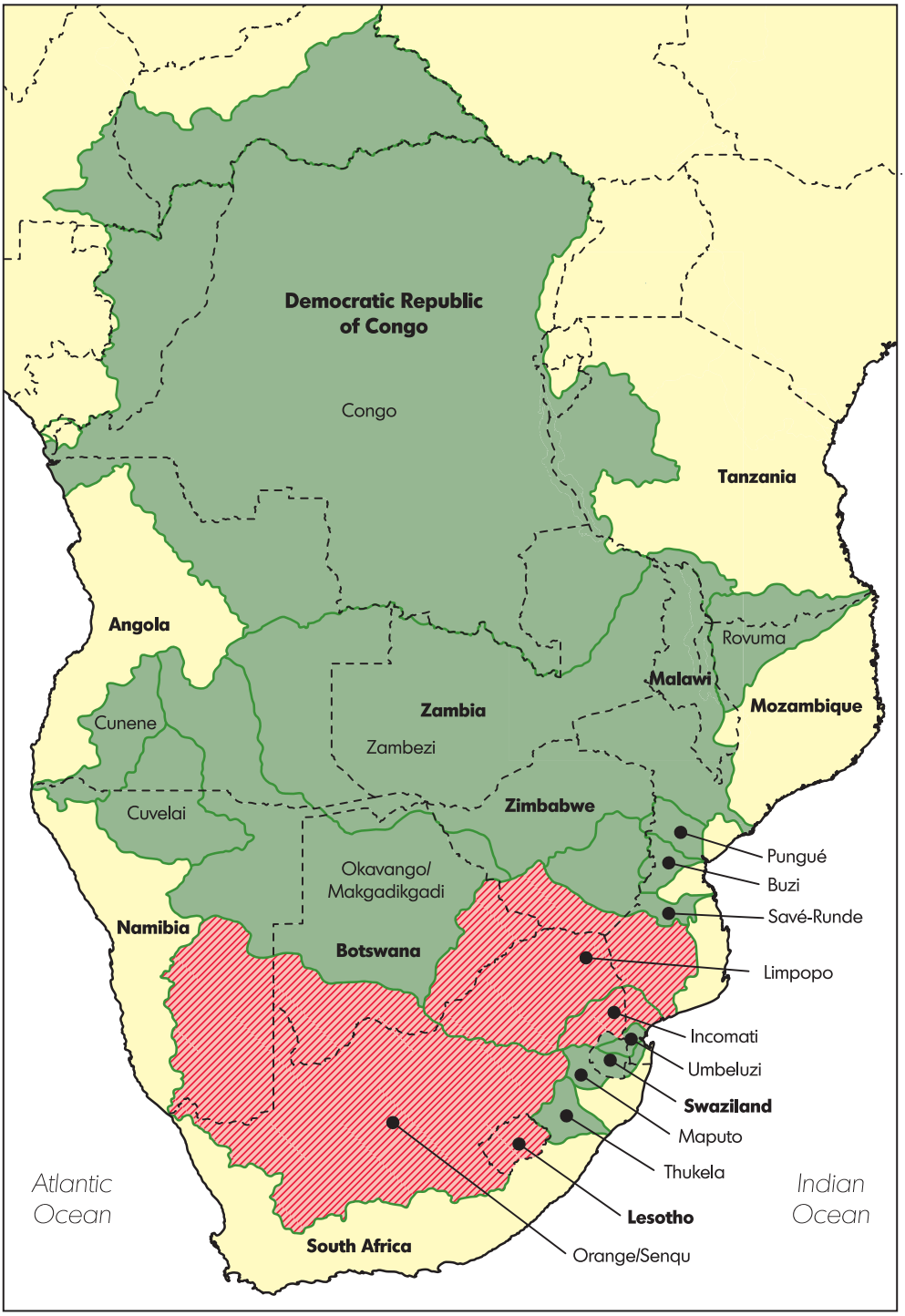


Source: Turton AR, Ashton PJ & I Jacobs, *op. cit.*

pivotal states that depend on them for economic development (see figure 4 on page 13).

Having defined the 21 transboundary river basins to which a SADC member state is riparian in general terms above, it is now possible to zoom in on specific basins in order to

Figure 8: Closed transboundary rivers in the SADC region



Source: Turton AR, Ashton PJ & I Jacobs, *op. cit.*

obtain a better understanding of their physical characteristics. As a point of departure, it is important to note that there is very little public domain data on river volumes and flows. While it is true that many river basins have been studied in great detail, these studies are

mostly consultants' reports commissioned by specific riparian states, which means that the data contained in these documents are usually not available to the general public. This is a significant challenge that needs to be addressed.

Table 3 provides a rough indication of the relative size of the major transboundary basins in the SADC region in terms of their area and volumetric flow. It is clear that greater effort is needed to improve the quality and availability of this data.[23]

Table 3: Physical description of the major transboundary rivers in the SADC region

Basin	Total basin area (km^2)			River length (km)	Mean annual runoff (mm^3/yr^{-1})
	Pallett	UNEP	Wolf		
Buzi	31 000	–	–	250	2 500
Congo/Zaire	3 800 00	3 669 100	3 669 100	4 700	1 260 000
Cunene	106 500	110 000	–	1 050	5 500
Cuvelai	100 000	–	–	430	Ephemeral
Incomati	50 000	46 000	46 000	480	3 500
Limpopo	415 000	414 800	414 800	1 750	5 500
Maputo	32 000	30 700	30 700	380	2 500
Nile	2 800 000	3 038 100	3 038 100	6 700	86 000
Okavango/ Makgadikgadi	570 000	706 900	706 900	1 100	11 000
Orange/Senqu	850 000	945 500	945 500	2 300	11 500
Pungué	32 500	–	–	300	3 000
Rovuma	155 500	151 700	151 700	800	15 000
Savé–Runde	92 500	–	–	740	7 000
Umbeluzi	5 500	10 900	10 900	200	600
Zambezi	1 400 000	1 385 300	1 385 300	2 650	94 000

Sources: Columns 2, 5 and 6: Pallett J *et al., Sharing Water in Southern Africa*. Windhoek: Desert Research Foundation of Namibia, 1997; column 3: UNEP (UN Environment Programme), *Atlas of International Freshwater Agreements*. Nairobi: UNEP & Corvallis: Oregon State University, 2002b; column 4: Wolf AT (ed.), *Hydropolitical Vulnerability and Resilience along International Waters: Africa*. Nairobi: UNEP, 2006.

The data presented in figure 8 on page 19 shows that three of the transboundary river basins — the Incomati, Limpopo and Orange/Senqu — have all reached (or are about to reach) the point of full allocation and are now closed (where all available resources have been allocated to productive activities) or are approaching the point of closure.[24] This means that these three basins, called pivotal basins in the SAHPC (see figure 1 on page 9, figure 4 on page 13 and Turton[25]), are all likely to have deteriorating water quality in

the future. This is already happening in South African portions of these basins, where a number of drivers of poor water quality are occurring. These include eutrophication, which is a process whereby nutrient enrichment, specifically nitrogen and phosphate, often associated with sewage treatment processes, results in the rapid proliferation of toxic microcystin-producing single-celled organisms known as *cyanobacteria* (or blue-green algae[26]), which have the capacity to produce a range of human health problems ranging from cancer to skin lesions; endocrine disruptors,[27] which generally impact on biological functions that define gender; the contamination of rivers draining gold-mining areas by radionuclides and heavy metals,[28] which have a range of unintended consequences, ranging from cancer to the sterilisation of water bodies; and excessive sulphate concentrations[29] arising from coal-mining activities, which reduce agricultural potential by increasing salinity in rivers and soils.

Unfortunately, no reliable data is available at the regional level to provide an indication of water quality trends. What can be said is that there is a general trend in the SADC region towards a deterioration of water quality.[30] One of the drivers of this is the unique developmental pattern in the region, where a number of the major cities or centres of economic development are located on watersheds rather than on rivers, lakes or the coast. This pattern is evident in Botswana, where both Gaborone and Francistown are located on watershed divides; Namibia, where Windhoek is close to the watershed divide; South Africa, where Johannesburg straddles the Orange and Limpopo watershed, with significant sewage return flows entering the upper reaches of the Limpopo; and Zimbabwe, where both Harare and Bulawayo are on watershed divides, with their drinking water sources downstream of sewage works draining the cities. This will be exacerbated as growing urbanisation results in increased numbers of slums around major cities.[31]

CHAPTER 3

BRIEF SUMMARY OF THE DEVELOPMENT OF THESE RESOURCES

Given the fact that the SADC region has the type of precipitation reflected in figure 1 on page 9, there has been significant development of hydraulic infrastructure in several places. Here it is useful to note that the World Bank has found strong correlations between economic development and water security.[32] It is therefore instructive to see where the hydraulic infrastructure that has become the basis of water security has been developed. South Africa, with the strongest and most diversified economy on the entire African continent, has the largest portion of that infrastructural development (see figure 9 on page 23), which shows all of the dams found in the mainland SADC region as registered with the International Commission on Large Dams).

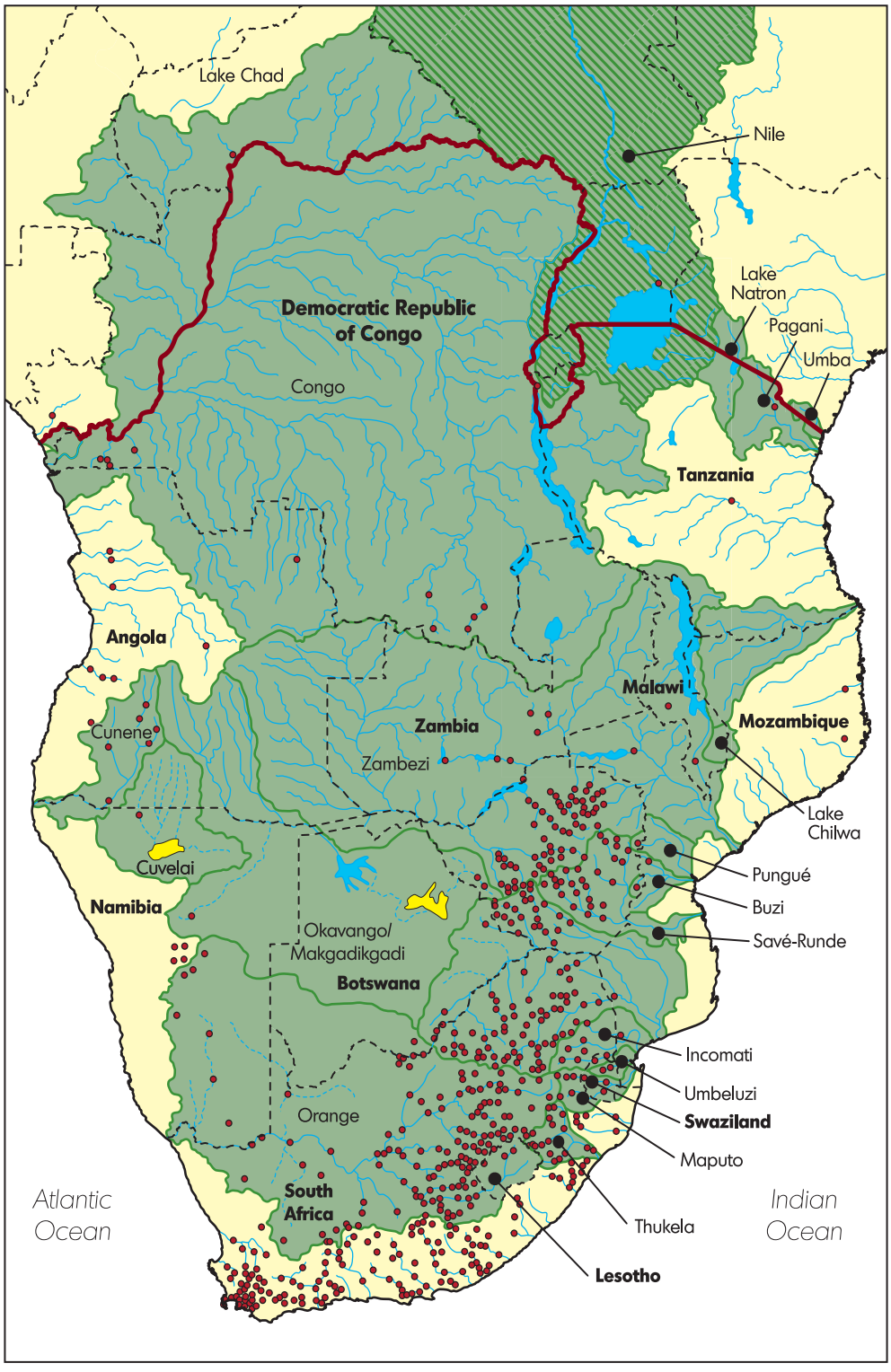
From figure 9, a number of characteristics are immediately apparent.

- There is a distinct clustering in South Africa and Zimbabwe, where in many cases river flows have become fully controlled by a series of dams.
- The rest of the SADC region has relatively few dams. Namibia has a distinct clustering around Windhoek on the watershed divide.
- Angola has a number of dams, but at nowhere near the same density as that found in Zimbabwe and South Africa. Beyond that, the SADC region has very few dams.

It is safe to conclude that if economic growth is to become a driver of regional integration, then a key element of that development strategy has to be the development of infrastructure that is needed to improve the water security and hence the economic foundation of the entire region.[33] Namibia has popularised this conclusion,[34] specifically through the person of Piet Heyns, the former permanent secretary of the Ministry of Agriculture, Water and Rural Development, who advocates the increased use of inter-basin transfers (IBTs). The present author is of the view that the economic developmental aspirations of SADC are hard to imagine without serious consideration being given to improving water security at the regional level.[35] This will need robust governance structures capable of dealing with complex issues like water allocation among states where a shared river is depleted by virtue of it becoming a donor basin, such as the Lesotho Highlands Water Project (LHWP), which depletes the Orange River for Namibia.[36] These governance structures would need to explore whether future strategies should include 'hard' engineering like IBTs, or 'softer' engineering approaches like groundwater recharge, specifically in basins like the Orange, where the total volume of dam storage is around 271.3% of the annual average flow of the river.[37]

One can learn much from the South African experience with respect to investment in hydraulic infrastructure, including dams and IBTs. Table 4 on page 24 shows details of some of these, specifically as they relate to transboundary rivers.

Figure 9: The distribution of large dams in the SADC region



Source: Turton AR, Ashton PJ & I Jacobs, *op. cit.*

Table 4: Inter-basin transfers in South Africa involving transboundary rivers

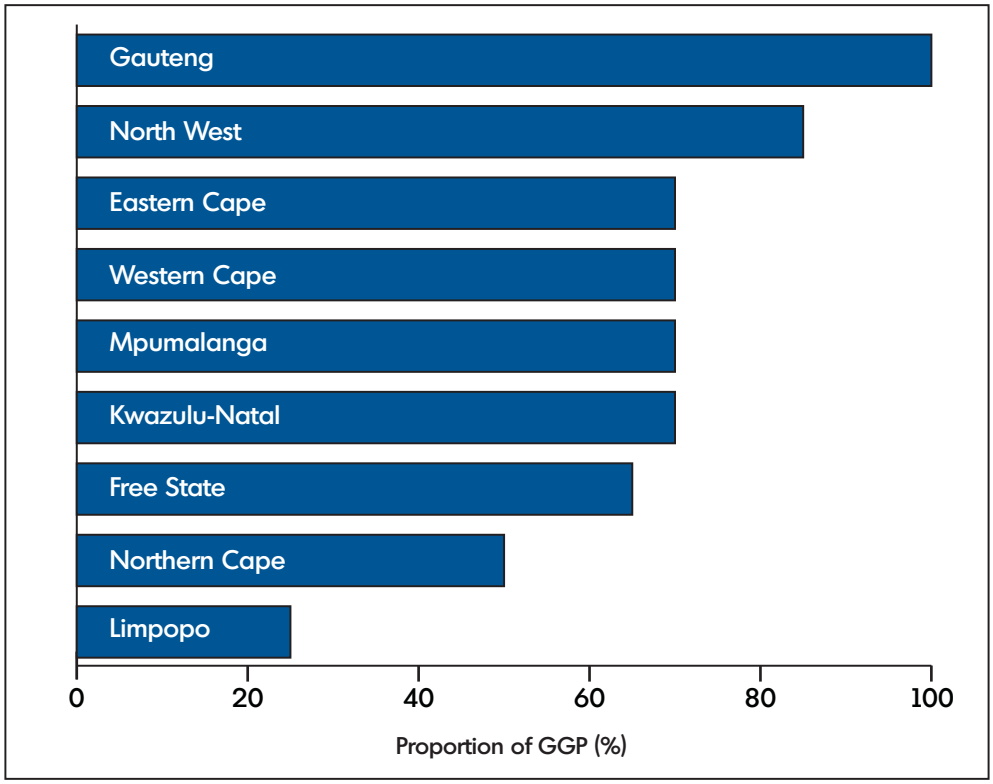
Name of transfer scheme	Source international basin	Recipient international basin	Average transfer ($10^6 m^3 yr^{-1}$)	Primary water use
Vaal–Crocodile	Orange	Limpopo	615	Industrial, domestic
Vaal–Olifants	Orange	Limpopo	150	Industrial (Eskom)
Olifants–Sand	Limpopo	Limpopo	30	Pietersburg
Crocodile–Limpopo	Limpopo	Limpopo	6	Gaborone
Komati–Olifants	Incomati	Limpopo	111	Industrial (Eskom)
Usuthu–Olifants	Maputo	Limpopo	81	Industrial (Eskom)
Assegaai–Vaal	Maputo	Orange	81	Industrial, domestic
Buffalo–Vaal	Non-international basin	Orange	50	Industrial, domestic
Thukela–Vaal	Non-international basin	Orange	630	Industrial, domestic
Orange–Buffels	Orange	Non-international basin	10	Industrial, domestic
Orange–Lower Vaal	Orange	Orange	52	Irrigation, domestic
Orange–Riet	Orange	Orange	189	Irrigation
Orange–Fish	Orange	Non-international basin	643	Irrigation, domestic, industrial
Fish–Sundays	Orange via Fish	Non-international basin	200	Irrigation, domestic
Caledon–Modder	Orange	Orange	40	Industrial, domestic
LHWP (1A)	Orange	Orange	574	Industrial, domestic
LHWP (1B)	Orange	Orange	297 (by 2003)	Industrial, domestic

Source: Turton AR, 'The political aspects of institutional development in the water sector: South Africa and its international river basins', DPhil thesis, Department of Political Science, University of Pretoria, 2003a.

These IBTs have resulted in massive economic growth for the country, but they have had unintended consequences. One of these is a loss of ecological integrity, which is often accompanied by a loss of biodiversity as flood pulses are lost to damming, increased

evaporation occurring over large open reservoirs, and the introduction of alien species and pathogens.[38] Another — potentially far more serious — impact is the dependence that arises from such infrastructure. Figure 10 below shows the gross geographic product (GGP) of each of South Africa's nine provinces supported by IBTs.[39] Eight of the provinces are reliant on IBTs for more than 50% of their GGP. Gauteng Province, which supports around 25% of the total population of South Africa, generates around 10% of the economic output of the entire African continent and is 100% reliant on the IBT of water. If that transfer were to stop for any reason, then that economic output would no longer be sustainable; so, while the hydraulic infrastructure underpins economic growth, it also creates vulnerabilities that need to be fully understood before such schemes are embarked on. This shows to what extent economic development is dependent on IBTs, but it also shows an increase in vulnerability as this dependence grows, specifically if future governments fail to appreciate the need to invest heavily in operations and maintenance of infrastructure, rendering such economic development vulnerable to collapse.[40]

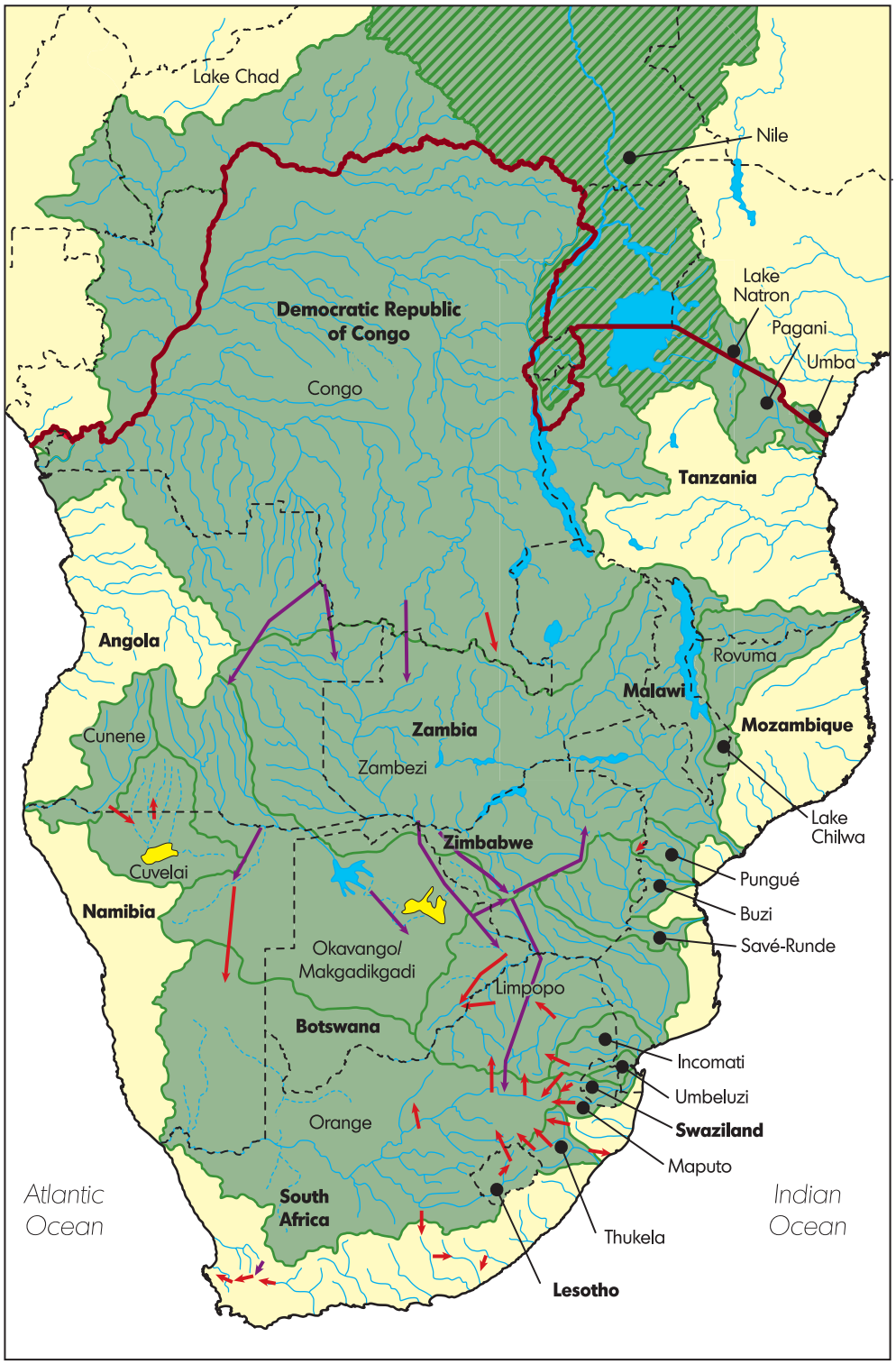
Figure 10: Gross geographic product of South Africa's nine provinces expressed as a function of dependence on IBT of water



Source: Adapted from Basson MS, Van Niekerk PH & JA van Rooyen, *op. cit.*

The key lesson emerging from the South African case is that IBTs improve the assurance of supply level, which in turn attracts investment, and so the economy starts to grow and diversify. This means that once water security has been established in an area that

Figure 11: Existing IBTS of water in the SADC region (red) and those considered or still under consideration (purple)



Source: Turton AR, Ashton PJ & I Jacobs, *op. cit.*

is actually hydrologically insecure (as with much of the SADC region), then economic development follows. The South African experience is thus fully compatible with the World Bank's view that it is impossible for a country to grow economically when it is still a 'hostage to hydrology'.[41]

Against this background, it is instructive to examine the regional planning situation with respect to IBTs. Figure 11 on page 26 shows all of the existing transfers (red arrows), or the transfers that have been mooted at some point in time (purple arrows). These plans are ambitious and at least some of them are probably needed if the SADC region is to optimally manage its water to drive regional integration. To succeed, a high premium will be placed on robust science to support decision-making processes that are accepted by all parties as being unbiased in favour of any specific national interest; and the existence of robust institutions capable of dealing with issues related to the integrity of shared data that are tasked with managing the complex range of issues arising from such ambitious hydraulic infrastructure development. The Transboundary Water Opportunity (TWO) methodology currently under development[42] will be in a position to assess if such complex and grand schemes are in fact viable, and, if so, to generate a robust project concept note that will be attractive to financiers of such massive engineering schemes.

The following question then arises: What is appropriate hydraulic infrastructure for regional integration? The simple answer to this is, 'We do not know', because the methodology used to calculate the costs and benefits at a regional scale has not yet been developed. In order to fill this gap, the TWO methodology is at an advanced stage of development.[43] This methodology has particular value in determining whether 'hard' hydraulic infrastructure like dams should be built as a foundation for economic growth in areas of high evaporative losses, as opposed to artificial recharge in confined aquifers, which entails the storage of water in confined aquifers rather than dams.

CHAPTER 4

BRIEF SUMMARY OF MAJOR RIVER BASIN GOVERNANCE INITIATIVES IN THE SADC REGION

A few specific river basins have been described in great detail. These include the six basins in the SADC region that Wolf and his co-researchers defined as being 'basins at risk' by virtue of their institutional capacity lagging behind demands being made on the resource base,[44] all of which have been described in considerable detail by the present author.[45] The analysis will consist of a physical description of each river basin, followed by a discussion of institutional development, which is summarised in table 5 on page 29. (The abbreviations and acronyms for the various regimes are those used in the discussions that follow, and are given in the list of abbreviations that appears at the beginning of this report.)

The six basins at risk identified by Wolf and his co-researchers[46] are listed in the first column of table 5. The second column lists the riparian states to each of these basins. Attention is drawn to the Okavango basin, which is listed as the Okavango/Makgadikgadi basin, because in reality the Okavango is a sub-basin of the Makgadikgadi basin, to which Zimbabwe is also a riparian on the Nata River.[47] For this reason, Zimbabwe is listed as a special case, as indicated by the asterisk in column 2. The third column lists the abbreviated name of each known international regime applicable to each specific river basin, as sourced from Turton and co-researchers.[48] The fourth column lists the abbreviated name of each known international regime that is applicable in a context other than within the specific river basin.[49]

INCOMATI RIVER BASIN

The Incomati River has three riparian states. South Africa is upstream, with a portion of one of the tributaries (the Komati) flowing through Swaziland and back again into South Africa, making the latter both an upstream and downstream riparian in the basin. The downstream riparian is Mozambique. The basin is strategically important to South Africa because the energy base of the country consists of coal-fired electricity generation, with most of the coal fields located across the watershed in the Limpopo basin. The Incomati and its various tributaries are a significant source of the water needed to convert coal into electricity. For this reason there are a number of water transfers out of the basin (see table 4 on page 24 and figure 11 on page 26), which can be regarded as a form of resource capture. The basin is important for Swaziland because hydropower is generated at the Maguga Dam on the Komati and irrigated agriculture forms the foundation of the local economy. The Mozambique portion of the basin lies in a semi-arid area that supports the population around the capital city of Maputo.

Table 5: Selected examples of transboundary river basins and regime evolution in the SADC region

Basin name	Riparian states	International regime	
		Basin level	Other
Incomati	South Africa Swaziland Mozambique	First use Second use TPTC JPTWC JWC1 KOBWA JWC2	SARCCUS SADC FP SADC WP SADC TCM NPA
Cunene	Angola Namibia	First use Second use Third use (PJTC) JOA Fourth Use	SARCCUS SADC FP SADC WP SADC TCM ANJCC
Limpopo	Botswana Zimbabwe South Africa Mozambique	First use Second use Massingir Dam TPTC JPTC LBPTC Molatedi Dam LWC	SARCCUS SADC FP SADC WP SADC TCM NPA JPCC
Okavango/ Makgadikgadi	Angola Namibia Botswana Zimbabwe*	First use Second use JPWC PJTC OKACOM	SARCCUS SADC FP SADC WP SADC TCM ANJCC
Orange/Senqu	Lesotho South Africa Botswana Namibia	JTC JPTC LHDA TCTA LHWC PWC VNJIS JIA ORASECOM	SARCCUS SADC FP SADC WP SADC TCM
Zambezi	Angola Zimbabwe Zambia Namibia Botswana Malawi Tanzania Mozambique	ZRA ZACPLAN ZAMCOM	SARCCUS SADC FP SADC WP SADC TCM ANJCC JCC PCC PJCC JPWC PJTC

* Basin state not part of OKACOM

Source: Turton AR, 2008b, *op. cit.*

The hydropolitics of the basin has been described in detail by a number of authors.[50] Table 5 ion page 29 shows seven different basin-specific regimes that have evolved over time. The foundation of this regime creation lies in an agreement that was entered into between South Africa and Portugal in 1926.[51] This agreement, commonly known as the First Use Agreement, was actually about the management of the Cunene River, but it also included so-called rivers of mutual interest between South Africa and Portugal, which was the colonial power of the time, controlling both Angola and Mozambique. While the First Use Agreement is primarily about the Cunene, it is also relevant to the Incomati, Maputo and Limpopo as well, because it laid the foundation for all future co-operative arrangements in these basins.

In 1964 the so-called Second Use Agreement was reached between South Africa and Portugal.[52] As with the earlier agreement, it was also applicable to the Cunene, Incomati, Maputo and Limpopo basins. In 1967 Swaziland acceded to the Second Use Agreement, showing the significance of this historic evolution from the Cunene and so-called rivers of mutual interest, specifically to the Incomati and Maputo. In 1983 the Tripartite Permanent Technical Committee (TPTC) became the first basin-wide regime in Southern Africa, applying to the Limpopo, the Incomati and the Maputo basins. This did not function well, largely because of the Cold War, the civil war in Mozambique and the independence struggle in Zimbabwe, which strained relations between South Africa and Mozambique.[53] As a direct result of this failure, a bilateral agreement was reached between Swaziland and Mozambique in 1991, called the Joint Permanent Technical Water Commission (JPTWC), but it did not function well.[54] Two bilateral agreements were then negotiated between South Africa and Swaziland in 1992.[55] The first established the Joint Water Commission (JWC1)[56] and the second established the Komati Basin Water Authority (KOBWA). This was based on the successful model that had evolved from the LHWP. In 1996 a Joint Water Commission (JWC2) was established bilaterally between South Africa and Mozambique, to manage both the Incomati and Limpopo basins.[57]

With the cessation of hostilities associated with the end of the Cold War, the civil war in Mozambique came to an end and apartheid collapsed in South Africa. This acted as a strong stimulus for the normalisation of relations among all riparian states, which was done through the rejuvenation of the TPTC, which was the first basin-wide regime to have been created in the region. This was brought to a successful conclusion when the Incomaputo Agreement was signed in 2002.[58] This is a complex agreement recognising the rights of all riparian states, along with detailed water allocation and water quality formulae.

From this, it is evident that no less than seven different regimes have existed in the Incomati basin over time, not counting the smaller agreements that were negotiated in support of these agreements, and excluding the agreements that existed at a regional level, but were no less applicable. In the latter category, we find the Southern African Regional Commission for the Conservation and Utilisation of the Soil (SARCCUS), which was established in 1948. This has ten standing committees, one of which deals with water.[59] SADC was established in 1992 when the SADC Founding Protocol (SADC FP) entered into force after the collapse of the Cold War.[60] This created a regional political framework through which all future interstate relations would be structured. While this is not a water agreement, it is a profoundly important regime, because it creates the enabling environment through which all other interstate relations are regulated, including water.

It comes as no surprise, therefore, that the very first issue-specific protocol to be signed after South Africa became a member of SADC, was the SADC WP, which was signed in Johannesburg in 1995.[61] The SADC Protocol on Transport, Communications and Meteorology (SADC TCM) was signed by 12 member states in Maseru on 24 August 1996, establishing a regional co-operative framework for infrastructure and meteorological affairs. The Nkomati Peace Accord (NPA)[62] was signed in 1984 between South Africa and Mozambique, in the hope that a non-aggression pact could form the foundation of interstate relations during the years of intense military conflict. There are consequently at least four non-basin specific regimes that are applicable to the Incomati basin, as well as a non-aggression pact that created an enabling environment for water resource management to be used as an instrument for peace.

In conclusion, the Incomati basin has at least seven basin-specific regimes, four non-basin-specific regimes and one non-aggression pact. It also contains the first basin-wide regime ever created in the Southern African region, which was dysfunctional during the height of the hostilities associated with the Cold War and the struggle for independence in Southern Africa, but which survived nonetheless and is fully functional today. This comprehensive basin-wide agreement recognises the right of all riparian states to specific volumes of water, elaborates water-sharing formulae and specifies water quality standards. In short, the institutions in the Incomati have survived difficult years, showing a high level of resilience, and have evolved substantially since 1999. The KOBWA agreement is a complex bilateral arrangement with specific water allocation formulae, and it is nested within the larger basin-wide arrangement known as the Incomaputo Agreement.

CUNENE RIVER BASIN

The Cunene River basin is a relatively uncomplicated basin. There are two riparian states — Angola upstream and Namibia downstream — with the river forming a significant part of the border between these two countries. The real significance of this basin lies in three specific issues. Firstly, it is one of the few that has actually seen military action, with attacks on hydraulic infrastructure forming a feature of the hydropolitical history of the basin. Secondly, it is strategically important for the downstream country due to its hydropower potential and because it supports the people in central southern Angola and economic activity for a large portion of the Namibian population. Finally, the Cunene is a strategic water donor for the adjacent Cuvelai basin, which is an ephemeral river system that supports a major part of the Namibian population and is thus of great political and social importance. It is therefore impossible to understand the Cuvelai without also appreciating its link to the Cunene.

The hydropolitics of the basin has been described by a number of authors.[63] The foundation of regime creation was the First Use Agreement between South Africa and Portugal, which was finalised in 1926.[64] This was followed in 1964 with what became known as the Second Use Agreement.[65] Both of these agreements were specific to the Cunene, although they also dealt with other rivers of mutual interest between South Africa and Portugal. With the planned development of the hydropower capacity around Ruacana and Calueque, an agreement was reached between South Africa and Portugal in 1969 (Third Use Agreement), creating the Permanent Joint Technical Commission (PJTC) and

the Joint Operating Authority (JOA), but these never really got off the ground due to the war. Engineering started on the Calueque Dam, the Ruacana hydropower scheme and the Cunene–Cuvelai IBT, but this was disrupted at different times because of the war.[66] Regime development became stalled during the various wars that occurred in the Cunene basin, but immediately after hostilities had ended, the Fourth Water Use Agreement was reached between Angola and Namibia in 1990 reinstating the PJTC, which was charged with the responsibility of managing, among other things, the Epupa Dam hydropower scheme and the supply of water to northern Namibia.[67] At the same time, another agreement was reached between the two riparian states that re-established the JOA, which was charged with the responsibility of managing the regulating structure at Gové Dam and the Ruacana hydropower infrastructure.[68] Included in the ambit of the JOA was the repair of the Gové Dam arising from damage caused by military action.

From this assessment, it is evident that at least five regimes have existed regarding the Cunene River, excluding the non-basin-specific agreements, of which five exist. Four of these (SARCCUS, SADC FP, SADC WP and SADC TCM) have been described in the section on the Incomati. The fifth is the Angolan–Namibian Joint Commission of Co-operation (ANJCC), which was formed in 1990.[69] This is an enabling instrument that has a large number of functions, all of which are of a co-operative nature, one of which relates to water resource management.

LIMPOPO RIVER BASIN

The Limpopo River basin has four riparian states.[70] Botswana is upstream of certain tributaries and has a very arid climate. South Africa and Zimbabwe are in the middle reaches of the basin, with the border between them being formed by the main stem of the Limpopo River. Mozambique is the downstream riparian where the Limpopo meanders across a huge flood plain. There are no dams on the main stem of the river where it forms an international border, so there has never been a need to jointly manage hydraulic infrastructure. There is the possibility of future dams on a tributary that divides South Africa and Botswana.[71] The basin is strategically important to each country for different reasons. For Botswana, it supports the bulk of the human population that live in a belt wedged between the Kalahari Desert and the narrow belt of better-watered land adjacent to the South African border. For South Africa, it sustains a lot of mining and agriculture, as well as a large human population, and it also forms a substantial ecological resource for the Kruger National Park. For Zimbabwe, it is the only reliable and significant source of water other than the Zambezi, which for political reasons is impossible to develop for irrigated agriculture. In Mozambique, the Limpopo is the only reliable water in a very arid portion of the country with a moderate population density.

The river basin is closed — or rapidly approaching closure — and most of the water in the South African portion of the basin has been over-allocated. There is no chance for substantial future development of the resources, although some dams are still being considered, so a major challenge in the basin relates to three specific issues.

- Firstly, the need to reallocate water out of the agricultural sector to the industrial sector is a pressing and complex one.

- Secondly, water quality management is a growing concern, specifically as the result of non-point source pollution arising from mine closure, acid mine drainage, sewage effluent return flows promoting blooms of potentially toxic cyanobacteria[72] and endocrine-disrupting chemicals.[73]
- Finally, equity issues are of major concern, with a number of different dimensions to this problem. International equity relates to water-sharing arrangements, specifically with Mozambique having been disadvantaged over time. Intergenerational equity relates to ecological flows through the Kruger Park. Racial equity issues are specific to South Africa, where historically disadvantaged farmers in particular have the need for reallocation and government support. Recent land claims have reallocated farms to communities that were previously dispossessed, and their expectations are high, placing additional demands on the already over-allocated resource.

The hydropolitics has been described in detail by a number of authors.[74] The evolution of water management regimes has been complex, as shown in table 5 on page 29, with at least eight basin-specific regimes. As with the Incomati and Cunene basins, regime creation started in 1926 with the First Use Agreement.[75] Following a similar trajectory to these other basins, the Second Use Agreement was signed in 1964. Evolving from these rivers of mutual interest agreements was the Massingir Dam Treaty, which was signed in 1971,[76] allowing the development of a dam downstream from the Kruger Park in Mozambique. In 1983 the TPTC was established among South Africa, Swaziland and Mozambique, significantly leaving out Zimbabwe. The reason for this omission was Zimbabwe's refusal to join the Constellation of Southern African States that had been proposed by South Africa as a non-aggression pact based on regional economic development.[77]

Zimbabwe became particularly belligerent towards South Africa in 1980, placing pressure on the so-called Front-line States to join forces in the struggle against colonialism, capitalism and racism, which they did by founding the Southern African Development Coordination Conference.[78] A low-intensity civil war in South Africa got under way as a direct result of this, with the first military attacks inside the country occurring after the announcement by the African National Congress that it would intensify the armed struggle.[79] In 1983 a car bomb was detonated outside Military Intelligence Headquarters in Pretoria, taking the war right into the heart of the Limpopo basin. It was against this political background that the decision was taken to exclude Zimbabwe from the TPTC, which was designed to foster better relations with the other riparian states in an attempt to offer sufficient development inducement to them not to allow their territories to be used by guerrilla forces infiltrating into South Africa. This is why the NPA was signed in 1984,[80] so that a non-aggression pact could form the foundation of interstate relations in all fields of development, including water resource management.[81]

As a result of the exclusion of Zimbabwe, the TPTC did not function very well, so a bilateral regime was negotiated between South Africa and Botswana during 1983, giving rise to the Joint Permanent Technical Committee (JPTC).[82] This was followed in 1986 by the establishment of the Limpopo Basin Permanent Technical Committee (LBPTC) with all four riparian states as signatories.[83] This took place after the NPA came into effect, which served to stabilise interstate relations to the extent that joint development of the resource again became feasible. Botswana was experiencing an acute water shortage in its capital, Gaborone, so an agreement was reached in 1988 for a cross-border supply

from the Molatedi Dam. This agreement has escaped the notice of most scholars, because it was negotiated at the height of apartheid and it involved the so-called independent bantustan of Bophuthatswana. Given the strategic significance of water and the need to secure the supply for Gaborone, the government of Botswana overcame the political dilemma of negotiating with a bantustan by having the agreement signed by its national water utility rather than by a government department.[84] The bilateral JPTC was upgraded to a full commission in 1989. Regime evolution was completed in 2003 when a basin-wide agreement was reached among all riparian states to establish the Limpopo Watercourse Commission (LWC).[85]

From this, it is evident that there are eight basin-specific regimes pertaining to the Limpopo River. In addition to this there are six non-basin specific regimes that are relevant to the Limpopo. The SARCCUS, SADC FP, SADC WP and SADC TCM have been described in the section on the Incomati River, so they will not be discussed further. The NPA is also relevant to the Limpopo, because it created an enabling environment that eventually led to the normalisation of relations between South Africa and Mozambique, and hence over time played a role in the evolution of the basin-wide LBPTC and subsequent LWC. Hydropolitical scholars tend to ignore this fact by filtering out non-aggression pacts from datasets, on the pretext that they are not about water resource management. The bilateral agreement between South Africa and Botswana in 1997 that established the Joint Permanent Commission of Co-operation (JPCC) is also an enabling instrument that covers a range of issues from crime to migration, but significantly also includes water resource management.[86] Based on this evidence, it is clear that the Limpopo is no longer a basin at risk, having a number of regimes that have proven to be remarkably resilient over time. It must also be noted that the failure of the TPTC can be explained by the fact that it was a very ambitious agreement — in essence, an agreement among three sovereign states to manage three different river basins (one of which had four riparians) — something that exceeds the norms of contemporary river basin regimes.[87] Failure was therefore almost inevitable, simply because the scope of the intended regime was too wide in the first place. It should therefore be seen as a learning curve experience rather than a direct failure, remembering that river basin regimes are a relatively new phenomenon. Regime evolution in this case also provides evidence of the preference for bilateral arrangements after the failure of more inclusive basin-wide agreements. Significantly, however, this case also shows how basin-wide arrangements are negotiated once the political climate is conducive to the normalisation of relations. Under these conditions, the country that pulled out of the relationship for reasons of protest usually returned in a significantly weaker position than before.[88] There is consequently an important lesson to be learned from the Limpopo basin as a result of these hydropolitical dynamics.

OKAVANGO RIVER BASIN

The Okavango River basin has three riparian states, and flows from an area of high rainfall into the Kalahari Desert, where almost all of the water is lost to evaporation in the Okavango Delta.[89] Technically, the Okavango is a sub-basin of the Makgadikgadi basin, of which the Nata River is also a component.[90] It is an endorheic system that does not flow into the sea, much like the Cuvelai basin alongside it. Angola is upstream and is well

watered, having access to a number of large river basins for its own national development. In the middle reaches of the system, it becomes one of only three rivers to flow across Namibian soil (the other rivers being the Linyanti River, a tributary of the Zambezi River, and the Fish River, a tributary of the Orange/Senqu), which it does for a short distance as it crosses the Caprivi Strip. This is the only well-watered part of Namibia. Botswana is downstream with a relatively large human population deriving livelihoods from the resource-flows associated with the Okavango River and its delta.

The Okavango Delta was created because of tectonic activity, with fault lines that are associated with the Great Rift Valley of Africa defining the physical boundaries and ecological dynamics of the wetland, which is also a Ramsar site.[91] There is a hydraulic connection to the Zambezi River via the Selinda spillway, with back flooding into the Okavango during periods of extreme high flow in the Chobe/Linyanti/Zambezi.[92] On occasion, the Okavango Delta floods over the Thamalakane fault line via the Boteti River into the Makgadikgadi salt pans, which are also fed by the Nata River, which comes into Botswana from Zimbabwe. Therefore, depending on how one defines the overall river basin, there are either three or four riparian states. The basin is strategically important to each of the riparian's for different reasons. Almost all (>95%) of the surface flows in the Okavango River system arise in Angola[93] and the river system represents a potential hydropower and irrigation resource for the post-conflict reconstruction of an area that was devastated by the Angolan Civil War and Namibian War of Liberation. For Namibia, it represents the second most important river basin (after the Cunene), with planning for the use of the resource as a strategic back-up, thereby allowing the dams in other parts of the Eastern National Water Carrier (ENWC) system to be drawn down to lower levels. This is important because of the high evaporation losses in Namibia, so a strategic reserve such as the Okavango will enable Namibia to make better use of its existing resources, secure in the knowledge that during times of drought, there will be a reliable back-up. A pipeline has been planned to draw water at the town of Rundu and transfer this to the existing ENWC, finally delivering it into the reticulation system that supports the capital city, Windhoek. Research is ongoing regarding the possible use of confined aquifer systems for the storage of this water, in order to conserve as much of the resource possible from evaporative losses. For Botswana, it represents a substantial resource for rural livelihood support, as well as the generation of foreign currency through ecotourism. Botswana has previously tried to use the resource for mining, but this was vigorously opposed.[94] If Botswana does develop the resource, then it opens the door to Namibian plans, so there is somewhat of a checkmate situation prevailing. Public pressure in Botswana is high, where Namibia is portrayed by the media as being the 'bad' neighbour intending to dry up the Okavango Delta.[95] This rhetoric is devoid of any truth, and the Namibian government is known to be responsible, with a track record of co-operation throughout its short but stable existence.

The hydropolitics of the basin has been described by a number of authors.[96] A significant feature of the basin is that it is internationalised via a global stakeholder in the form of the environmental movement that will not allow the Okavango Delta to be harmed in any way,[97] even though the best available scientific research has shown that the proposed pipeline in Namibia will have an impact so small that currently available technology will be unable to measure it.[98] The basin was also the scene of intense fighting during the Namibian War of Liberation and the Angolan Civil War.[99] As with the Cunene

and Cuvelai basins, the Okavango saw heavy fighting with substantial loss of life and the total destruction of all infrastructure. There are many minefields throughout the basin, most of which are unmapped. There is consequently a major role to play in post-conflict reconstruction, with water resource management being a key instrument for the return to reasonable levels of household food security.

The number of regimes in the basin is presented in table 5 on page 29. As with the Incomati, Cunene and Limpopo basin's noted above, regime creation started with the First Use Agreement in 1926. This was followed in 1964 with the Second Use Agreement.[100] This facilitated contact between the Angolan and Namibian authorities, although the latter were at that time South African citizens, because Namibia was being administered as a de facto province of South Africa under UN mandate. Regime creation stalled from 1969 to 1990 because of the Namibian War of Liberation, the Angolan War of Liberation and the Angolan Civil War, during which time hydraulic installations became the target for military forces.[101] In 1990 a bilateral agreement was signed between Botswana and Namibia that established the Joint Permanent Water Commission (JPWC) for the management of both the Okavango and the Chobe–Linyanti–Zambezi transboundary aquatic ecosystems. This is one of the few river management regimes that has groundwater management as a component to it. As hostilities receded, a bilateral agreement was reached between Angola and Namibia, endorsing the Third Water Use Agreement that was reached between the former colonial powers in 1969, creating the PJTC.[102] As the Cold War ended, the political processes started to normalise, and South Africa gave Namibia its independence. This led to the Permanent Okavango River Basin Water Commission (OKACOM) being created in 1994. It is significant that this happened shortly after Namibia gained its independence, lending credence to the finding by Gleditsch[103] and his team that water scarce states have substantial long-term incentives to develop water management measures that avoid conflict. It also happened at a time when the Kasikili/Sedudu Island dispute was referred to the International Court of Justice (ICJ) for a ruling, thereby settling the issue in a peaceful manner.[104]

Consequently there are five basin-specific regimes at work within the Okavango River basin. These are supported by five non-basin specific regimes, all of which have been described already (SARCCUS, SADC FP, SADC WP, SADC TCM and ANJCC). Based on the balance of evidence presented, the Okavango River basin is probably no longer a Basin at Risk, although it has had little substantial institutional development since 1999, and the outbreak of regional peace is allowing post-conflict reconstruction to be considered for the first time.

ORANGE RIVER BASIN

The Orange River is a complex basin. Unlike many of the other basins at risk defined by Wolf and his co-researchers,[105] there has never been any prolonged military conflict in the Orange basin during modern times (post-Second Anglo–Boer War). Where it has existed it has been short, sharp and focussed, usually conducted by special forces with surgical precision, but once using conventional forces under SADC mandate during Operation Boleas.[106] The upper riparian is Lesotho, with a high economic reliance on South Africa. South Africa has a high economic dependence on the Orange, with a staggering 100%

of the GGP of Gauteng Province being dependent on inter-basin transfers involving the Orange system[107] (see figure 10 on page 25). Namibia is the downstream riparian with a high reliance on the Orange for economic activity in the southern portions of that country. Botswana is an interesting case, because it contributes no stream flow and uses none of the surface water in the basin, but it is riparian because of the ephemeral Nossob and Molopo Rivers, both of which form the border with South Africa, neither of which have made a measurable hydraulic contribution to the Orange in living memory. Botswana has made use of its legal rights to engage in all the activities of a 'normal' riparian state, and by so doing has opened the door to future water supply from the LHWP, which is technically feasible, but probably too expensive to be realistic at this time. Nonetheless, Botswana now plays an important role in decisions around the future development of the basin, wielding hydropolitical power beyond its own expectations because of the change in dynamics that it can create by voting either one way or another in the basin-wide management structure. It is for this reason that the details of the Zambezi River, explained in the next section, are so critically important within the overall framework of the SAHPC.

The Orange River is best understood in terms of six strategic issues.

- The first relates to the high reliance on the resource of South Africa and Namibia.
- The second relates to the complexity associated with water allocation away from the agricultural sector to industry and the services sector.
- The third relates to the deteriorating water quality, specifically associated with managing an almost closed river basin, where base flow in years of drought is adversely affected by effluent return flows[108] and specific pollution arising from acid mine drainage.[109]
- The fourth relates to good neighbourliness, as enshrined in the South African National Water Act,[110] which stipulates that minimum ecological flows and volumes agreed to in specific water sharing regimes must be adhered to. This Act is unique globally because it gives the environment a right to water, which is not found in any other water law known to the author. At the heart of this issue is the emotive aspect of balancing resource protection with resource use.
- The fifth relates to inter-basin transfers, a central feature of the Orange River system (see table 4 on page 24).
- Finally, the Orange River forms a border between Namibia and South Africa. The position of this border has been disputed for over 100 years,[111] making the Orange River an excellent case for an empirical study of how water resource managers deal with sovereignty issues that are typically conflict drivers in their own right, becoming more pressing under conditions of endemic scarcity.

The hydropolitics of the basin has been described by several authors.[112] Regarding regime creation, the basin history starts in 1948 with SARCCUS. The first major inter-basin transfer was developed in response to the Sharpeville massacre, taking water from the Orange River, via the Fish River to the Sundays River.[113] This marked the birth of the aggressive phase of the South African hydraulic mission, creating the mindset that water security was essential for future economic growth and political stability. In 1978 the Joint Technical Committee (JTC) was created to investigate the feasibility of what was later to become the LHWP. This led to the signing of the LHWP Agreement in 1986, which created the JPTC, the Lesotho Highlands Development Authority (LHDA) and the Trans-

Caledon Tunnel Authority (TCTA).[114] Various new agreements were signed, each dealing with specific issues as they arose, during the different evolutions of the LHWP. Details of these are excluded from this analysis for brevity. In 1999, the JPTC was upgraded to the Lesotho Highlands Water Commission (LHWC).

As the Cold War came to an end and South Africa could disengage itself from the various regional wars of liberation, the independence of Namibia became a reality. As a result the Permanent Water Commission (PWC) was established in 1999 between South Africa and Namibia. At the same time, the Vioolsdrift and Noordoewer Joint Irrigation Scheme (VNJIS) was developed. This scheme is interesting because the feed canal crosses the border between South Africa and Namibia, largely because of geophysical reasons, but this means that one canal feeds both countries, so there can never be a situation such as that which exists on the shared rivers between India and Pakistan. The Joint Irrigation Authority (JIA) was established to manage this scheme. As soon as Namibia became independent, negotiations were started on the establishment of the Orange–Senqu River Commission (ORASECOM), which came to fruition in 2000. This became the first basin-wide regime to be established in terms of the SADC WP, but the fourth to be established in Southern Africa.[115]

From this, it is evident that nine different regimes have evolved over time. While the initial focus was on bilateral arrangements between South Africa as the regional hegemon and the other riparian state,[116] a basin-wide regime was negotiated with relative ease when the circumstances were right. The two bilateral agreements both have complex water-sharing formulae, and the LHWP Agreement eventually formed the foundation on which the KOBWA, PWC and Incomaputo Agreement were based. This shows evidence of cascading from basin to basin, contrary to the global trend identified by Conca.[117] In addition to this, there are four non-basin-specific regimes — SARCCUS, SADC FP, SADC WP and SADC TCM — each of which has already been describe earlier in this report.

In conclusion, the Orange River basin is the most stable international river basin in the entire SADC region, with the highest number of basin-specific regimes, some of which occurred after 1999 when the initial basins at risk study was done. It has the most sophisticated water resource management structures, and the underlying agreements that have evolved over time have shown a deepening in complexity, to the point where they have become the foundation for subsequent agreements in the other basins at risk. More significantly, the Orange River case provides some of the best evidence in support of the SAHPC, because of the activities of Botswana, specifically in linking the Orange issue to the Zambezi problematic to be discussed in the next section.

ZAMBEZI RIVER BASIN

The Zambezi River is the most complex of all the basins at risk defined by Wolf and his co-researchers,[118] given the large number of riparian states (eight). With this large number of riparian states, it is a classic example of the likelihood of Pike's Law applying, given the inherent complexity of reaching consensus among so many different sovereign states, each with different levels of development and each with possibly opposing perceptions of its respective national interest. Pike's Law is named after Peter Pike, an engineer at ORASECOM, who observed that the level of effort needed to reach an agreement increases

by the cube of the number of participants involved. This was reworded by the present author into a hydropolitical principle stating that the likelihood of reaching an agreement decreases by the cube of the number of stakeholders involved.[119] This means that in basins like the Zambezi and Nile with a large number of stakeholders, the likelihood of reaching a basin-wide agreement is extremely remote, and where reached will be a product of the lowest common denominator and will take long periods of time (decades) to change. The Zambezi basin has been the location of different forms of military conflict during the Cold War period. In Angola, the rebel UNITA[120] movement had its headquarters at Jamba, between the Cuito River (a tributary of the Okavango) and the Cuando River (a tributary of the Zambezi). There was heavy fighting in this area, mostly of a conventional nature, and many minefields are still present. Further downstream, the Zambezi valley formed a theatre for the guerrilla activities associated with the Rhodesian Bush War, also known as the Zimbabwean War of Liberation or the Second War of Chimurenga.[121] The fighting here consisted mostly of skirmishes between government and guerrilla forces as they infiltrated from Zambia. Similarly, the rebel RENAMO[122] movement in Mozambique was based around Meringue and the Gorongoza massif, with heavy fighting in the Zambezi basin area.[123] It was here that the war was probably the most protracted and intense. The Beira corridor, a vital economic life-line for land-locked Zimbabwe, was threatened by RENAMO forces, prompting the Zimbabwe government to commit troops to the defence of this infrastructure on 31 May 1982. This is the background to the NPA, signed in 1984.[124] The armed conflict in the lower Zambezi basin was mostly of a guerrilla and counter-insurgency nature, with few of the conventional battles that were typical of the Angolan reach of the Cunene/Cuvelai and Okavango basins.

The hydropolitics of the basin has never been described accurately or in great detail, but some authors have covered aspects of the core drivers at work.[125] Regime creation in the basin dates back to the construction of the Kariba Dam in the 1960s, with the negotiation of the Zambezi River Authority (ZRA) for the sole purpose of managing the hydropower associated with the project. The ZRA is a bilateral arrangement between Zimbabwe and Zambia and it has a limited mandate. In the 1980s there was considerable foreign donor interest in the basin, and an initiative was launched to establish a basin-wide commission. Given the name of the Zambezi Action Plan (ZACPLAN), agreement was reached among the riparian states on the need for such an approach,[126] but this was largely a donor-driven initiative. One of the positive spin-offs from ZACPLAN was the drafting of the SADC WP, which the riparian states felt would be necessary to support the Zambezi Water Commission (ZAMCOM) when it was eventually established.[127] Agreement on the establishment of ZAMCOM has been reached among all riparian states, with seven of them signing the treaty on 13 July 2004 at Kasane in Botswana.[128] The eighth riparian state has committed itself to the agreement, but needs time for additional internal consultations. The ZAMCOM Agreement will enter into force when two-thirds of the signatory states have ratified it through their respective parliamentary systems. Until the ZAMCOM Agreement comes into force, the provisions of the SADC WP act as a surrogate basin-wide agreement.

There are also a number of regimes that foster co-operation among the various riparian states outside of the immediate ZAMCOM configuration. These are SARCCUS, SADC FP, SADC WP and SADC TCM, described in the Incomati basin section of this chapter. In addition to these, there is the ANJCC, which fosters co-operation between the Angolan and

Namibian governments in the field of water resource management. The Joint Commission of Co-operation (JCC) between Malawi and Tanzania, the Permanent Commission of Co-operation (PCC) between Malawi and Zambia, the Permanent Joint Commission of Co-operation (PJCC) between Malawi and Mozambique, the JPWC between Botswana and Namibia and the PJTC between Angola and Namibia all act in a similar way, by bringing together commissioners from the various countries, but in smaller groups where it is easier to gain consensus (with Pike's Law in mind). The NPA also played a role when it was linked to the revitalisation of the Cahora Bassa project within weeks of South Africa and Mozambique agreeing to the non-aggression pact.[129] This is not listed in table 5 because South Africa is not a riparian to the Zambezi. The existence of so many bilateral agreements raises the possibility of using parallel national action (PNA) as an approach to regional integration, as described by Nielsson[130] in general and the present author and his team in the specific context of water resource management.[131]

An interesting aspect of the Zambezi basin relates to the river as a component of the SAHPC. Three Zambezi riparians have a pressing need to secure water from the Zambezi in future (Botswana, Namibia and Zimbabwe), but there are subtle complications in each case. Zimbabwe has major water needs, but the Zambezi valley is so steep and high that the cost of pumping water out of the river makes it prohibitive.[132] This is one of the reasons why the Batoka Gorge Dam was mooted: by reducing the pumping head and by generating surplus electricity, it could allow Zimbabwe to use the resource. Zambia does not want to support the plan, however, and given the current (2009) state of the Zimbabwean economy, the government is unlikely to be able to mobilise the money needed for the project. Namibia has a pressing need for improved assurance of supply in the Windhoek area. This is why the Namibian government has announced its intention of building a pipeline from the Okavango River. This is being opposed on environmental grounds, much the same as the Botswana government's plans to use Okavango water for the Orapa diamond mine were opposed.[133] This is causing Namibia to look to the Zambezi for solutions. The one remedy is to build an IBT from the Zambezi into the upper reaches of the Okavango,[134] thereby creating a surplus for Namibia to use downstream, theoretically without reducing the base flow to the Okavango Delta. Botswana has a similar problem, but for different reasons. The Botswana energy base is derived from coal, but there is not enough water to generate sufficient steam. It cannot use Okavango water, because international environmentalists had vigorously blocked such plans previously.[135] This leaves only the Zambezi open as an option, but here there are problems. Both Namibia and Botswana have only a very small frontage onto the Zambezi River, in an area where the geology precludes dam construction. The only option open is to develop a co-operative basis for the use of the Zambezi and then to develop a communal pipeline that serves the interests of various stakeholders. Such a pipeline has been mooted by the Botswana government,[136] taking water from the Zambezi at a point where Namibia could also be serviced, then delivering water to Bulawayo in Zimbabwe via Francistown in Botswana, where it would connect to the existing north–south carrier at Selibe Pikwe, for onward delivery to the capital city, Gaborone.

This is an ambitious plan that would cost a lot of money, but it is one that has a viable future because it looks after the strategic interests of the three riparians in the Zambezi basin. What is really significant about the plan, however, is the way in which the Botswana government has shown that water could also be delivered to Pretoria in South Africa

through the same system. This is an attractive idea for the South African government, whose possible involvement in such an ambitious plan would ensure the economic feasibility by increasing the throughput of the system and increasing the investment base of the project. South Africa has been interested in the Zambezi River as a strategic supply of water in the past,[137] with some detailed planning having been done.[138] The post-apartheid South African government no longer harbours such aspirations, either in private or in official policy documents, but it was considering a major financial loan to Zimbabwe at the time of writing. This loan could create leverage for future negotiations about access to the Zambezi, if such access is deemed to be strategically significant by South Africa. Seen in this light, then, the strategic interests of four water-constrained states could be met, to the mutual benefit of all, including the riparians that lack the financial capacity to raise the funds to develop the necessary infrastructure. This is one of the key reasons why the existence of a hydropolitical complex in Southern Africa is so important, because it enables strategic trade-offs to be made at a level other than the river basin.

Another indication of interstate relations over water has been provided in the Zambezi basin. The Kasikili/Sedudu Island is in the Chobe River, a tributary of the Zambezi, on the border between Namibia and Botswana.[139] When Namibia became independent, a dispute arose over sovereignty of this small island. Tension rose when a flag was hoisted on the island by one country, prompting a vigorous response by the other. This evolved over time to an agreement to refer the matter to the ICJ at The Hague. The ICJ finally ruled in favour of Botswana, thereby settling the dispute in an amicable way. From this it is evident that the favoured channel for dispute resolution, at least between some of the Zambezi riparian states, is by recourse to legal processes.

In conclusion, the Zambezi basin has one functioning bilateral regime (ZRA), with a basin-wide agreement that is about to launch ZAMCOM. This commission does not yet exist formally, but the treaty has already been signed by seven of the eight riparians, is awaiting the ratification process and should enter into force soon. This is the result of decades of work under ZACPLAN. Compensating for the absence of a basin-wide regime is the existence of a large number of non-basin specific arrangements — ten in all — which is the highest number in this category of any of the basins at risk (see table 5 on page 29). While it was called a basin at risk by virtue of the absence of a dedicated river basin institution at the time of the initial Transboundary Freshwater Dispute Database study, the existence of the SADC WP can be regarded as a surrogate regime, because it provides the necessary legal framework. Significantly, however, the Zambezi basin has the largest number on non-basin-specific regimes in place (see table 5) and it also gives empirical evidence of the peaceful resolution of disputes by means of recourse to the ICJ. This trend should also be interpreted against the background of the global norm, with a direct relationship known to exist between the number of riparian states and the likelihood of a multilateral regime.[140] Very few international rivers with eight riparian states have negotiated a functioning basin-wide regime, so the absence of such an institution does not mean that the basin is still at risk. On the contrary, the fact that negotiations have taken so long suggests that the riparian states are taking the process very seriously indeed — an interpretation supported by the fact that the SADC WP was spawned from the ZACPLAN deliberations.

CHAPTER 5

THE WAY FORWARD

CHALLENGES FACING RIVER BASIN ORGANISATIONS

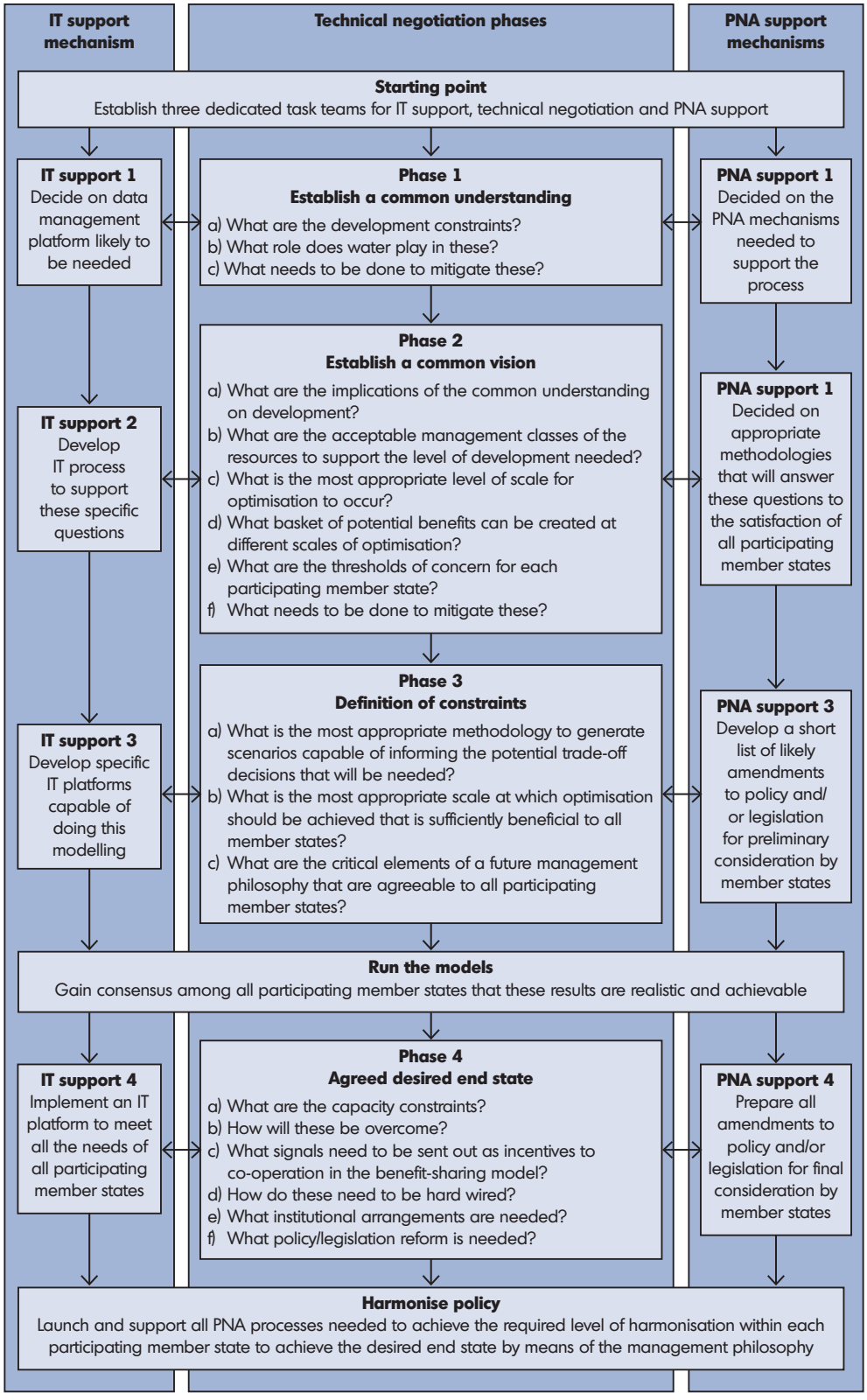
Recent work[141] has shown that RBOs face three clusters of challenges.

1 External challenges exist, mostly arising from the concept of sovereignty. Recent work by the present author[142] has shown that sovereignty can be managed in a way that does not erode state sovereignty, so this challenge is manageable. The issue here is the risk aversion of donors, who are fearful of embarking on a new governance experiment in case it fails.
2 Internal challenges exist, specifically around issues like stakeholder participation, the equitable allocation of a shared resource, and financial issues arising from an unclear mandate and an unclear legal status. Work currently under way by the South African Council for Scientific and Industrial Research (CSIR) in conjunction with the Stockholm International Water Institute (SIWI), GTZ[143] and the SADC Secretariat is focusing specifically on how these challenges can be overcome by means of a tool that supports the RBO while also improving stakeholder interaction by means of making useful information available. The issue here is how internal (sub-sovereign) management gets linked to international relations among sovereign states. Should this take place in one governance structure, or should there be a cascade of structures, each capable of dealing with specific issue types?
3 Cross-cutting issues arise, like the environment and gender, mostly driven by the concept of integrated water resource management. The approach presented in figure 12 on page 43 can be considered as a vehicle to overcome these constraints. In many cases, donors have a specific agenda, e.g. for gender mainstreaming, that is not necessarily consistent with the national priority in a given governance structure. The issue thus becomes how to set national priorities when these might clash with other priorities, either of co-riparian states or of other external stakeholders like donors.

ANALYSIS OF KEY RIVER BASIN GOVERNANCE THINKING FOR CONSIDERATION

Contrary to popular belief, water resource management in transboundary river systems is not a major driver of conflict in the SADC region.[144] Having noted this, however, it is important to understand that specific issues can drive conflict, and these need to be understood and managed in a proactive way. Three specific issues have the capacity to trigger conflict if left unmanaged. These are:

Figure 12: Proposed approach to harmonising interests in a transboundary river basin as the foundation for long-term investment programmes



Source: Turton AR, 2008c, *op. cit.*

1 water quality arising from waste disposal and mine closure;[145]
2 eutrophication arising from enrichment of water by nutrient return flows; and[146]
3 the presence of IBTs that take water from donor basins and divert flows to recipient basins, bringing wealth and prosperity to some while limiting future development options for others.

Given the serious need to balance regional water availability with reasonable development aspirations, specific attention needs to be given in the early stages of project planning to the establishment of an effective dispute resolution capability. One element of this can be investment in a robust methodology that is capable of mapping out costs and benefits in a way that is not considered by some member states as being too restrictive of their own sovereign aspirations. The TWO methodology currently under development[147] should therefore be monitored in order to determine what lessons are being learned from this technology development process that will have regional benefits.

Despite significant progress being made since the Revised SADC WP came into effect on 22 September 2003,[148] there is still a level of disconnect in the water-related policies of SADC member states.[149] There is, however, a high level of understanding of what these specific gaps are, with effluent-related management being a noted example.[150] Agreement already exists on the need for harmonisation,[151] with specific processes having already been discussed to a point of considerable consensus among member states. So while the absence of policy harmonisation is a problem, because economic growth and development across the SADC region are potentially constrained by the availability of water at a high level of assurance of supply,[152] it is not an insurmountable obstacle. There has certainly been considerable progress in the right direction, specifically with regard to the 'what' areas of policy — the known areas of harmony and gaps. The problem that now arises is how policy can be harmonised to the level needed for all aspects of water resource management (quality, quantity and assurance of supply) to become a robust foundation for the regional economic integration aspirations embodied within SADC.

SADC as an entity consists of an amalgam of member states, each with a different colonial heritage, resulting in different legal systems, different economic and developmental trajectories, different expectations among its citizens about the use of natural resources, and different levels of institutional capacity. This shifts the policy harmonisation context to the sensitive issue of sovereignty, which matters considerably, given that the price of national independence has been paid in blood, often after a protracted period of armed struggle for liberation.[153]

PRINCIPLES OF PARALLEL NATIONAL ACTION

Work done by the present author over a period of time has shown that a process known as PNA is viable in the context of transboundary water management.[154] The PNA process was the foundation for Nordic co-operation prior to the Scandinavian countries becoming members of the EU, so it has a robust history of success. PNA as practised by the Nordic Council organisations was based on three core normative principles that were seen to be inviolable.[155] It was these three normative principles that drove the co-operative behaviour

that ultimately led to policy harmonisation. These three principles are therefore very important if a PNA approach is to be considered by SADC.

The three fundamental principles on which PNA is based are as follows.

1 **The avoidance of constitutional fusion**: This means that at no time does co-operation imply an intention to eventually fuse two or more sovereign states together into a new sovereign grouping. This is manifested as a deep-seated aversion to the creation of any new form of bureaucratic structure or measures that would ultimately involve regional supranational authority.
2 **The expectation that the autonomous member states would remain the unalterable basis for regional integration in areas of low politics**: This reinforces the first principle noted above and means that by agreement among all participating states, the nation state remains the non-negotiable unit of engagement, retaining at all times the authority associated with sovereign independence as a nation state.
3 **The deliberate exclusion of areas of high politics such as national security from policy harmonisation processes**: This demarcates areas where consensus is likely to be reached by deliberately eliminating areas that are known to be divisive, which are typically those that challenge state or national security. It is for this reason that water resource management, if closely linked to national security, is unlikely to be the subject of high levels of policy harmonisation.

PARALLEL NATIONAL ACTION AS A VEHICLE

In order to create the necessary incentive for more powerful states in a given hydropolitical configuration to wish to negotiate a new policy dispensation, it is vital that 'space' must be created in which two critical objectives are achieved.

1 Learning must be fostered in order that the core problem being managed can be redefined to the point where a high level of unanimity exists. It is this learning process that slowly institutionalises data and the rules by which this data is eventually interpreted into a final decision. This is fully consistent with the concept of incrementality already agreed to within the context of policy harmonisation in the SADC region.[156] This iterative aspect of the PNA process, specifically where consensus seeking is the central dynamic, is highly conducive to the need for institutions and actors to learn by doing. This is a core element of what is being dubbed 'adaptive management'.[157]
2 Confidence must be fostered among all participating member states interested in a given harmonisation outcome that they are still in control of the process, even when it is a joint effort. It is here that the core process of moving back and forth into and out of the black box of PNA described by the present author[158] becomes a powerful tool. This hard-wired process gives participating member states the full confidence that in the final analysis they remain in exclusive control of the outcome where it affects areas of critical national interest. It is this aspect that gives the PNA process the advantage over earlier attempts at policy harmonisation within the SADC region.

It is therefore the professional opinion of the present author that PNA as a vehicle provides the necessary incentives to all participating member states engaged in the process of policy harmonisation, specifically when it is used within the context of a higher-level benefit-sharing framework.

POLICY RECOMMENDATIONS

Four specific areas can be highlighted for consideration.

1 There is a need for public domain data that is reliable and accessible in a format that is useful to a range of stakeholders. While this is a classic problem in transboundary river basin management, it is hoped that this is not an insoluble problem. In this regard, there is considerable potential within the SADC region to experiment with different tools that can meet this need. It is encouraging to note that GTZ, in collaboration with the SADC Secretariat, is currently investing in the development of a tool that can do so. The contractor is CSIR, working in conjunction with SIWI in Stockholm. This report would therefore like to draw attention to this process, because it is believed that once the tool has been developed, it will need to be tested in a real-life situation. Arising from this application will be a great deal of institutional learning that can then be fed into other regional processes.

2 As noted in table 1 on page 11, at least 22 aquifers are known to be transboundary in nature. As shown in figure 4 on page 13, these aquifers create a complex set of linkages with surface water resources. Significantly, little has been done by way of deepening our regional capacity to map out and characterise these resources. As a result, groundwater management is generally left to each member state to do in relative isolation, usually divorced from surface water management such as that practised in river basin commissions. As shown in figure 5 on page 14, the exact geographic extent of many of these transboundary aquifers has not been defined beyond a simple circle on a map. It is therefore vital that regional capacity be built in this regard. Specifically, we need to build the knowledge management and information-sharing capacity to map out the exact geographic extent of these transboundary aquifers, while also characterising the hydrogeological and geochemical parameters of each system. Similarly, we need to build the regional capacity to identify confined aquifers that can be considered for artificial recharge in the future. Artificial recharge is a strategic issue, specifically for countries where high evaporative losses occur from large storage impoundments, which is not receiving adequate attention in the SADC region. Parallel to this is the need to develop regional technology to make groundwater safe for human consumption, specifically in areas where high nitrates and fluoride levels pose human health risks. A specific risk is associated with the condition known as methaemoglobinaemia, sometimes called 'blue baby syndrome', which can occur when HIV+ mothers' bottle feed infants using contaminated groundwater.[159] The mapping process called for above should pay specific attention to this issue and indicate clearly on a map where such human health risks are likely to occur.

3 There is a substantial gap in our regional knowledge about existing agreements between/among states. While an earlier attempt was made by the UN Environment

Programme[160] to capture this data, which was subsequently refined by Wolf,[161] there are still massive gaps in our knowledge. Some of these gaps have been filled at the local level,[162] which has established a reliable database of all transboundary freshwater agreements to which South Africa is a signatory. It is necessary for consideration to be given to the establishment of a reliable central depository of all agreements (water, mining, industry, agriculture, etc.) relative to SADC to be created within the SADC Secretariat. This depository should contain the original text of such agreements and should be in the public domain, preferably in the form of an Internet-based tool. This is likely to foster co-operation, specifically among the various sectors, which is not strong enough at present, as each sector generally remains uninformed of interstate agreements within other sectors.

4 Environmental health is an emerging issue. In the context of rivers, this is associated with basin closure and the loss of dilution capacity. Emerging from this are five distinct subsets of environmental health that are not currently being addressed at a regional level. These are as follows.

Endocrine-disrupting chemicals: The key question here is what endocrine disruption is taking place at different levels, in order to start developing an appropriate regional response. Issues already known to be problematic are loss of human fertility,[163] the increase in children being born with both male and female genitalia,[164] and elevated levels of oestrogenicity.[165]

Mine water: The key question here is how to deal with a legacy of mining where mine closures that are likely to be felt across international political borders impact on society, in order that an appropriate regional response can be considered. A specific question centres on the need to understand what happens if heavy metals and radionuclides arising from mine activities enter the food chain via irrigation. Central to this is acid mine drainage and the impacts it might have on human health.[166]

Groundwater: Given the heavy dependence of rural communities, many of whom are extremely poor, on groundwater, there is a need to understand what regional interventions are appropriate for groundwater management. Known issues are methaemoglobinaemia[167] and cancer arising from long-term exposure to carcinogens in groundwater with a specific geochemical signature.[168]

Eutrophication: The key question that needs to be answered is how to manage eutrophication at a regional level. Specific subsets of this question relate to the development of transboundary water quality standards for sewage works discharging into rivers.[169] Other issues relate to the need to understand the implications of chronic exposure to microcystins arising from cyanobacteria blooms, specifically in communities with compromised immune systems.[170]

Climate change: The key question that needs to be addressed is how climate change is likely to impact on water resource availability, including the nature and extent of acid rain, which is likely to impact on regional food production by changing soil chemistry.[171] A closely associated question is that associated with the changes in disease vectors.[172]

CHAPTER 6

CONCLUSION

Water resources are vital for sustained economic growth and development in Africa. Given that most of these are shared across international political borders, this means that joint management is vital, raising the issue of governance structures. This report has shown that in the SADC region a highly nuanced situation exists. If this is extrapolated up to the continental level, then it is probable that an even more nuanced situation will be found. The SADC region has a political grouping that already exists and is also supported by enabling legislation such as the SADC WP. This is absent in other parts of Africa, which can potentially hinder the joint management of transboundary water resources from becoming drivers of regional integration and economic prosperity. Above all else, it is clear that water is far too important to become a driver of conflict between states. Parallel national action is a process that can be used to enhance co-operation by reducing any fear of the erosion of state sovereignty.

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