Water – and the Peaceful, Sustainable Development of the SADC Region

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By
Anton Earle and Daniel Malzbender
African Centre for Water Research (ACWR)
Cape Town, South Africa
antonearle@acwr.co.za

1. Water Resources of the SADC

Introduction

Southern Africa, in this report taken to refer to the 14 Southern African Development Community (SADC) countries, is marked by the natural climatic disparities between regions (refer to Figure 1: Countries of the SADC). National average depth of precipitation in the region ranges from a low of 285 mm/yr in Namibia to 1,543 mm/yr in the Democratic Republic of Congo (FAO, 2006).

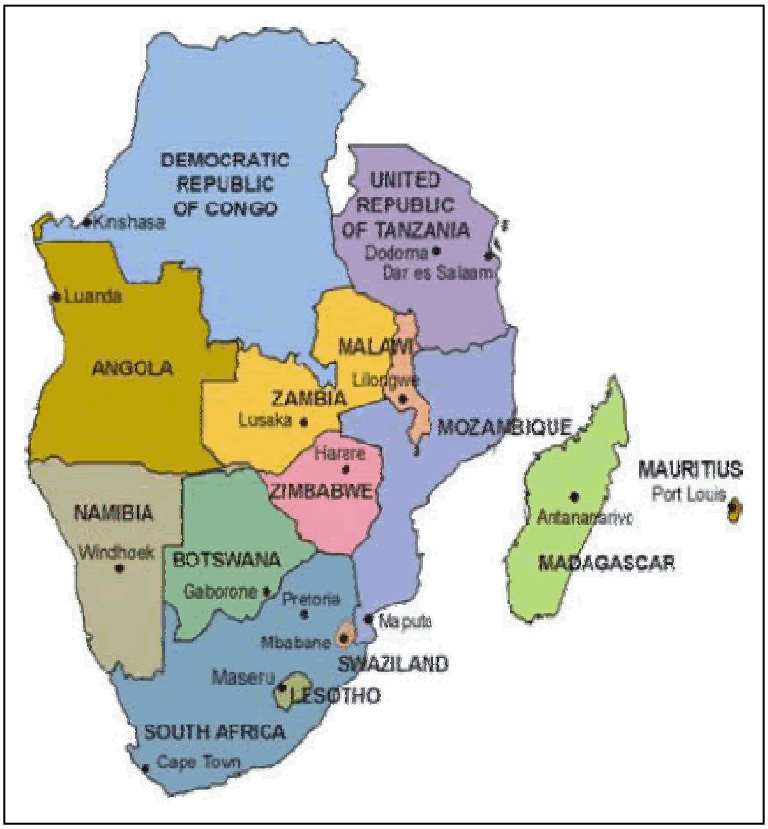

Figure 1: Countries of the SADC (SADC, 2005)

With an overall population growth rate of around three percent a year and an urbanisation rate of over six percent a year competition for water resources between sectors and users is bound to increase over the coming years (Hirji et al, 2002). There is great variation in water availability with countries such as South Africa and Zimbabwe having around 1,100 and 1,500 cubic metres per person a year respectively and Mozambique and the DRC having 11,000 and 22,000 cubic metres per person a year (FAO, 2006 see Appendix 1: Water resources of the SADC). In addition to this spatial variability there is also marked temporal variability in rainfall. Year-on-year variation around the long term norm for various parts of the region is as high as 30 – 35 percent (Hirji et al, 2002). This makes planning difficult and has a direct impact on livelihood security for the population of the region.

Generally, the greatest water demand in the region is in the states with the most limited supplies. The states with more abundant supplies of water, such as the DRC and Angola have tended to have lower levels of demand (SADC, 2005). Several of the countries in the region are currently classified as being "water scarce". This number is set to increase in the coming decades along with several becoming classified as being "water stressed" – that is, less than 1,500 cubic metres of water available per person annually (see Figure 2).

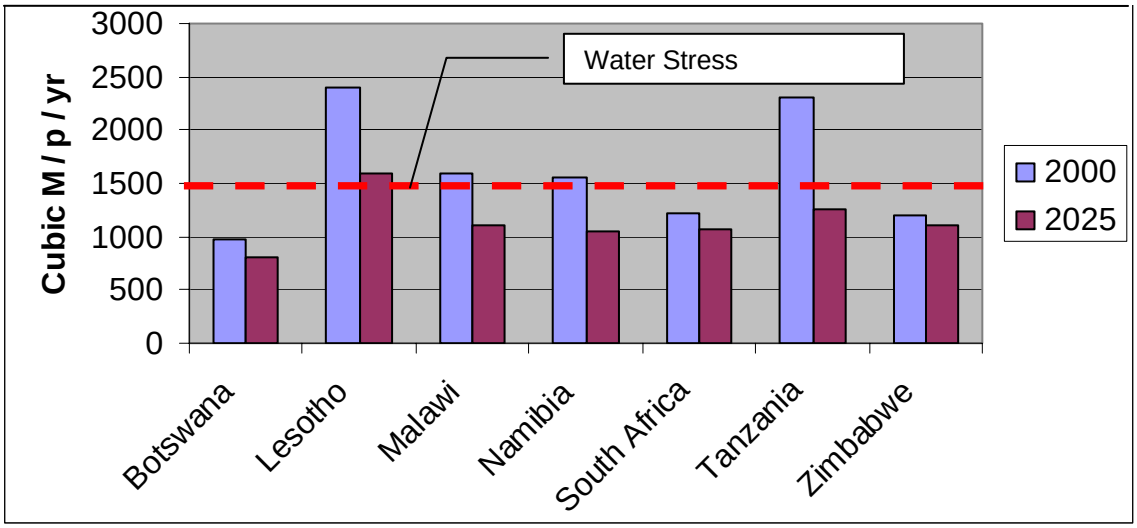

Figure 2: Water Availability in the arid SADC (after Ashton, 2002)

Of the 15 shared river basins in the SADC region three are projected to become severely water stressed by 2025 – i.e. less than 500 cubic metres of water available per person annually, while another five will face a moderate level of water stress – under 1,700 cubic metres per person annually (see Figure 3: Projected water stress by basin – 2025 (UNEP, 2005)). The increase in water use is driven partly by population growth, but also through trends such as urbanisation, industrialisation and increased agricultural activity in post-conflict countries. As the countries in the region become increasingly industrialised the sectoral demand composition will change from agriculture being by far the largest consumer of water (typically using over 80% of available supplies) to industrial, power generation and mining consuming a greater share. This creates a type of rural vs. urban competition for water, with the latter usually having a greater capacity to pay for water use. The temporal and spatial variability of rainfall in the region, coupled with increasing demand for water has led to large-scale water infrastructure being planned or constructed. The net result is that the southern Africa region accounts for around 40 percent of the dam storage volume of Africa – mostly for water storage and supply (FAO, 2006).

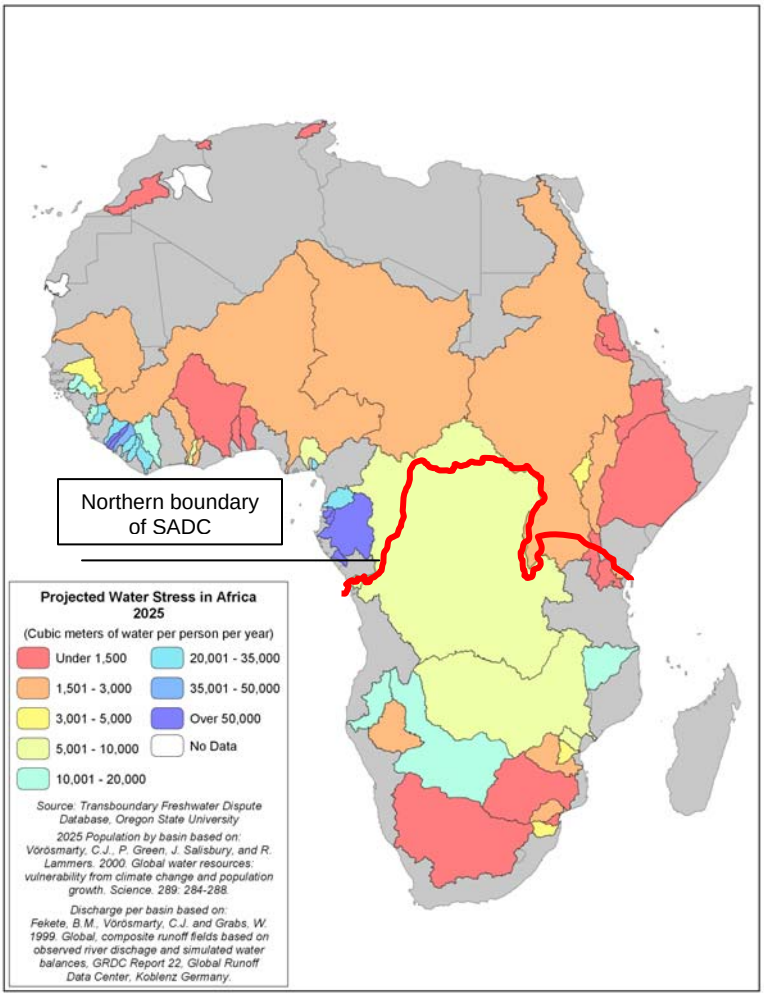

Figure 3: Projected water stress by basin – 2025 (UNEP, 2005)

In comparison, much of the water infrastructure developed in West and Central Africa is for hydro-power or navigation. Most of the countries in those regions are better endowed with water resources (in comparison with their population numbers) and have more predictable precipitation patterns (Turton et al, 2005). Some of these countries, such as the Republic of Congo and Gabon, are looking at exporting some of their "surplus" water supplies to drier countries. Although water scarcity in these regions is not such an issue, water access on the local level is poor, with many people not having a ready supply of clean water. Consequently many communities are affected by water-borne diseases (Turton, et al, 2005).

The North Africa region includes the Sahara desert, covering some of the driest places on the planet. Rainfall is typically low (under 200mm annually), with most rivers being ephemeral of nature. Several important transboundary aquifers support populations in this region, mainly drawing on reserves of fossil-water, dated at several thousands of years in age (Turton et al, 2005). Egypt, although receiving very little rainfall, sustains a large rural agricultural industry through irrigation using the waters of the Nile River. This provides it with a perennial source of secure water, although this situation may change as upstream states of the Nile start to exploit water resources in their territories. Most of the North Africa region has relatively high levels of water supply coverage.

Strategic Value of Water in the Region

Water has become of strategic importance to the economies of the SADC region, forming an input to various sectors, such as agriculture, industry, mining and power generation. In addition, water resources have the potential to be developed in such a way as to contribute to the achievement of food security and poverty eradication objectives. Thus in the SADC Regional Water Policy the statement is made that "The goal of SADC - "*the attainment of an integrated regional economy on the basis of balance, equity and mutual benefit for all Member States",* with three key SADC objectives – poverty reduction, food security, and industrial development – can best be achieved through development and management of the water resources of the SADC region" (SADC, 2005).

Water resources have been and will continue to be developed and managed in the region to promote agriculture, industry, mining and power generation, thus contributing to regional development. Increasingly it is being recognized that water needs to be secured to sustain biodiversity and natural ecosystems, including wetlands, which are the basis for rural livelihoods and for tourism (SADC, 2005). At present agriculture is by far the largest consumer of water in the region, using between 70 and 80 percent of available resources. Botswana and South Africa devote the lowest percentage of their water-use to agriculture – less than 60 percent, indicating that as the economies of the other countries in the region become increasingly diversified (reliant on industry, mining, tourism etc) agricultural water use will be placed in competition with other sectors of the economy.

Although most water is used in agriculture the amount of irrigated land (as a proportion of total cultivated area) in the region is low (see Table 1). Eleven countries have less than 10 percent of total cultivated area under irrigation, with five of these having less than one percent under irrigation.

Table 1: Irrigated area in relation to total cultivated area for SADC countries (adapted from FAO, 2006)

Percentage cultivated area under irrigation	Countries
Less than 1 %	Angola, Botswana, DRC, Lesotho & Namibia
1 to 10 %	Malawi, Mozambique, South Africa, Tanzania, Zambia & Zimbabwe
11 to 30 %	Madagascar, Mauritius, Swaziland

In some of the cases the lack of development of irrigated area has been due to political instability – several civil wars in the region have only recently ended. While rural populations may be able to carry on with rainfed farming under these conditions it would not be worth the risk to invest in irrigation technology. Thus much of the population of the region are still engaged in rainfed agriculture – placing them at the mercy of the variable climate. In most of the countries in the region there is a strong positive correlation between annual rainfall, output of staple foods and GDP (especially in the countries with a heavy reliance on the agricultural sector contribution to GDP). For example, during the 1991 to 1992 drought in the region the production of staples dropped by 70 percent in Namibia and around 45 percent in Zimbabwe (Hirji et al, 2002). The potential thus exists for large-scale development of water resources for irrigation in the region.

Thus a continued development of agricultural water use is likely to be impacted by the rapid industrial and urban development several SADC countries are experiencing. Water for mining and industrial processing is increasingly in demand in countries like Botswana, Angola, South Africa and Zambia. To keep pace with this rapid development the electricity production of the region will need to be stepped – in the process consuming more water. Water use by the industrial sector is projected to increase by a third by 2020 from 1995 figures – accounting for 20 percent of water used by then (Hirji et al, 2002).

At present the largest industrial water user in South Africa is electricity production – mainly as a coolant in coal-fired power stations in the east of the country. Although the consumptive portion of the total amount of water used is relatively low, much of the return flow is higher in temperature, with a variety of ecological impacts for recipient water systems. It is estimated that less than ten percent of the region's hydro-power potential has been exploited. In the coming years it is likely that hydro-power developments in DRC, Zambia, Mozambique and Angola will increase (SADC, 2005). Again – although not all the water used in hydro-power generation is consumed there are various long term environmental and social repercussions of building hydro-power infrastructure. Ecosystems such as wetlands and floodplains provide water purification services and other resources – to the benefit of the environment, including humans. These ecosystems are often inundated through the construction of large dams – such as those required for hydropower – thus impacting on water quality. The still waters in these dams also can become susceptible to infestations of parasites, such as schistosomiasis, with resultant health implications for local communities. Additionally, large dams inundate some of the most fertile agricultural soils – in river valleys and on floodplains.

Two hydrological important factors in the region are the high number of transboundary rivers and the high reliance on groundwater. The 15 shared rivers of the SADC (see Table 2) account for roughly 78 percent of the region's available water resources and all but one of the continental SADC states have over 50 percent of their land area in international river basins (Hirji et al, 2002). These shared river basins support much of the economic activity in the region such as agriculture, industry, as well as small-scale farming and social uses of water. The development and use of the resources of these shared basins is potentially complex as consideration needs to be taken of other basin states.

Table 2: International River Basins of the SADC

Basin	SADC Basin States	Other Basin States
Buzi	Mozambique, Zimbabwe	n/a
Congo	Angola, DRC, Tanzania, Zambia	Burundi, Cameroon, Central African Republic Congo (Brazzaville), Gabon, Malawi, Rwanda
Cunene	Angola, Namibia	n/a
Cuvelai	Angola, Namibia	n/a
Incomati	Mozambique, South Africa, Swaziland	n/a
Limpopo	Botswana, Mozambique, South Africa, Zimbabwe	n/a
Maputo	Mozambique, South Africa, Swaziland	n/a
Nile	DRC, Tanzania	Egypt, Ethiopia, Kenya, Rwanda, Burundi, Uganda, Sudan
Okavango	Angola, Botswana, Namibia	n/a
Orange-Senqu	Botswana, Lesotho, Namibia, South Africa	n/a
Pangani	Tanzania	
Pungwe	Mozambique, Zimbabwe	n/a

Ruvuma	Mozambique, Tanzania	n/a
Save	Mozambique, Zimbabwe	n/a
Umbeluzi	Mozambique, South Africa, Swaziland	*n/a*
Zambezi	Angola, Botswana, DRC, Malawi, Mozambique, Namibia, Tanzania, Zambia, Zimbabwe	n/a

The actions of an upstream country can hold repercussions for water quantity and quality downstream. For example, the Okavango River shared between Angola, Botswana and Namibia terminates in the Okavango Delta – a Ramsar wetland of international importance. The delta forms the basis of a large eco-tourism industry in Botswana, with local and foreign visitors prepared to pay large sums to spend time in the relatively pristine environment. However Angola, where most of the water originates and Namibia, over whose territory the river passes, have expressed the desire to construct water storage and transfer infrastructure on the river. Some of this infrastructure, if constructed with due consideration for the ecology of the river, would have very little impact on the health of the delta ecosystem. Water from the river could be used to stimulate agriculture in the southern areas of Angola – needing reconstruction after the civil war, as well as providing an input to industry in Namibia, creating jobs in that country. These developmental needs run into a range of local and international interest groups aiming to conserve what they perceive to be the "fragile and unique" ecosystem of the river, specifically in the delta. The result has been to thrust any mention of development of the river into the realm of politics with claims and allegations, some factual and others not, being made by the various stakeholders involved (Turton & Earle, 2004). In this situation the delta is conserved – by freezing all development upstream, but this is hardly a stable solution to the problem, given the pressing socio-economic development needs in the region. Thus there is a risk that developmental pressures in Angola and Namibia will become so acute at some point in the future that large-scale infrastructure development takes place unilaterally, without incorporating the various environmental safeguards for the preservation of the delta ecosystem.

In an effort to promote the sustainable and equitable management and development of these shared water resources various regional governance instruments have been developed – discussed in the section of this paper reviewing existing governance frameworks. Four of the SADC states (Namibia, Botswana, Mozambique and Swaziland) have water resources dependency ratios of over 50 percent – that is, they rely on water generated outside their borders to supply more than half of their total water resource stock (see Figure 4: Water dependency ratios (UNEP, 2005). This links the futures of basin states, with impacts on water quantity, quality or flow patterns being transferred downstream. These highly water dependant states are geographically located in the cross-over zone between the wetter north (equatorial) parts of the region and the drier southern areas and could become the settings for increased future inter-state competition for water.

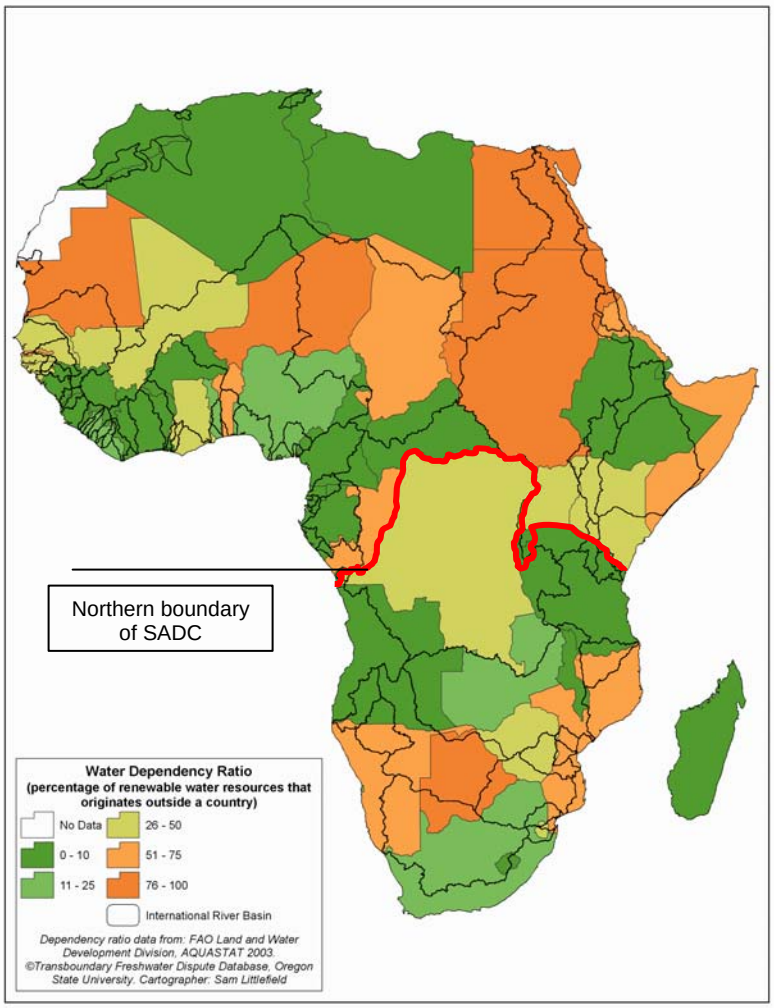

Figure 4: Water dependency ratios (UNEP, 2005)

Urban as well as rural populations in the region have a high reliance on groundwater – several of them shared aquifers. In several parts of the region groundwater provides the only perennial source of water. However, these aquifers, specifically their transboundary nature, are not well understood and more research needs to be conducted in this field. In the driest parts of the region, groundwater is the primary source of drinking water for the human population and livestock. Groundwater is the main or a complementary source of intensive irrigation in some parts of the SADC region and has a significant role to play in achieving food security through small-scale irrigation. It is estimated that groundwater supplies roughly 27 percent of the water needs of urban communities in the region and 35 percent of the water needs of rural communities, with this figure increasing in times of drought when surface water supplies dwindle (Molapo and Puyoo, 2002).

The following groundwater provinces have been distinguished in Southern Africa on basis of the dominant geological setting by Vasak:

- Basement Provinces. The Precambrian crystalline basement rock forms the continental mass outcrops in a 100 to 300 kilometres wide band inland from the Atlantic coast in Zaire, Angola,

Namibia, and South Africa. They cover most of the area of Tanzania, Malawi, and Zimbabwe. In large parts of these regions, groundwater is only present at shallow depths.

- Sedimentary Basin Provinces. Unconsolidated and consolidated sedimentary formations overlie the depressed basement in the axial part of the continent, including the Congo and Kalahari basins. The Karoo basin is a vast raised plateau of coarse sandstone. Basins developed along the coast vary in width. Coastal basins include limestone layers which are often karstified. Thick and extensive sediments sedimentary layers can contain groundwater to considerable depth. Some coastal aquifers are artesian.

- Volcanic Provinces. The vast basalt effusions are especially situated in the Rift Valley zone, Malawi and Tanzania, and in South Africa and Botswana. Relatively recent volcanism affects both the groundwater occurrence and groundwater quality.

- High-Relief Folded Mountain Provinces. Cape Fold Belt in South Africa belongs to this category. Inside the folded rocks arranged in complex structures, the occurrence of groundwater is fragmented (Vasak, 2005).

According to Vasak, the above division provides the first insight in the probable pattern of groundwater occurrence. In most of these large basins aquifer characteristics, direction and continuity of groundwater flow, recharge mechanism and possible cross border impact of abstraction, are generally not well identified, except in cases where exploration has been conducted along international borders (Molapo and Puyoo, 2002). At present very little is known about these shared aquifers in the region. Most of them are not coincident with the major river basins in the region, although there is a strong interaction between surface & groundwater. Much of the base-flow of rivers in the region is dependant on groundwater (SADC, 2005). The flow characteristics, recharge rates, permeability and transmissivity of these water bodies is not well understood. Groundwater use in these shared aquifers could thus have an impact on shared river systems. Rates of recharge are highly dependant on rates of precipitation and runoff, showing considerable spatial as well as temporal variation (Vasak, 2005). There is evidence in several parts of the region of groundwater over-abstraction, with recharge rates and water tables dropping. In addition much of the groundwater in the region is under threat of decreased water quality from industrial, mining and agricultural pollutants. High salinity caused by the dissolution of mineral salts occurring in some sedimentary horizons (e.g. in Karoo formation and Kalahari sands) and the intrusion of saline water in the coastal aquifers are also threats to the groundwater quality (Vasak, 2005).

Climatic Variability and Change

An added stressor is that of climate change – compounding the naturally variable climate. It is typical for drought years and flood years to follow-on directly from each other, with very few years displaying any type of “average” rainfall. Coupled with the high levels of evapotranspiration in the region (up to almost 4,000 mm/yr or ten times the average rainfall) this explains much of the variation in the discharge of rivers in the region. The average international conversion ration for Mean Annual Precipitation (MAP) to Mean Annual Runoff (MAR) is around 30 percent. In most of the countries in southern Africa it is closer to 10 percent – meaning that only 10 percent of average rainfall is available as stream flow to rivers.

The case of the Okavango River is representative of much of the region. Since records of inflows to the Okavango Delta began in the early 1930s flows have varied from -45% to +60% of the mean

annual flow (Ashton & Neal, 2003). From the 1980s until around 2003 there has been a downward trend in flow volumes into the delta. But the 2004, 2005 and 2006 seasons have included some of the biggest flow events in the past 35 years. As there are less than 80 years of rainfall records to go on it is difficult to know if this upturn constitutes a long-term trend, thus forming part of a natural cycle of wet and dry years.

By looking at layers of sediment and sand dune formation in the Okavango Basin and surrounds, as well as periods of intense plant growth, it is possible to reconstruct an approximation of the rainfall pattern of the past 200,000 years. What emerges is a series of cycles taking about 23,000 years for each to complete (Mendelsohn & Obeid 2004). Rainfall during the wettest cycles would have been higher than today, while during the driest cycles much of the system as we know it would have been covered in sand. Frequently the assertion is made that the climate is changing – usually that it is becoming drier as a result of human activities. The only constant in the climate of the region over the past 200,000 years has been change – if by "climate change" a change in this rate or direction of change is meant it will be difficult to predict the outcome. According to the Intergovernmental Panel on Climate Change (IPCC) study conducted in 2001 the Okavango River headwaters region on the Bie Plateaux falls partly in a zone predicted to experience a decrease in runoff of 50 to 150 mm per year and partly in a zone predicted to experience an increase in runoff of 1 to 25 mm per year (IPCC, 2001).

Most of the predictions about the direction of climate change in the region have a low to medium level of confidence. However there is a high level of confidence in the prediction that the southern African region generally will experience greater climatic extremes leading to an increase in the severity of the floods and droughts in the region.

The latest stochastic and systems models point to several possible trends associated with an increase in temperature of between 0.2 and 0.5 degrees per decade, including:

- An increase in precipitation for the eastern seaboard & interior of the region
- A decrease in precipitation for the south-west of the region;
- A possible shift from winter and toward summer rainfall in the Cape region

These changes in precipitation timing and delivery will have complex repercussions on the social, environmental and economic water use activities in the region. A shift towards an increase in precipitation, if it is accompanied by an increase in temperature, could lead to diseases such as malaria and cholera becoming more widely spread. A decrease in precipitation would obviously have a negative impact on water stress in the region, compounding water scarcity induced by natural climatic variability. Surface water flows would drop more or less in proportion to the drop in precipitation, but the impact on groundwater would be more complex (Turton et al, 2005). Aquifers tend to recharge in a non-linear way, with the rate of recharge dropping sharply when precipitation is less than 200 mm. Thus the areas in the west of the region with already low levels of precipitation and a high reliance on groundwater (such as the Northern Cape area of South Africa, most of Namibia, southern Angola and parts of Botswana) would be heavily affected.

Ecosystem services are vital to the well-being of communities and the continued economic development of the countries in the region. Some of the most important ecological hotspots in the world are located in the region – the Okavango delta, Kafue Flats, Barotse floodplain, Etosha pan &

Cuvelai, Incomati delta, St Lucia estuary etc (Hirji et al, 2002). These are part of the global environmental heritage and therefore deserve a high level of support and protection. But over and above this global significance, they also provide environmental services – such as absorbing and recycling nutrients and pollutants (both natural and anthropogenic in origin), de-salinisation processes, supply of food and building materials for local communities, minimum flows for hydro-power generation and water purification. A drop in the ability of these eco-systems to function would have dire consequences for communities and ultimately the economic growth and stability of the region – displacing people as environmental refugees.

2. Review of existing governance frameworks

Where water resources are shared between countries, an effective governance framework depends on the interplay between the local, national and international spheres of governance, with sufficient implementation capacity required at all levels.

It is in this context that the Africa Water Vision 2025 (UN Water/Africa. 2004) identifies "strengthening governance of water resources" and "developing and implementing institutional reform and capacity-building at local, national and trans-boundary water-basin levels" as key points in its framework for action to achieve the objectives of the vision. This vision is "An Africa where there is an equitable and sustainable use and management of water resources for poverty alleviation, socio-economic development, regional cooperation, and the environment" (UN Water/Africa. 2004).

Policy framework

The main water related policy documents at SADC level are the Regional Water Policy (SADC, 2005) and the Regional Water Strategy (SADC, 2006). They lay down regionally agreed policy guidelines concerning water resources management, covering a wide range of topics from infrastructure development, information exchange, capacity building to gender aspects and stakeholder involvement. Although, being policy documents, they are not legally binding on the SADC member states; they are important guides for the ongoing harmonisation of national water policies of the SADC member states, many of which are still based on the water policies and laws developed under colonial rule. They also inform the implementation of the SADC Regional Indicative Strategic Development Plan (RISDP) and the SADC Regional Strategic Action Plan (RSAP), the water related development plans of the SADC.

In addition to the regional policies at SADC level, there is increasingly a drive for policy development and joint decision making at the continental level. The Africa Water Vision is one such example, the various initiatives being discussed under the umbrella of the African Ministers' Council on Water (AMCOW) and Nepad being other ones. Whereas regional integration in the SADC region is more advanced than in other parts of Africa, cooperation on issues around water management, and making best use of the development potential of water, is generally increasing in Africa, as the new developments described above are evidence of. Given their existing experience with respect to cooperation over transboundary water resources, the SADC states can make a valuable contribution to these processes.

Legal framework

Given the large number of transboundary water resources in the SADC region it is not surprising that there is an abundance of water related international agreements in the region. The countries of the region have signed numerous international agreements related to the use and management of shared water resources – many of them entered into by the former colonial powers. According to international law principles these agreements are still in force and together with the agreements signed after the SADC countries became independent, form part of the currently applicable resource governance framework.

Whereas historically, many of the agreements are bilateral and do not include all basin states (Ashton et. al., 2006), there has over the past two decades been a trend towards more regional integration and the development of governance frameworks at a basin scale, thereby including all riparian states. The SADC states are committed to managing their shared water resources in accordance with the principles of international water law.

This commitment becomes evident in the large number of SADC states that have signed the 1997 UN Convention on the Law of the Non-navigational Uses of International Watercourses (hereafter referred to as the UN Convention). No SADC countries voted against the Convention, with Tanzania abstaining, Swaziland, Zimbabwe and the Democratic Republic of the Congo being absent and the rest of the SADC countries voting for the Convention (UNEP, 2005). Although the UN Convention has not yet come into force, it is considered to be an important instrument in international water law, as it "largely codifies the general principles of international water law" (McCaffrey, 1999).

The SADC Protocol

From a legal perspective, the SADC Protocol on Shared Watercourses (hereafter referred to as the SADC Protocol) is the key instrument for transboundary water management in the SADC region. Whereas the SADC Regional Water Policy and Regional Water Strategy are important guideline documents, the SADC Protocol establishes a legally binding framework for transboundary water management in the region.

The generic provisions of the SADC Protocol are drafted in line with the provisions of the UN Convention, thus reflecting what is generally considered to be "modern" international water law at present. With signing the SADC Protocol the SADC Member States have undertaken to respect the existing rules of customary or general international law relating to the utilisation and management of shared watercourses (Article 3 (3)). In line with these rules of international water law the SADC Protocol contains the principles of "equitable and reasonable utilisation" (Article 3 (7)) and the "duty to prevent significant harm" (Article 3 (8)). It furthermore, among others, contains provisions dealing notification and consultation requirements regarding planned measures and rules on pollution, prevention, reduction and control (SADC, 2000).

It is important to recognise that the SADC Protocol is a framework agreement. It contains the generic rules for the management of shared rivers within the SADC region, but does not contain basin-specific rules. The latter are to be included in (basin-wide) watercourse agreements, such as the Incomaputo-

Agreement[1]. The link between the SADC Protocol and the basin agreements is made in Article 6 (3) of the SADC Protocol, which states that "watercourse states may enter into agreements, which apply the provision of this Protocol to the characteristics and uses of a particular shared watercourse or part thereof". The SADC Protocol thus provides the general direction and principles for any future watercourse agreements concluded in the SADC region, while allowing for the consideration of certain characteristics that may be specific to the watercourse in question (Ashton et. al., 2006).

Cooperation at basin level

The multitude of bilateral agreements referred to above, is evidence that until recently cooperation on transboundary water management issues was largely on a bilateral basis. Areas of cooperation range from undertaking joint basin studies to the development of large-scale infrastructure – the Lesotho Highlands Development Project implemented by Lesotho and South Africa being one of the most prominent examples. Most of the more recently signed basin-wide agreements pertain to the establishment of Shared Watercourse Institutions, such as the agreements establishing the Orange-Senqu River Commission (ORASECOM) or the Okavango River Commission (OKACOM).

The Incomaputo-Agreement is the first basin-wide agreement establishing a comprehensive management regime for the basin. It is directly rooted in Article 6 (3) of the SADC Protocol and based on the principles established therein, such as equitable and reasonable utilisation and the obligation not to cause significant harm. Furthermore the agreement contains rules on water allocation (e.g. detailed flow regimes and priority allocations for specific uses in times of drought), water quality, data and information exchange and notification requirements. The agreement assigns monitoring and enforcement tasks to Tripartite Permanent Technical Committee (TPTC) as the responsible shared watercourse institution.

Whereas the Incomaputo-Agreement is currently the only legal agreement pertaining to transboundary water resources management in the region establishing such a comprehensive basin-wide regime, it is likely that in the long-run more agreements of this nature will be signed in the SADC region.

National water laws

The legal framework for transboundary water resources management set by the SADC Protocol and basin-wide agreements is complemented by the domestic laws of the member states. The implementation of international agreements depends on the interaction between international and national laws, as enforcement on the national level has to make use of the instruments of national laws. Many countries of the SADC region have reformed their domestic water laws and policies (or are currently in the process of doing so).

One tendency of the new domestic water laws is the devolution of water management to the lowest possible levels, in line with the principles of IWRM. Examples of this are the establishment of Catchment Management Agencies (CMAs) in South Africa, which over time will take over most water resources management responsibilities from the Department of Water Affairs and Forestry (DWAF).

[1] Tripartite Interim Agreement Between The Republic Of Mozambique And The Republic Of South Africa And The Kingdom Of Swaziland For Co-operation On The Protection And Sustainable Utilisation Of The Water Resources Of The Incomati And Maputo Watercourses.

Similar examples of management devolution can be found in Namibia, where the Water Resources Management Act (No 284 of 2004) provides for basin management committees, local water user associations and water point user associations and Zimbabwe where Catchment Councils are largely in charge of water resources management. Botswana is in the process of developing a new water act and the first draft bill (Republic of Botswana, 2005) provides for the establishment of water management areas along catchment boundaries.

Institutional framework

The institutional framework for water management in the SADC region corresponds to the legal framework established at the different spheres of governance. The SADC Protocol establishes an institutional framework at the regional level for the implementation of the instrument. In Article 5 it establishes the SADC Water Sector Organs and mandates them, as well as Shared Watercourse Institutions with the implementation of the Protocol.

In practice, the SADC institutions are currently mandated primarily with monitoring functions concerning the application of the SADC Protocol as well as with facilitating the harmonization of water law and policy between SADC member states. SADC institutions are not mandated with the implementation and enforcement of basin-wide agreements. Where those have been concluded this is to be done by Shared Watercourse Institutions as well as the domestic institutions in the countries that are party to the basin-wide agreement.

Defining the interface between Shared Watercourse Institutions and national water management institutions is one of the main institutional challenges for transboundary water resources management in the region to date. Although national water laws, as for example Section 2 (i) of the South African National Water Act 36 of 1998 (RSA, 1998) require that international obligations are met, domestic water management institutions are often not well informed about their role in this process and how it relates to their other obligations resulting from the respective national laws. It is crucial for transboundary water resources management in the region that capacity is built in institutions at all levels to understand the nature of the interrelated governance framework and the institutional responsibilities resulting from it in order to ensure the effective implementation of international agreements in practice.

The involvement of the public and of stakeholders in particular, in decision making processes is increasingly being recognised by countries in the region as an important pillar of the institutional framework for water resources management (at national and transboundary level). Under the South African National Water Act (No 36 of 1998), the Catchment Management Agencies, once established, are responsible for the implementation of stakeholder participation activities. Article 80 (e) of the Act stipulates that it is a function of the Catchment Management Agencies to "to promote community participation in the protection, use, development, conservation, management and control of the water resources in its water management area". Similarly, Section 3 (j) of the Namibian Water Resources Management Act lists "facilitating and encouraging awareness programmes and participation of interested persons in decision-making" as a fundamental principle of water management in the country. On the institutional level each basin management committee, guided by the Water Resources Management Agency (Article 7 (f)), is responsible to "promote community participation in the protection, use, development, conservation, management and control of water resources in its water management area through education and other appropriate activities".

At the same time there are stakeholder participation initiatives at the level of transboundary institutions. OKACOM has established links with the Basin Wide Forum, a transboundary stakeholder forum in the Okavango delta. The chairperson of the Basin Wide Forum attends the official meetings of the Commission. ORASECOM is currently in the process of developing a stakeholder participation strategy for the Orange-Senqu River basin. The Ministerial declaration of the Johannesburg Hydropower conference (March, 2006) is further evidence that the relationship between water resources development and communities is increasingly integrated into water resources management practice – thus recognising the human security aspect of development. It is stated in the Declaration that hydropower development needs to "emphasise the importance of resettlement principles, which include full participation of affected communities, with particular attention to vulnerable groups and culturally sensitive areas" and "that those local communities affected by a hydropower project, must derive positive sustainable benefits" (AMC, 2006). Following this declaration there are now plans to start a dialogue with regional stakeholder representatives on issues arising in connection with the planned development of future large-scale infrastructure developments.

One issue related to stakeholder participation that has so far received little attention at a political level or in statutory water management institutions, is the fact that much of the population of the region lives under non-codified customary law regimes. These regimes enjoy a high degree of legitimacy on the local level, yet their integration into national and regional legislative structures is virtually non-existent. It is illustrative that for example the South African National Water Act, widely considered to be at the cutting edge of modern water legislation, does not make any reference to customary water management arrangements (Malzbender et. al., 2005). It is argued though, that customary water management could be accommodated under the Act (Malzbender et. al., 2005), which would complete the interrelated governance framework from local to the international level and avoid the existence of a parallel governance framework at local level.

Gaps in the governance framework

Whereas the integration of water management frameworks at the different spheres of governance (local, national, international) is improving (despite remaining capacity constraints, see Section 4 below), gaps remain with respect to intersectoral coordination. Since water permeates all aspects of life and is of relevance for virtually all production sectors, an improved integration of management frameworks between sectors is required. At this stage there is only minimal or at best limited cooperation across sectors, leading to overlaps and gaps in governance frameworks, which contributes to inefficient resource use. This situation can be observed both at the national level in member states as well as at the regional level (SADC).

It is thus consequent that the action agreed on at the Johannesburg Hydropower conference calls on the states to "adopt, at country level, better coordination of relevant sectoral ministries in hydropower development, and at river basin level enhance integrated approaches amongst the various sectors relevant to hydropower development" (AMC, 2006). Such actions should not be limited to aspects relating to hydropower development but need to be applied to all water use sectors in order to create the interrelated management framework that is currently lacking.

Similar to the lack of intersectoral cooperation between water use sectors there is a lack of integration of different natural resources governance systems, such as land, forests etc., with the water governance system. The principle of Integrated Water Resources Management (IWRM) takes cognisance of the interrelationship between different natural resources and aims at integrating them into a holistic

management system. The water policies of SADC countries recognise the principles of IWRM (or will do so after being reformed in line with the SADC Regional Water Policy). Efforts are being made in member states to implement IWRM on the ground but the process is still in an early stage. It is important for the effective implementation of IWRM that the interrelated governance framework illustrated above, be further integrated and strengthened.

Arguably the biggest gap in the water resources governance framework is the virtual exclusion of groundwater from the existing management framework. For a long time the relevance of groundwater for water supply, specifically in rural areas, has received little attention. To date there is no international agreement in the SADC region that deals with groundwater issues and the mandate of existing Shared Watercourse Institutions is limited to the management of shared surface water resources. The underestimation of groundwater as a vital component of water supply has had the consequence that comparatively little is known today about the interaction between surface and groundwater, the impact of groundwater abstraction or even the exact location and extent of (shared) groundwater resources (Molapo and Puyoo, 2002). A lot of research needs to be done to understand the characteristics of the region's groundwater resources in order to integrate them into the regional water management frameworks. This has been realised and a Groundwater Management Programme for the SADC Region has been launched, but the development of regional information on groundwater resources and efforts to include groundwater in the water management framework are still in their infancy.

3. Challenges and Trends

Water and Security

Meeting growing water demand is essential for the economic development of the SADC region in general and thus to the reduction of poverty – a stated objective of the SADC Treaty. Given the strategic value of water to the countries of the SADC region described above, in areas such as food security, economic development, power generation and health, it seems evident that water resources and the way they are managed have security implications. In this context it is emphasised that in the "Solemn Declaration on a Common African Defence and Security Policy" (CADSP), security is understood as encompassing the traditional, state-centric notion of survival of the state and its protection by military means from external aggression, as well as intra-state conflict (CADSP, 2004). Specifically the latter category includes the aspects of environmental security and human security, which recognises the importance of the human-environment interface.

Following the distinction made by The CADSP, when analysing the security implications of water and water resources management, various conflict scales are distinguished in this overview (while at the same time being cognisant of the fact that local dynamics influence international ones in a complex web of interactions).

Inter-state level

The CADSP defines interstate conflicts as aggression or threats of aggression from a country, incidents involving the use of force or the threat of using force between states and situations which undermine the sovereignty, territorial integrity and independence of states (CADSP, 2004). Despite the

often quoted statement that water will be the cause of the wars of the 21st century, there is substantial evidence proving that the likelihood of this happening is in fact relatively small. Historically cooperative events over water by far outnumber conflictive events, and where the latter have happened, only a minimal number involved violence (Wolf, 2005). Despite occasional conflicts between states, where water is a driving element, water is much more a security problem at the intra-state level.

The assumption has for a long time been that water scarcity is the key driver for conflict over water resources (Wolf, 2005). Climate change models predict with some certainty that the south-western parts of the SADC region will become significantly drier in the next few decades. This combined with population growths (though slowed down due to the HIV/ Aids pandemic); increasing demands for agricultural and industrial water use and high dependency ratios in some SADC countries (see above) would let it seem that there is growing potential for conflicts in the light of increasing water scarcity.

And indeed, water resource availability has been and still is high on the national security agenda of most SADC states. Yet, instead of growing conflict, the response has been increased cooperation with respect to shared water resources. An illustrative example in this regard is the changing approach to the sharing of hydrological data. In many countries in the region data on water resources has traditionally been classified information. This indicated the level of securitisation generally in the region up until the end of the Cold War and associated conflicts. Since that time there has been a trend towards de-securitisation generally and a commensurate de-classification of hydrologic data in several countries. Having ready access to hydrologic data is essential for the sustainable collaborative development and management of the region's water resources.

Cooperation over shared water resources in the region has historically been mostly on a bilateral basis – however, more recently solutions are sought on a multilateral or a regional level (SADC) and cooperation over shared water resources is further increasing, with new Shared Watercourse Institutions formed and more basin-wide agreements (i.e. agreements including all riparian states) being concluded (see description of governance frameworks below).

In addition to more institutional cooperation, there are increasing tendencies to develop regional and even continental approaches to joint infrastructure development. The New Partnership for Africa's Development (NEPAD) and particularly the African Ministers' Council on Water (AMCOW) are key drivers of these processes. The African Ministers' Conference on Hydropower and Sustainable Development held in Johannesburg in March 2006 was a milestone in this regard. Not only did the Ministers agree on initiatives to jointly develop Africa's hydropower but in the Declaration placed specific emphasis on the fact that the development of hydropower must be implemented in accordance with national, regional and international agreements and respect the principles of sustainable development, and requires an integrated and holistic approach (AMC, 2006). This commitment to cooperation and adherence to legal principles is evidence that African countries, including the SADC member states, place strong emphasis on cooperation over shared water resources.

Water resources managers, planners and Ministers from various countries in Africa met in Accra, Ghana in September 2006 to develop guidelines on inter-basin transfers (IBTs) on the continent. The meeting, under the auspices of AMCOW and the UNECA (UNWater/Africa), developed a framework to assist and support African countries in formulating cooperative arrangements for meeting the challenges of water scarcity and associated problems on a regional basis. This framework is going to

be developed into a set of guidelines by UNWater/Africa for the construction of IBTs on the continent (UNECA, 2006). At present the framework consists of four main areas:

- *General policy matters:* building of trust between partners, the need for IBTs to form part of national and regional development initiatives and the need to optimise benefits from the system.

- *Economic and financial matters:* equitable distribution of benefits between parties, cost benefit analysis incorporating financial, social and environmental costs and a systematic approach to securing finance.

- *Institutional and civil society issues:* strengthening and formation of appropriate institutions, AMCOW and RECs to assist where no appropriate institutions exist and the impacts of an IBWT on stakeholders, particularly women, should be addressed and they should be involved in its development

- *Technical and Environmental issues:* the potential environmental effects of an IBT should be assessed, monitored and mitigated and reliable baseline data is needed.

There is no doubt that IBTs will increasingly be a part of the water management and development plans of many countries on the continent, including the SADC – the economic and social needs for water in "drier" basins can partly be mitigated by transfers from the "wetter" basins. It is however important that common understandings are reached on the environmental, social and financial risks of IBTs. That this is now being done on a continental basis points towards the new direction water management is taking in Africa, moving away from countries acting in isolation and towards a more integrated approach.

This emphasis on joint development and the strengthening of legal frameworks and institutions is critical in the context of the concept of hydropolitics. The hydropolitics concept relates to the ability of geopolitical institutions to manage shared water resources in a politically sustainable manner, i.e. without tensions or conflict between political entities (Wolf, 2005). Hydropolitical resilience, defined as the complex human-environmental system's ability to adapt to change, and hydropolitical vulnerability, defined as the risk of political dispute over shared waters (Wolf, 2005), are the two sides of the hydropolitical coin. The assessment of thousands of conflictive and cooperative events related to shared water has revealed that there is no physical parameter that was statistically significant as an indicator for conflict or cooperation (Wolf, 2005). Instead it is institutional capacity that determines the outcome (Wolf, 2005). Where institutional capacity such as Shared Watercourse Institutions are developed and international agreements on the use of shared water resources are in place, there is hydropolitical resilience and the potential for conflict is comparatively low.

Given the increasing drive towards cooperation and the establishment of new international agreements and Shared Watercourse Institutions it can be concluded that the conflict potential over shared water resources in the SADC region is currently relatively low (although major challenges remain with respect to capacity development – see Section 3 Challenges and Trends below). This applies at least with respect to the criteria identified by the CADSP, such as aggression or use of force. There are currently, and probably will be in the future, disagreements between SADC countries over water resources they compete for. So far the institutional frameworks have been resilient enough to resolve these disagreements without them spilling over into conflict and given the ongoing further

strengthening of institutions and legal frameworks it is unlikely that this situation worsens in the foreseeable future.

Intra-state level

Although also of relevance on the inter-state level, the concept of human security is critical on the intra-state level. The analysis done at Oregon State University of past conflicts over water has revealed that the likelihood of conflict increases dramatically on the intra-state level, compared to the minimal amount of conflict at inter-state level (Wolf, 2005). The key driver for conflict at the intra-state level is water scarcity (Wolf, 2005). Scarcity of water is closely linked to water quality issues, since high pollution levels can render water inappropriate for human consumption and other uses (e.g. irrigation), thereby aggravating its scarcity.

The drivers for such conflicts are increasingly viewed in the context of the human security concept, which places human beings, rather than states, at the focal point of security considerations. Summarised in the catch-phrase "Freedom from want, Freedom from fear and Freedom from hazard impact" the human security concept includes a wide range of issues such as access to resources, protection of the environment and participation in governance. Africa has traditionally followed an expansive approach to the concept of human security (Cilliers, 2004). According to the definition of the CADSP common security threats in the context of intra-state conflict are, among other factors, poverty and inequitable distribution of natural resources as well as the absence of popular participation and good governance (CADSP, 2004). It identifies a lack of access to resources and basic necessities, lack of protection against natural disasters, ecological and environmental degradation as well as inadequate protection from poverty as common security threats (CADSP, 2004).

Water is a centre point of the interface between humans, the environment and poverty (see Table 12) - hence water arguably lies at the heart of human security.

Table 3: Linkages between water, environment and poverty (Hirji and Molapo, 2004)

Dimensions of poverty	Examples of water and environmental linkages
Income and Consumption	Access to water for productive use, access to natural resources, sustainable growth
Inequality and Equity	Secure tenure and access to natural resources, water rights and entitlements
Sustainable Livelihoods, Health	Sustainable land and water use practices, water quality, safe drinking water and sanitation, protection against water-borne disease
Security and vulnerability	Improved disaster preparedness and response, water harvesting and conservation
Inclusion and Empowerment	Participation, devolution of ownership, rights and responsibilities to water users, community groups, basin organisations, local governments

Despite progress having been made, many of the causes of human insecurity are still prevalent in the SADC region. Poverty levels are high and the burden of disease is increasing, particularly due to the HIV/ Aids pandemic (Turton et. al., 2005). There are numerous examples of environmental degradation and access to safe water and sanitation is limited, particularly in rural areas. Inappropriate agricultural practices lead to further environmental degradation such as erosion and wetland degradation and pollution levels are increasing.

With the demand for water rising and competition over the resource increasing, the conflict potential rises. Such conflict can occur in various forms, e.g. conflict between commercial and subsistence farmers, conflict between agriculturalist and pastoralists, conflict between different water use sectors (agriculture, industry, domestic) or conflict between consumptive uses and the need to maintain ecosystems. If not addressed this increasing conflict potential can lead to greater security risks both with respect to the individual aspect of human security as well as to security in the wider context of security within a state (and indirectly beyond).

Developing responses

International experience shows that the politics of water tends to be subservient to the macro level political process in the region. If states are not cooperating or are even in some form of active conflict over issues such as ideology, access to and control over "higher value" resources (such as oil, gold, diamonds etc), ethnic tensions etc., levels of cooperation over shared water resources may also drop (Kalpakian, 2004). Deterioration in the macro-level political environment will reduce the capacity of shared watercourse institutions to effectively deal with other challenges such as climatic change and increased water demand. Likewise a continued improvement in the security situation in the region based on continued regional integration should promote the ability of these institutions to effectively manage exogenous threats.

The assessment of potential security risks related to water makes it clear, that the biggest conflict potential lies at the intra-state level. With the root causes of conflict being competition over an increasingly scarce resource, insufficient access to natural resources (specifically access to safe water supply for multiple uses in rural areas) and inappropriate use practices that result in environmental degradation, it becomes evident that the problem is essentially a management problem. Hence, the key to developing responses lies in the development of institutional structures that can effectively manage the region's water resources in a way that reduces conflict, thereby making the region more hydropolitically resilient.

The drivers of change (climatic, demographic, developmental or other) are not the sole determinants of the degree of cooperation or conflict between states. The degree of institutional development – represented by the laws, treaties, agreements and organisations referred to above – is important to analyse from the SADC perspective. As the countries in the region develop, whether through large-scale agriculture, industry, mining, services or tourism, so do the available options for mitigating water stress increase. Countries lacking abundant or stable supplies of the primary resource, in this case fresh water, can source solutions in the realm of secondary resources (Ohlsson and Turton, 1999). These secondary resources include aspects such as socio-economic development of the country, education and health levels of the population, diversification of the economy and political stability. Countries with more of these secondary resources have a greater range of options over how to use water available to them, allowing scarce water supplies to be used in the (economic of geographical) setting

which will generate the most benefit. Thus, instead of sharing the water directly and each country using it for low revenue generating activity such as the production of staple foods it is possible to use water in the most efficient setting and then share the benefits generated. To use the Okavango example again – the upstream states, Angola and Namibia could, in return for not developing their rightful share of the water from the Okavango river, be involved in the lucrative eco-tourism activities of the delta. The difficult part remains to develop a robust methodology for the sharing of these benefits, but the point remains that focussing on the benefits associated with the resource allows one to break away from environmental determinism and limits to growth approaches by using water more effectively and efficiently. The study of the sharing of water benefits, at local as well as transboundary scales, is comparatively new. The first systematic study was produced in 2005 by the Expert Group on Development Issues (EGDI) at the Swedish Ministry of Foreign Affairs by David Phillips et al. This study showed that there is no "one size fits all" approach to the sharing of benefits – each basin and each situation needs to be assessed individually (Phillips et al, 2006). They propose an analytical model incorporating variables under three areas:

- ***Security*** – a certain degree of regional security needs to be in place for benefit-sharing to be viable – but in the long run benefit-sharing can also improve regional security,
- ***Economic Development*** – again this is a pre-requisite for effective benefit-sharing while also benefiting from it;
- ***Environment*** – ecosystem services are valued and factored into management decisions.

As was mentioned above there exists a range of well developed shared water institutions in the SADC, involving each of the member states. These institutions have done much to promote the cooperative development and management of shared water resources in the region, addressing the three variables listed above – security, economic development and environmental issues. However there are several challenges which still need to be addressed in an effort to improve what is in place. The SADC Water Sector, in collaboration with regional development partners, held a workshop on 11 & 12 September, 2006 in Gaborone, Botswana, to discuss the actions needed to strengthen river basin organisations (RBOs). The participants of that workshop as well as the Pretoria workshop (10 July, 2006), convened by SaferAfrica, discussed several of these challenges, as well as proposing some possible first steps towards their solution, including:

- *Lack of capacity of water management organisations:* this relates to both human as well as financial resources and includes organisations at the regional (SADC), basin (RBOs), national (departments of water), sub-national (catchment councils etc) and community levels. The SADC RBO workshop highlighted the need for the exchange of knowledge and experience between organisations in the region (SADC, 2006).
- *Mandate of River Basin Organisations:* at present most RBOs operate in an advisory capacity, providing technical advice on water management issues to national governments. This role needs to be strengthened and expanded to include responsibility for management aspects such as data collection, water quality monitoring, implementation of joint development projects and programmes and implementation of directives, amongst others. In effect this would mean national states having to relinquish a degree of sovereignty to the RBO.

- *Involvement of other stakeholders:* The management of shared watercourses has traditionally been the domain of national governments – operating with input from RBOs. The private sector, local government, water user groups, local communities, traditional leaders, woman's groups, academia and research institutions all have a role to play in the management of shared watercourses in a sustainable manner. What needs to be determined is how, when & where to involve these various stakeholders and if there should be common minimum conditions for their participation amongst the various shared watercourse institutions. The SADC RBO workshop made the suggestion of establishing a stakeholder forum at regional level.

- *Harmonisation of national water laws and policies:* Several countries in the SADC still use water legislation passed during colonial times – drawing on the arguments and thinking prevalent in the home-country at the time. Much of this is unsuited to the local context – due to differences in climate, hydrology, capacity and development trajectories. In addition, these differences in national legislation potentially hinder cooperation between basin states. An added dimension, linked with stakeholder participation, is that much of the population of the region lives under non-codified customary law regimes. These regimes enjoy a high degree of legitimacy on the local level and it is important to integrate their directives into the national and regional legislative structures.

- *Inter-sectoral water governance:* both on a national level as well as a the SADC level there is little communication or joint planning between various sectors which have an impact on or are impacted by water management decisions, such as health, agriculture, land use planning, housing, electricity, mining etc. A framework needs to be developed to link the planning and management activities of organisations engaged in these sectors into a harmonised approach to water management.

- *Gathering and sharing of data:* There is a paucity of reliable long term hydrological data in the region. This data is essential for the management of water resources, yet in many parts of the region it has not been collected for decades, with activities disrupted by wars, civil conflict or economic and capacity reasons. In cases where data exists there is frequently a problem around its legitimisation – with parties not always agreeing on the accuracy, precision or relevance of the data. Access to data has also been a problem, with several countries still viewing hydrological data as classified information.

- *Development of guidelines:* The SADC RBO workshop participants suggested the development of systems, guidelines and procedures in the following areas:

    - Developing guidelines & procedures on environmental management

    - Develop standardised procedures for operations of RBOs

    - Develop guidelines on stakeholder participation in basin management (national and regional scales)

    - Guidelines on water allocation & benefit sharing

- Development of a performance monitoring system for RBOs

- *The need for infrastructure development:* The region has, with a few notable exceptions, lagged behind in the construction of water storage and reticulation infrastructure. Most of the population in the region use water at very low per-capita rates – not because of water demand management (WDM) strategies, but caused by a physical lack of access to the resource. The SADC region is on the verge of a major infrastructure development process and it is important that the relevant financial, social and environmental safeguard mechanisms are developed as minimum "guidelines".

- *Human security:* The importance of adopting a human security approach to water resource governance, based on the three pillars of freedom from want, freedom from fear and freedom from hazard impact.

4. Recommendations and Conclusion

The last two points on the above list – infrastructure development the human security approach – form the essence of the regional governance framework which needs to be developed for water resources. The achievement of the aims of the three pillars of human security (freedom from want, fear and hazard impact) drive much of the need for appropriate infrastructure development in the region. Likewise, they are potentially impacted by the negative externalities of un-harmonised infrastructure development. Thus it becomes important to develop guidelines, as referred to above, at the regional (SADC) and eventually at the continental level, in recognition of the fact that water is an embodiment of "our common future". The resilience of institutions, such as laws and RBOs, needs to be developed to pro-actively respond to drivers of change. It will not be enough to purely mitigate the impacts of stresses placed on the water resource through drivers such as climatic variability and change, economic development and population growth. Increasingly what is needed is a framework whereby the benefits associated with the water resource can be unlocked.

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Appendix 1: Water resources of the SADC

2003-2007	Angola	Botswana	DRC	Lesotho	Malawi	Mozambique	Namibia	South Africa	Swaziland	Tanzania, United Rep of	Zambia	Zimbabwe
Total population (1000 inhab)	14 533	1 801	56 079	1 797	12 572	19 495	2 032	45 323	1 087	38 365	11 043	12 963
Average precipitation in depth (mm/yr)	1 010	416	1 543	788	1 181	1 032	285	495	788	1 071	1 020	657
Groundwater: produced internally (10^9 m3/yr)	58	1.7	421	0.5	2.5	17	2.1	4.8	0.66	30	47	6
Surface water: produced internally (10^9 m3/yr)	145	0.8	899	5.23	16.14	97.3	4.1	43	2.64	80	80.2	11.26
Overlap: surface and groundwater (10^9 m3/yr)	55	0.1	420	0.5	2.5	14	0.04	3	0.66	26	47	5
Water resources: total internal renewable (10^9 m3/yr)	148	2.4	900	5.23	16.14	100.3	6.16	44.8	2.64	84	80.2	12.26
Water resources: total internal per capita (m3/inhab/yr)	10 184	1 333	16 049	2 910	1 284	5 145	3 031	988.5	2 429	2 189	7 263	945.8
Water resources: total external (actual) (10^9 m3/yr)	0	9.84	383	-2.208	1.14	116.8	11.56	5.2	1.87	12.27	25	7.74
Water resources: total renewable (actual) (10^9 m3/yr)	148	12.24	1 283	3.022	17.28	217.1	17.72	50	4.51	96.27	105.2	20
Water resources: total renewable per capita (actual) (m3/inhab/yr)	10 184	6 796	22 878	1 682	1 374	11 137	8 718	1 103	4 149	2 509	9 526	1 543
Dependency ratio (%)	0	80.39	29.85	0	6.597	53.8	65.23	10.4	41.46	12.75	23.76	38.7
Water resources: total exploitable (10^9 m3/yr)							0.65	13.91				
Total dam capacity (km3)	4.47			2.82								103

Source: Aquastat, 2006