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Water scarcity, climate change and water governance in Southern Africa

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I am an Australian and international lawyer, expert in disaster risk management law and policy, who lived in Zimbabwe from 2014-2016. Although I am not a water resources expert or climatologist, while looking at transboundary management of water-related disaster risks in southern Africa in 2015, I read a swathe of technical material on the issues. I produced this referenced summary, which I think others interested in water policy in the region might find useful. This article is adapted from my book chapter: Mary Picard, 'Water Treaty Regimes as a Vehicle for Cooperation to Reduce Water-Related Disaster Risk: The Case of Southern Africa and the Zambezi Basin' in David Fisher and Jacqueline Peel (Eds), The Role of International Environmental Law in Disaster Risk Reduction, Brill Nijhof, 2016.

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The current water emergency in Cape Town, South Africa, is part of a major challenge facing the dry southern African region in the coming years, as population growth, development and climate change combine to create water scarcity. South Africa is hardest hit by this, as it is already one of the driest countries, with a fast-growing population and high level of economic development, meaning it is already drawing heavily on its existing water resources.

The following overview of the water challenges and water-related disaster risks in southern Africa, including climate change projections, highlights the tasks that face the national governments and the Southern African Development Community (SADC) institutions. This paper focuses on the southern tip of the continent, the area more traditionally described as 'southern Africa', (rather than the whole SADC region), i.e. southern Angola, Namibia, Botswana, Zimbabwe, southern Zambia, southern Malawi, and Mozambique, South Africa, Lesotho and Swaziland.[1]

A. The available water resources

Overall, the region faces the baseline challenges of low average rainfall, high evaporation rates, and high seasonal and inter-annual variation in rainfall (long dry seasons, floods and droughts), as well as high groundwater withdrawals. The region's weather is influenced by both the Indian and the Atlantic Oceans, as well as continental climatic patterns, which cause high rainfall variation between years, or in cycles of years, meaning peak flooding some years, and extremely dry seasons in others that may stretch over several years to become major droughts.[2]

The water story tends to be one of too much or too little at a time, but increasingly water scarcity and water quality issues are coming to dominate the risk landscape. Some key facts about the available water resources are:

- The average annual rainfall in the southern tip of Africa is well below the global average of 860 mm (most of the area has less than 500 mm), but precipitation is highly skewed, with higher rainfall in the north and east of the region and lower rainfall in the south and west.[3] Significantly, the most economically diverse countries, in particular South Africa, are on the 'wrong side' of the rainfall distribution. This means that the highest per capita water user states in the region also have the lowest rainfall.[4]
- There is high evaporation of rainfall, with a low ten percent of rainfall converting into water flowing into the SADC region's transboundary rivers, (compared with the African average of 20 percent, in contrast with Asia & North America at 45 percent).[5]
- Rainfall over most of this region is markedly seasonal, with the majority of the rain falling in the summer half of the year (October-March), peaking in December-February when most of southern Africa receives 80 percent of its annual rainfall; some areas receive as much as 90 percent in those 3 months.[6]
- The pattern of intense wet seasons and long dry seasons is reflected in the fluctuations of the natural water levels of its rivers across the year, with frequent wet season floods, and seasonal droughts if the wet season is delayed in any year. Tropical cyclones also affect the eastern coastline at the peak of the wet season, often causing or exacerbating floods in Mozambique, Malawi and eastern Zimbabwe.
- The high rainfall variability has also led to a strong reliance on groundwater by between 60 and 70 percent of southern Africa's residents,[7] although its recharge mechanisms are often unknown locally.[8] Although underground aquifers are hydrogeologically part of the larger river basin

systems,[9] so far there is little regulation for sustainability within each country, or calculation of the effects on transboundary waterways,[10] although SADC is now initiating research and cooperation on groundwater extraction.[11]

B. Projected impacts of climate change

The Intergovernmental Panel on Climate Change (IPCC) projected impacts of climate change on southern Africa's water resources include less water in rivers overall, more intense high and low river flows, more floods, and increased risk of both water pollution and decreased water quality, linked to erosion, high rainfall events and increased water temperature.[12] Some key climate risk findings and projections according to 2014 IPCC reports, are:

- warming across Africa has already increased and temperatures are likely to rise faster than the global average, especially in the arid areas.[13] This could exceed a 2˚C increase by the end of the 21st century over extensive areas of Africa. Heatwaves and warm spells will likely increase in length and there will be more hot days in total, increasing evaporation and exacerbating seasonal water stress in southern Africa.
- Rainfall changes are already observed in southern Africa, including reduced late summer rain (the wet season) from Namibia to Angola, and slightly less rainfall overall for Botswana, Zimbabwe and South Africa.[14] The IPCC projects a continuing trend that the summer rains will come later, creating a longer dry season, [15] and that droughts will intensify.[16]
- The IPCC concludes that for Africa as a whole, climate change will 'amplify existing stresses on water availability,'[17] causing 'compounded stress on water resources' that is the highest regional risk from climate change,[18] and that as yet there is little institutional capacity for effective climate change adaptation (CCA) measures.[19]

Rainfed small-scale agriculture and grazing will be especially impacted by long dry periods,[20] affecting regional food security, as only around five percent of cultivated land in the region is equipped for irrigation.[21]

A particular type of compounded water stress for southern Africa may come from the region's present and planned reliance on both hydroelectricity and irrigation, two major uses whose continued growth may soon become a trade-off against each other requiring a policy choice.[22] Recent studies highlight the vulnerability of existing hydropower capacity in the region, facing increasing unreliability due to climate change.[23] Low river and dam levels have affected the Zambezi River Kariba Dam's hydropower production in the past (shared by Zambia and Zimbabwe), including 1992 after a prolonged regional drought,[24] and again in 2015. In 2015 this followed a relatively minor drought, but with the compounding effects of population growth and new economic demands in the intervening decades.[25]

C. Water-related disaster risks

Water-related disaster risks in southern Africa therefore include floods, droughts, water stress/scarcity and river water pollution. All of these affect shared watercourses, including the Zambezi, for which regional and/or river basin cooperation is required for effective management. These disaster types fall under three main categories, being (1) floods and droughts, (2) water stress and scarcity, and (3) water quality.

1. Floods and droughts

- Major floods and droughts remain the triggers for devastating disasters in the region. These tend to be part of alternating cycles, although sometimes they are more localized, so that both can occur in different parts of the region, or even the same locality, in a given year.[26]
- The extent to which river floods because disasters depends on factors such as early warning systems, the nature of riverside development (principally whether urban areas are built on flood plains) and the capacity to moderate peak flows, primarily through the use of large dams.

- Mitigation of drought through multi-purpose water storage is also a necessary adaptation measure for the region, which currently lacks water storage infrastructure; sub-Saharan Africa as a whole stores only 4 percent of annual runoff compared with 70-90 percent in most industrialized countries.[27]

2. Water stress and scarcity

- Some countries in the region now face a chronic shortage of water, described as 'water stress' and 'water scarcity'.[28] This results from a combination of natural and human-made phenomena, in that physical scarcity of water is compounded by population growth, industrial uses and their impacts on water access and quality.[29] Water scarcity is the point where the impact of all users on the quantity and quality of the water under the current institutional management arrangements means that the demand by all sectors – including the environment – cannot be met.[30] The population-water equation, or 'real' scarcity, gives a good overall indication of the water issues facing southern Africa.[31] On this basis, South Africa, Malawi, Lesotho and Zimbabwe are already facing water stress; and South Africa and Malawi are both very close to water scarcity.[32]
- South Africa, Swaziland and Zimbabwe also use much more water per person than other countries of the region, and withdraw significantly higher proportions of their renewable water resources each year.[33] This demand is mainly a result of economic activity, and will grow in these and the other SADC states as population and economic diversity increases. The already-high water users may soon approach high water stress,[34] creating additional demand for intra-basin and inter-basin transfers from other SADC states.[35]
- As yet there has been little use in the region of alternative water supply sources such as desalination, wastewater reuse and green water. There is also very little rainwater harvesting, or management of the demand side through water use efficiency.[36]
- Equitable distribution needs, pollution controls and efficient usage are among the policy approaches needed to mitigate water scarcity.[37] The SADC treaty regime could provide an opportunity for regional and river basin cooperation in these areas.

3. Water quality

- There is a 'a general trend in the SADC region towards a deterioration of water quality.'[38] The intense utilization of some river basins has already led to full (or almost full) allocation of all available water resources, such in the Incomati, Limpopo and Orange/Senqu basins that traverse South Africa.[39]
- The water quality impacts of such usage in the South Africa portions of these rivers includes excess nutrients associated with sewage treatment and agriculture, causing toxic blue-green algal blooms, and chemical and heavy metal contamination from gold and coal mining that can cause serious and long-term health problems to people who consume or use the water, as well as affecting agriculture.[40] Water pollution in the region is expected to increase with economic development, population growth and urbanization.[41]
- In addition, water supply and sanitation is still low in most SADC countries, where in 2011 more than 98 million people did not have access to safe drinking water and close to 154 million did not have access to improved sanitation.[42]

The need for national, regional and international action

Water resource management has been recognized as essential to management of the human environment and as 'at the core of sustainable development' in a series of UN resolutions and international conference declarations and outcomes - from Stockholm in 1972 to Rio+20 in 2012, and now the 2015 Sustainable Development Goals, which place access to and conservation of water resources as central to human rights and development (SDG 6 is to "Ensure availability and sustainable management of water and sanitation for all.")[43] These are non-binding 'soft law'

instruments with extensive implementation guidance that underpin much of the UN and other international policy and practice on water management in the context of development.

Access to potable water for drinking and clean water for sanitation was the focus of a sustained campaign and research through the United Nations International Decade for Action 'Water for Life' 2005-2015, the establishment of the inter-agency mechanism, UN-Water, as well as the mandate for a Special Rapporteur under the UN Human Rights Council.[44]

There is also an international treaty that is binding on the state parties, the 1997 United Nations Convention on the Law of Non-Navigational Uses of International Watercourses (hereinafter the 'UN Watercourses Convention'), which entered into force in 2014.[45]

The concept of integrated water resource management (IWRM) remains central to these international policy approaches. It defines 'the river basin, including surface and groundwater' as the 'most appropriate geographical entity for the planning and management of water resources.[46] IWRM recognizes that water is a finite resource, so that aquatic ecosystems and river basins (including groundwater) require holistic and sustainable management for the benefit of all.

Most governments appear to find implementation of IWRM a huge challenge, in both developed and less developed economies. Furthermore, as river basins are rarely confined within the national territory of one state, and rivers themselves often form national borders, much of this management needs to be done across national boundaries.

Better water governance in southern Africa is an urgent issue for all the national governments as well as SADC. Increased population, development and climate change are compounding the natural water scarcity of the region. The SADC Water Sector Climate Change Adaptation Strategy of 2011 is a broad strategy for integrated water resource management (IWRM) and is a good basis for moving forward if adequate priority and resources can be committed to its implementation.[47]

Endnotes

[1] Excluding the Congo Basin and Great Lakes regions in the northern part of the SADC region.
[2] Including the El Niño Southern Oscillation (ENSO), the 'Inter-Tropical Convergence Zone' (ITCZ) convection currents around equatorial Africa, and 'the 'Botswana Upper High Influence,' an anti-cyclone system. See: DAVIS (Ed.), (2011), 9.
[3] Mozambique and Malawi each have up to 1000mm pa, while Namibia and South Africa have less than 200mm average, including extremely arid areas with almost no precipitation. See: Anthony Turton, *New Thinking on the Governance of Water and River Basins in Africa: Lessons From the SADC Region*, Research Report 6, South African Institute of International Affairs, (2010), 8.
[4] Turton, (2010), 8.
[5] Africa 20%, Australia & Europe 35%, South America 43%, Asia & North America 45%. See: Turton, (2010), 9-10, Figure 1.
[6] C. L. Davis (Ed.), *Climate Risk and Vulnerability: A Handbook for Southern Africa*, (2011), 9.
[7] 60% estimate from: AMCEN & UNEP, *Africa Environment Outlook: Past, present and future perspectives,* http://www.unep.org/dewa/africa/publications/aeo-1/032.htm; and over 70% estimate from: SADC, Sustainable Groundwater Management (2014), 3.
[8] Jude Cobbing & Jeff Davies, *Groundwater - returning to the sources,* Planet Earth Online (2010), avaiable at http://planetearth.nerc.ac.uk/features/story.aspx?id=666. IAEA, Sustainable Development Of Groundwater Resources In Southern And Eastern Africa: Regional Technical Co-Operation Project RAF/8/029, (c.2004).
[9] FAO, *Global interactive maps*, AQUASTAT Global Water Information System, (1 May 2015), http://www.fao.org/nr/water/aquastat/main/index.stm.
[10] SADC, Sustainable Groundwater Managment in SADC Member States Project: Parts 1 And 2 [Consultation Draft], (2014).
[11] ibid.
[12] Tadross et al., "Regional scenarios of future climate change over Southern Africa", in Davis (ed.) (2011), 60.

[13] IPCC, *Climate Change 2014 - Synthesis Report: Summary For Policymakers,* (2014); IPCC, *Climate Change 2014*, Ch. 22 – Africa in Impacts, Adaptation, and Vulnerability. IPCC *Fifth Assessment Report (AR5) - IPCC Working Group II* (DRAFT Oct 2013), (2014), (hereinafter 'IPCC, WGII, AR5'), paras. 22.2.1. – 22.2.1.2.
[14] IPCC, WGII, AR5, (2014) para. 22.2.2.1.
[15] Ibid. para. 22.2.2.2. (Findings that are consistent with earlier southern Africa projections based on downscaled climate modeling, reported in: Tadross et al., in Davis (ed.), (2011).)
[16] Ibid., para 22.1.2.2. Based on: IPCC, *Special Report on Managing the Risks of Extreme Events in Disasters to Advance Climate Change Adaptation* (SREX), (2012).
[17] IPCC WGII AR5, (2014). Executive Summary, citing paragraphs 22.3.22, 22.3.3.
[18] IPCC, *Climate Change 2014 - Synthesis Report: Summary for Policymakers*, (2014), 14. Figure SPM.8
[19] IPCC WGII AR5, (2014). Executive Summary, citing paras 22.4.2-22.4.4
[20] Ibid., para. 22.3.4.
[21] SADC, *Climate Change Adaptation in SADC: A Strategy for the Water Sector* (2011) (Hereafter SADC Water Sector CCA Strategy). 23.
[22] Randall Spalding-Fecher et al., *Water Supply and Demand Scenarios for the Zambezi River Basin. Climate Change and Upstream Development Impacts On New Hydropower Projects in the Zambezi Project*, (University of Cape Town, 2014), Conclusions, 67-68.
[23] Richard Beilfuss, *A Risky Climate for Southern African Hydro: Assessing Hydrological Risks and Consequences for Zambezi River Basin Dams,* (2012), 6-7; Spalding-Fecher et al., (2014), (Results, 41-65; Conclusions 67-68, modeling different scenarios based on policy priorities for water supply and demand).
[24] SARDC et al., *Zambezi River Basin - Atlas of the Changing Environment*, (2012), 14. (2012), 46.
[25] Kariba Dam on the Zambezi dropped to very low levels in 2015, resulting in severe electricity rationing in Zambia and Zimbabwe, both of which rely on the dam for the majority of their power production. See: ZRA, *Lake Levels (Kariba)* (16 July 2015), http://www.zaraho.org.zm/hydrology/lake-levels); and Laura Sustersic, *Multilateral versus bilateral agreements for the establishment of river based organizations: comparison of legal, economic and social benefits in the Zambian experience,* LARS 2007 - Lake Abaya Research Symposium, University of Siegen, Germany, (2007).
[26] SADC Water Sector CCA Strategy, 27.
[27] SADC Water Sector CCA Strategy, 21.
[28] Further, see A. Dan Tarlock, "The Potential Role of International Environmental and Water Law to Prevent and Mitigate Water-Related Disasters," in Fisher and Peel (Eds), *The Role of International Environmental Law in Disaster Risk Reduction*, Brill Nijhof, 2016. 187.
[29] UNDESA, *Water Scarcity* (9 May 2015), http://www.un.org/waterforlifedecade/index.shtml
[30] Ibid.
[31] Ibid. A key water stress indicator is when there is less than 1,700 m3 per person per year; water scarcity is below 1,000 m3 per person, and below 500 m3 is 'absolute scarcity'.
[32] *Global interactive map*s, FAO AQUASTAT (2015).
[33] *Irrigation water requirement and water withdrawal by country,* FAO AQUASTAT, (2015) - renewable water resources withdrawn, SA 24%, Swaziland 23%, Zimbabwe 21%, Malawi under 8% and less then 2% in each of Angola, Botswana, Lesotho, Namibia, Mozambique and Zambia.
[34] High water stress occurs if the proportion of withdrawal of a country's renewable water resources reaches 40 percent. See M. Falkenmark, et al, (2007), citing *United Nations, Comprehensive Assessment of the Freshwater Resources of the World* (1997).
[35] SADC, *SADC@35: Success Stories*. Vol.1, (2015), 19.
[36] SADC Water Sector CCA Strategy, 21, 23-24, 28.
[37] M. Falkenmark, Et Al., *On the Verge of a New Water Scarcity: A Call for Good Governance and Human Ingenuity*, (Stockholm International Water Institute, 2007), 7-10.
[38] Turton, (2010), 20.
[39] Turton, (2010), 20.
[40] Turton, (2010), 20, fns. 27, 28, 29.
[41] SADC Water Sector CCA Strategy ,29.
[42] SADC Water Sector CCA Strategy, 22.
[43] Rio+20 UN Conference on Sustainable Development, *Outcome of The Conference*, (2012) Para 119; Declaration *of the United Nations Conference on The Human Environment* ('Stockholm Declaration'), (1972) Principles 2,3; and UN General Assembly, A/RES/70/1 - *Transforming our world: the 2030 Agenda for Sustainable Development* (Annex) ('SDGs'), (2015), Goal 6.
[44] *UN-Water: The United Nations Inter-Agency Mechanism on All Freshwater Related Issues, Including Sanitation*, UN, (May 2015) http://www.unwater.org/); UN Human Rights Council, Res 16/2 The Human Right To Safe

Drinking Water And Sanitation, (2011); UNDESA, *'International Decade for Action 'Water for Life' 2005-2015'*, http://www.un.org/waterforlifedecade/index.shtml.

[45] Entry into force 17 August 2014. 36 state parties as at 1 January 2018.

[46] International Conference on Water and the Environment, *The Dublin Statement On Water And Sustainable Development*, (1992).

[47] SADC Water Sector CCA Strategy, 29.