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Securing the future of the Limpopo River Basin

High Impact Responses to Climate Change

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RESILIM : Resilience in the Limpopo River Basin Program

Securing the future of the Limpopo River Basin – High Impact Responses to Climate Change

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KEY POLICY MESSAGES

- Water **scarcity poses the greatest threat** to the livelihoods, economies and ecosystems of the basin
- **Water demand is so high that the system is scientifically termed as "closed,"** meaning that there is little water available for new uses or growth in current demand
- **Responses are required at a regional or basin level-scale**, facilitating regional cooperation and decision making
- **Development in the LRB is accelerating and demand for water is rising rapidly** – primarily agricultural, followed by industry, mining and urbanization
- **High levels of pollution are threatening communities** throughout the basin, reaching as far as Mozambique – severe water pollution restricts economic activity and affects aquatic biodiversity
- **Water resources are also stressed by** climate and biodiversity loss and temperatures are rising because of climate change
- **A no- or low-regrets adaptation path facilitates the selection of solutions** that simultaneously address possible future climate scenarios and are critical to sustainable development
- **Conserving the LRB's high altitude catchments** is a high-impact way of securing water inflows
- Although most of these catchments lie within the borders of South Africa, **action and accountability for their conservation is a basin-wide issue**
- **Improving water quality through the "polluter pays" principle** is a critical policy intervention
- **Strengthened early warning systems and disaster prevention** are essential responses in the face of increased intensity and frequency of extreme events affecting livelihoods and GDPs
- **Reversing and controlling severe land degradation** is critical to opening the water flows in the LRB, in addition to providing opportunities for job creation

Executive Summary

The Limpopo River Basin (LRB) faces multiple pressures which threaten the livelihoods, economies, and ecosystems that rely on it. In this mainly semi-arid environment, rainfall is highly unreliable and its effects are short-lived.

Climate change - evident in rising temperatures and an increase in the frequency and intensity of extreme events – threatens to intensify the already limited water supply.

Moreover, the basin faces pressure from increased water demand due to the ambitious economic development and growth trajectories of the riparian nations – Botswana, South Africa, Zimbabwe and Mozambique. Given this current reality, decisions regarding the LRB's future management and resilience-building strategies are required ***now***. Securing water inflows through conservation of high altitude catchments, addressing land degradation, and improving water quality through the 'polluter pays' principle are all critical actions necessary to promote resilience and combat the current pressures facing the LRB. These actions need to be taken across the LRB – nationally focused solutions alone will not solve the problem.

Introduction

Water scarcity already poses the greatest threat to the livelihoods, economies and ecosystems of the Limpopo River Basin (LRB). Climate change – mostly felt in the LRB in terms of rising temperatures and an increase in the frequency and intensity of extreme events – will further reduce water availability, while continued growth and development will increase water demand. A future in which current and projected economic growth scenarios, together with the expected impacts of climate change, can only accelerate water scarcity (as well as biodiversity loss) in a basin that has already reached scientific closure (meaning there is no water left to allocate to new users). Protecting the high altitude catchments is one way of keeping the LRB water flows open – a strategy that could yield high returns across the basin, including returns for downstream countries.

Reversing land degradation and ensuring water quality are also important means of securing and protecting this vital resource. Basin-level and national decisions are urgently required in managing the future of the LRB System (LRBS) and action must be taken to build resilience. Decision making processes should increasingly also occur at a transboundary level, informed by planning across sectors and disciplines, rather than on a country-by-country basis.

"Threats to security are most likely to arise in those regions where climate change impacts are most acute."

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The development-water-climate-biodiversity interface

Water resources are also stressed by other biophysical sub-systems.

In the LRB these are primarily biodiversity and climate – a change in one has significant impact on the others. A systems approach helps to analyze the complexities in, and particular vulnerabilities of, the LRB system[1]. The human interface adds further complexity – the relative strength and capacity of underlying governance systems can be a determining factor of critical thresholds, or tipping points, from which there is no return. Further closure of the basin, with a supply deficit, is a critical threshold that must be avoided.[2]

Opening water flows in the LRB is essential if the LRB is to retract this tipping point. However, preserving water flows alone is not enough. Reserves are needed to build resilience to additional, future shocks, often associated with climate change, and to facilitate accelerated development in a system that has been characterized by water scarcity since 1992[2].

Accelerated development across the LRB countries, coupled with climate change impacts, will mean that scarcity increases into the future.

The LRBS, however, is not only dealing with water insecurity – food insecurity is also a serious and current issue, and demands are rapidly on the rise. Development-based demands on water for agriculture, mining, industrial, and urban uses, in addition to levels required to maintain aquatic ecosystems, are intensifying.

Ashton et al. (2008) forecast an increase in water demands in the LRB of 46% by 2025, with urban demands rising the fastest [3].

Given the already water-scarce situation, it is obvious that these sectors will experience rising vulnerability to water shortages in a region that is understandably determined to accelerate development.

As resources dwindle and the risk of resource shocks increases, decisions based on informed trade-offs between equity, efficiency, and sustainability criteria must be made. Water shortages will have different impacts on urban and rural communities and different consequences across the various economic sectors reliant on this resource.

Current shortfalls are largely being met by Inter-basin Transfers (IBTs), particularly in South Africa. While this activity could be increased, and the efficiency of water use must certainly be promoted, greater resilience to the hazards posed by climate change, intensifying water shortages and biodiversity loss are where interventions are needed most. The challenge of managing the interdependencies in the LRB – between water, biodiversity and climate - are complicated by the steady degradation of the environment and biodiversity resulting primarily from the production of mining and mineral resources.

Climate change – mostly felt in the LRB in terms of rising temperatures (high runoff, increasing dry spells) and an increase in the frequency and intensity of extreme events – is already noticeable.

Future warming is expected at twice the rate predicted in the IPCC's 4th Assessment Report (2007) and this will continue [4].

The LRB is experiencing a significant increase in the frequency of hot extremes and a decrease in cold extremes, as well as shifts in rainfall seasonality. The implications for water are severe and scale through the entire system, potentially reducing resilience and realizing tipping points.

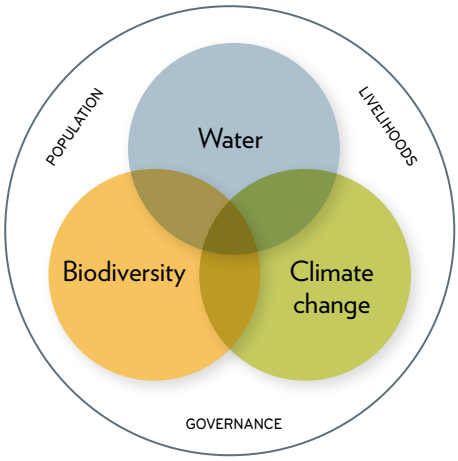

Figure 1.1: The nexus dimensions of biodiversity, water and climate change represented in the Limpopo River Basin and the external drivers of change

Economic development is increasing the demand for water, accelerating scarcity

The LRB is the focus of intensifying developments that require water. Agricultural demands for water account for about 63% of abstractions in the whole of the LRB, while urban and industrial demands, including abstractions for mining, account for 37% [1]. There is ongoing pressure for irrigation expansion but the necessary allocations to satisfy this demand are likely to be moderate in the future. The LRB has enormous mineral wealth, the extraction of which requires substantial amounts of water. The basin contains 56% of globally known platinum group metals, along with huge reserves of base metals and diamonds, with associated high demand. It also has substantial coal reserves (around 80 billion tonnes). Coal-based power generating stations require water for cooling. Substantial bulk water infrastructure is already being developed by South Africa and a new power station is being built. National economic development plans of all the riparian countries – Botswana, South Africa, Zimbabwe and Mozambique—indicate that economic expansion will further increase demands for water, exacerbating shortages despite the

Climate change projections for the region — a poor outlook

As a key result of climate change, the LRB faces rising temperatures. There is a high level of certainty in these projections – Global Circulation Models (GCMs) are consistent in indicating increasing temperatures across the LRB[5] .

Higher temperatures will reduce agricultural production, decreasing crop yields and animal production through increased physiological stress. Adaptations are required to cope with these projected higher temperatures and associated impact. The outlook for future rainfall is unclear – the different GCM model ensembles project different outcomes. There are fundamentally two different projected outcomes – either little change in annual rainfall, or a future of strong drying. A consideration of the implications of either outcome does not improve the outlook of a water scarce river basin.

Therefore, while the uncertainty in the model projections may slow or hinder decision making, it is evident that resilience-building is an absolute necessity. Related adaptation measures need to be developed on the basis of 'no'- or 'low-regrets' options in which the

adaptation accommodates either climatic outcome and is likely to be required even in the absence of climate change.

This is to avoid 'stranded assets' – those which have suffered from an unanticipated devaluation due to environment-related effects.

It is scientifically accepted that the impact of climate change will also manifest through an increase in both the intensity and frequency of extreme events, to which the LRB is no stranger. Intense rainfalls will continue to cause occasional but severe flooding, especially in the lower LRB. As a result, tens to hundreds of thousands of people are at continued risk of displacement. Heat waves are expected to become more frequent, or lengthen in duration. Irrespective of the number of cyclones making landfall on the eastern boundaries of the LRB, very severe floods will continue.

Despite lagging progress, it is obvious that global efforts to reduce global greenhouse gas (GHG) emissions need to intensify. African regions and basins, such as the LRB, have an important role to play in developing a contextually-specific evidence base to inform African positions on climate diplomacy in the UNFCCC negotiations, as well as global security platforms. Scientific reviews should include analysis on the security and stability implications of climate change. At the same time, lobbying for increased global support for adaptation, continuing investments to reduce poverty and vulnerability, integrating climate change into all relevant levels of governance, supporting stronger governance and institution building, investing in better climate data and increasing cooperation to meet shared climate challenges will all be critical success factors.

Severe water pollution restricts economic activity and affects aquatic biodiversity

The industrial, mining and urban heartland of South Africa, located in Gauteng province, is the source of severe water pollution in the southern headwaters of the LRB. Acid mine drainage, poorly treated industrial and urban waste waters, and diffuse agricultural runoff result in very poor quality water. The impacts of decades of intense mining activity in Gauteng are becoming highly visible. Copper, chromium, iron, nickel, lead, arsenic, aluminium and zinc have all been recorded in the water and sediment at various places along the Olifants River and its tributaries, with negative impacts elsewhere, including the Kruger National Park [6, 7]. The toxic effects of mining activity, along with further abstractions and impoundments downstream, have deleterious effects on aquatic biodiversity as far downstream as Mozambique, more than 400km away. Ambient metal concentrations rise during low water conditions (towards the end of winter and as a result of droughts), and spike during floods when metal absorption increases.

Pollution affects the quality of water available and the implications for agriculture, the mainstay of LRB livelihoods, are significant. The chemical and physical characteristics of the water are very important for crop irrigation; salinity causes loss of yield, and sodium reduces infiltration rates, whilst heavy metals and trace metals can have phytotoxic effects. Metal accumulations in plants can accumulate in human and animal organs, increasing the risk of morbidity. It is likely that in the near future, the metal concentration in some soils will exceed permitted limits. Enforced food laws in export target countries (such as the European Union) are strict about the presence of contaminants.

Chrome, released from alloy smelters in South Africa, is extremely toxic to aquatic life [8]. Artisanal mining in Zimbabwe is releasing mercury into the tributaries of the Limpopo. These and other heavy metals accumulate in the sediments, algae and invertebrates within the river systems, and result in toxic, direct impacts on LRB aquatic biodiversity.

Figure 1.2: Water pollution is severe in the upper parts of the Limpopo River Basin, especially as a result of acid mine drainage

Land degradation leads to a loss of productivity and high sediment loads

Severe land degradation is a feature in parts of the LRB, particularly in the Lebowa/Capricorn District Municipality, parts of the Vhembe District Municipality and north of the Soutpansberg towards the Limpopo River around Nzhlele [9]. There are also high levels of degradation within the Botswana portion of the basin, along the border with South Africa. The nature of degradation is observed as severe erosion over most of these areas, primarily through inappropriate land use, and overstocking and overgrazing of grasslands. Consequently, the sediment load in the LRB rivers is twice as high as the general Southern African value [1]. Erosion is least severe along the escarpment and high altitude catchment areas (and must be maintained). Bush encroachment/ thickening, as a form of land degradation, has occurred over a signifcant span of time (more than a hundred years) as disturbance pressures have increased – a process not easily reversed [10]. However, tackling the issue of land degradation cannot be ignored, and has the added benefit of opportunities for related job and enterprise creation in bush clearing and in fuel conversion (to, for example, compressed logs).

A no-regrets approach minimizes investment risks

Climate conditions are evolving in the LRB and predictions are uncertain. Incremental and transformative pathways that change the underlying risks to adverse impacts are an imperative.

A 'no-' or 'low-regrets' approach to adapting to climate change is the safe and optimal solution. These options are critical development decisions and will be useful whichever long-range climate condition emerges. Due diligence is required to determine whether the selected approach is able to provide the reduction in vulnerability that it promises. Each of the projected climatic impacts are likely to produce a variety of option trade-offs. These trade-offs need to be understood, particularly where they cross sectors and political boundaries, given

the vast differences in economic size and development status of the four countries. Institutions are often a major barrier to implementing solutions. Governance systems need to be robust and able to adapt to changing climates and different development futures.

Strategies that are adapted to a drying future climate are among the more obvious choices for the LRB. These should focus on preventing further basin closure, thus ensuring the water security essential to livelihoods, economies and ecosystems of the LRBS.

The other obvious adaptation focus is the changing frequency and intensity of extreme events. The LRB will continue to receive flood-generating rainfalls, rendering increasing populations and new economic developments located in exposed locations increasingly vulnerable. Enhanced Early Warning Systems (EWS) and practical risk avoidance measures or improved Disaster Risk Reduction (DRR) are essential resilience-building responses.

Conserving high altitude catchments will open and maintain water flows

Generating up to 100 times more runoff per unit area than the surrounding lowlands, protecting the high altitude catchments in the LRB is an important priority. These catchments are centres of botanical endemism and hotspots of exceptional biodiversity, and include the Soutspansberg-Blouberg complex,[11,12] the Wolkberg and Sekhukhuneland,[11,13] the Waterberg,[14] Strydpoortberg, the Lebombo mountains in the Kruger National Park, the Tswapong Hills in the Botswana portion of the basin, and bounding on the Matobos in Zimbabwe. Situated along escarpments and mountain chains, with higher rainfalls, steep terrains, and high rainfall-runoff coefficients, these catchments constitute the high runoff-generating areas that are exceptionally important to the water resources of the LRB. Since most of the LRB's high altitude catchments fall within South Africa, it is important that the country has an adequate regulatory environment to enable such preservation with a suite of protective policies under the overarching National Environmental Management Act (NEMA).

Detailed analysis of the conservation boundaries is needed with elevation being a key factor. This knowledge will inform decision makers on what must be protected and to what extent. A general principle is that the strength of the required protection measures increase with altitude, and that a combination of formal protection stewardship and job creation through public works programs would see high-impact returns. The most useful approach will be to apply some restrictions on land use, applying the strongest restrictions to a core area and reducing controls toward the lower altitudes. All of the concerned zones are endowed with spectacular scenery, making ecotourism a viable option. However, the different legislation available to the identified areas must be coordinated to facilitate this adaptation. Widespread public consultations would be required in order to take such a process forward. Conserving these catchments not only preserves biodiversity, but also preserves the ecosystem services of water storage, purification and production that the basin relies on so heavily.

Figure 1.3 High biodiversity, high runoff catchment areas (green) juxtaposed against lowland degraded land (red) in the Limpopo River Basin.

Reversing and controlling land degradation

Entrenching the principles espoused by the United Nations Convention to Combat Desertification (UNCCD) to address desertification and degradation across the LRB will have a significant impact and will provide a common basis for regulating land use within the national legislative frameworks. South Africa's National Action Plan for Combating Land Degradation to Alleviate Rural Poverty[15] is a useful framework for implementation that has relevance in other LRB riparian countries. In particular, riparian countries need to align objectives and processes for controlling land degradation. Given the high degree of migration across national borders, transboundary approaches are necessary for the enhancement of livelihoods and the promotion of sustainable use of natural resources. Approaches will need to include Integrated Natural Resource Management (INRM) principles, while addressing the complex water and food security issues faced by smallholders and rural communities requires integrated solutions planned across sectors and disciplines. The LRB is a fragile and challenging system – soil degradation and loss is already severe in parts in this arid and semi-arid environment. The specifics of what is practically required will be different in different parts of the LRB. Increasing the human development status of the inhabitants will be a valuable indirect approach, but has its own trade-offs to consider.

Providing safe water to the inhabitants of the LRB

Improvements in water quality in the LRB are urgently required and must remain a key focus of the management of the basin. These improvements need to be integrated and holistic, considering all elements of the economy and environment. Community driven groundwater governance is important to manage sustainable extraction and provide resilient groundwater infrastructure. A precautionary approach is also required, in that the potential water quality impacts of any new developments should be resolved in advance. Policies

already exist in this regard, or are being developed, and should be enforced (such as the Waste Discharge Charge System (WDCS) in South Africa). This approach supports the 'polluter pays' principle. Decisions on the implementation of controls will need to be transparent. Improving the capacity of wastewater treatment plants is essential, as is greater awareness that wastewater is a valuable resource and the effective management of it is essential for future water quality and security. The drive to improve surface water quality must be extended to that of groundwater. Groundwater resources will become a key factor in increasing the availability of water during dry periods and contamination must be strictly avoided to prevent permanent damage. Monitoring and evaluation of the water quality status across the LRB needs to be a core function of the relevant institutions operating within the basin, including LIMCOM.

References

[1] Aurecon. (2013). Limpopo River Basin Monograph LRBMS-81137945: Draft Final Monograph, Technical report, Aurecon AMEI (Pty) Ltd Report Number 8337. Prepared for LIMCOM with the support of GIZ.

[2] Turton, A. and Ashton, P. (2008). Basin closure and issues of scale: The southern African hydropolitical complex. International Journal of Water Resources Development 24(2), pp. 305–318.

[3] Ashton, P.; Hardwick, D. and Breen, C. (2008). Changes in Water Availability and Demand withing South Africa's Shared River Basins as Determinants of Regional Social and Ecological Resilience. In: (Eds.) M. Burns and A. Weaver. Exploring Sustainability Science: A Southern African Perspective SUN PReSS. pp 279–310.

[4] Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha., Tabo, R. and Yanda, P. (2007). Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panal on Climate Change. Parry M.L., Canziani, O.F., Palutikof, J.P., van der Linden P.J., and Hanson C.E. (eds). Cambridge Unviersity Press, Cambridge U.K., pp. 433-467.

[5] DWA Botswana and DWA South Africa. 2012. Joint Water Quality Baseline Report: Limpopo Basin between the Republics of Botswana and South Africa. Department of Water Affairs: Botswana and Department of Water Affairs: South Africa.

[6] Wepener, V. (1997). Metal ecotoxicology of the Olifants River in the Kruger National Park and the effect thereof on fish haematology. PhD thesis, University of Johannesburg, Johannesburg.

[7] Dabrowski, J. and de Klerk, L. (2013). An assessment of the impact of different land use activities on water quality in the upper Olifants River catchment. Water SA 39(2), pp. 231–244.

[8] DWA Botswana and DWA South Africa. 2012. Joint Water Quality Baseline Report: Limpopo Basin between the Republics of Botswana and South Africa. Department of Water Affairs: Botswana and Department of Water Affairs: South Africa.

[9] Oldeman L.R., Hakkeling, R.T.A and Sombroek, W.G. (1991). World Map of the Status of Human-Induced Soil Degradation: An explanatory Note (rev. ed.), UNEP and ISRIC, Wageningen.

[10] Smit, G.N., Rethman, N.F.G., 1992. Inter-related floristic changes associated with different long-term grazing treatments in Sourish Mixed Bushveld. Journal of the Grassland Society of southern Africa 9, 76 – 82.

[11] Van Wyk, A. E. & Smith, G. F. (2001). Regions of floristic endemism in southern Africa: A review with emphasis on succulents, Umdaus Press, Pretoria.

[12] Mostert, T., Bredenkamp, G., Klopper, H., Verwey, C., Mostert, R. and Hahn, N. (2008). Major vegetation types of the Soutpansberg Conservancy and the Blouberg Nature Reserve, South Africa. Koedoe 50(1), pp. 34–48.

[13] Siebert, S.; Van Wyk, A. and Bredenkamp, G. (2001). Endemism in the flora of ultramafic areas of Sekhukhuneland. South African Journal of Science 97, pp. 529–532.

[14] Hahn, N. (2003). Botanical Diversity: A First Synthesis of the Environmental, Biological and Cultural Assets of the Soutpansberg. Institute of Conservation and Natural History of the Soutpansberg, Herbarium Soutpansbergensis (ZPB) , Technical report, Institute of Conservation and Natural History of the Soutpansberg, Herbarium Soutpansbergensis (ZPB).

[15] DEAT (2004). National Action Programme: Combating Land Degradation for Alleviating Rural Poverty. Department of Environment Affairs and Tourism, Government of South Africa. pp 114.

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Resilience in the Limpopo River Basin Program (RESILIM): Strengthening the overall resiliency of the Limpopo River Basin ecosystems and the people dependent upon them is necessary for sustainable development in the region. There is a need to bolster participatory processes built on sound science that effectively incorporate ecological, social and economic aspects of water resource management in the face of climatic change. In addition, individual and institutional capacities must be enhanced to be able to anticipate and respond to changes in ways that ensure equitable and lasting development.

The Resilience in the Limpopo Basin Program (RESILIM) provides the United States Agency for International Development (USAID) the opportunity to collaborate with the riparian countries of the basin to improve management of the basin's water resources — surface and ground — to meet the economic, biodiversity, and social needs of each country, and in parallel support the achievement of the development goals of the Limpopo Watercourse Commission (LIMCOM) and Southern African Development Community (SADC). RESILIM's goal is to improve trans-boundary management of the Limpopo River Basin resulting in enhanced resiliency of people and ecosystems. The strategic objective is to open water flows in the basin, given its current status of a "closed' basin, meaning it has no more resource to allocate.

OneWorld Sustainable Investments (OneWorld) is a climate and development consultancy and partner based in South Africa and operating across the African continent. OneWorld produces applied research, strategy development, policy analysis, thought leadership and interventions towards resilient development together with its partners and programme beneficiaries. For more information, see www.oneworldgroup.co.za.

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