

Resilience Building in the Limpopo River Basin (RESILIM)

Nkobi M. Moleele
RESILIM

**Regional Meeting on Tools for the Sustainable
Management of Transboundary Aquifers**

28-31 July 2015



USAID | FROM THE AMERICAN PEOPLE

SOUTHERN AFRICA



Resilience in the Limpopo Basin Program



WHY RESILIM ?

•Climate change, Demographic change and Globalization of economic systems

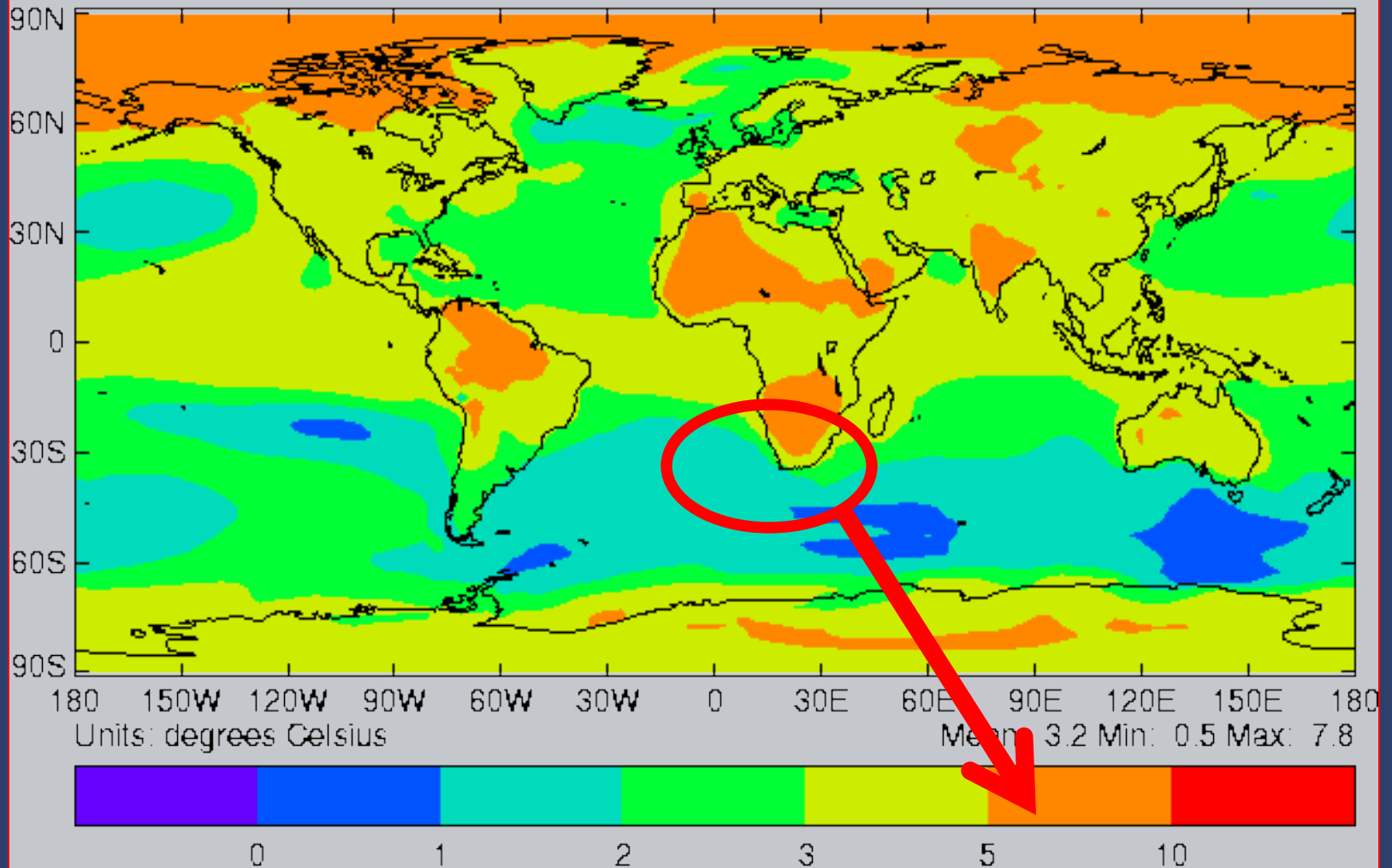
Presents enormous challenge to society world wide

Conceptualized and operationalised to complement the existing capacity development needs and initiatives in the Basin.

Ability of a socio-ecological system to anticipate and reduce risk or adapt to shocks or disturbances (e.g. climate variability and change). This includes the ability to “bounce back” from negative impacts or to “bounce forward”, transforming a challenge into an opportunity

Motivation

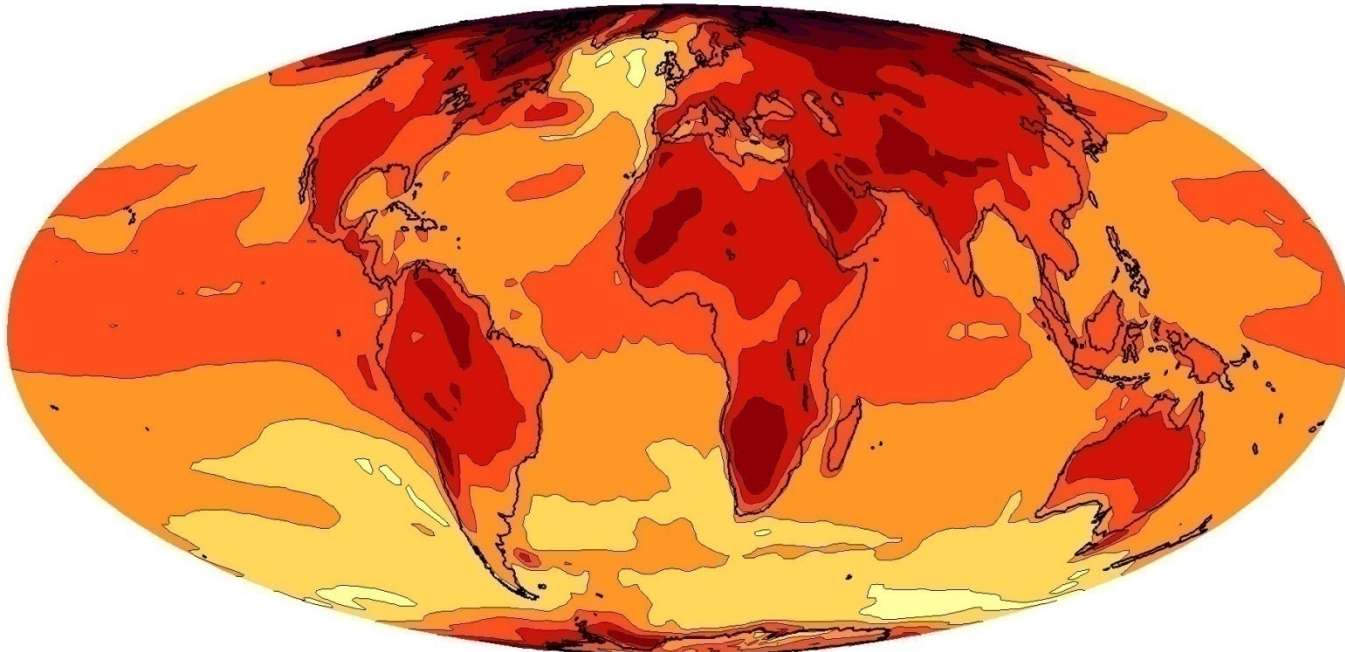
Change in annual average surface air temperature
from 1960–1990 to 2070–2100 from HadCM2 IS92a



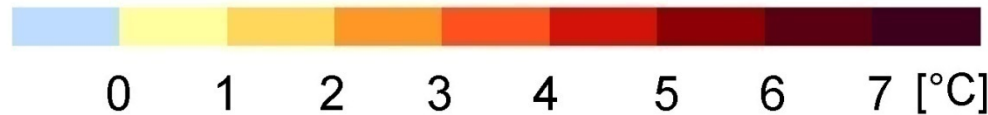
Hadley Centre for Climate Prediction and Research, The Met. Office

Global Warming prediction for this century: Strong and negative changes for most of Africa

IPCC Scenario A1B: 2m-Temperature Change (ECHAM5 / MPI-OM)



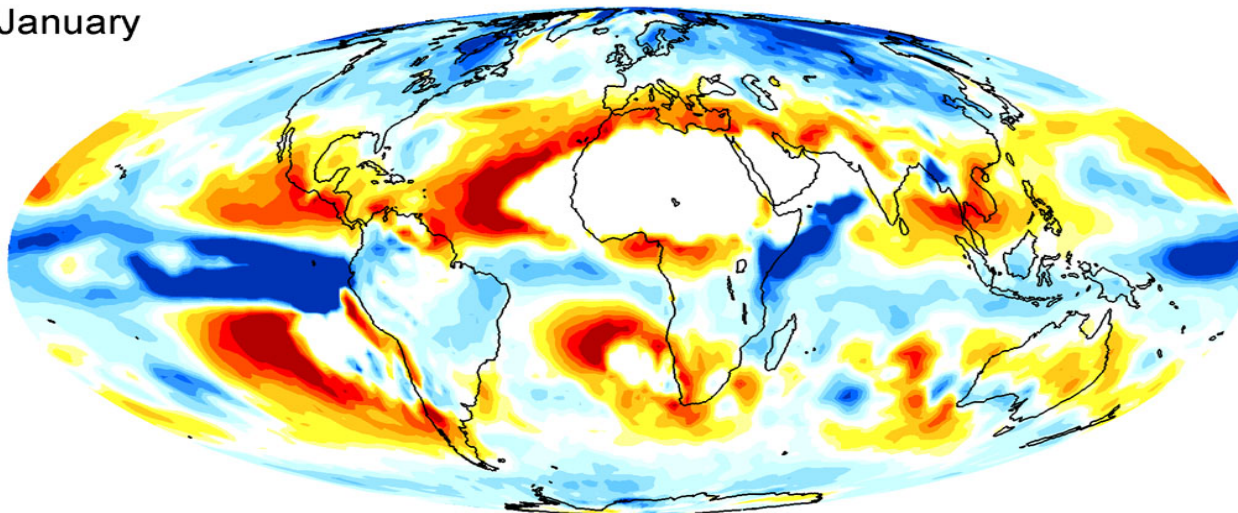
© MPI-M / DKRZ / M&D



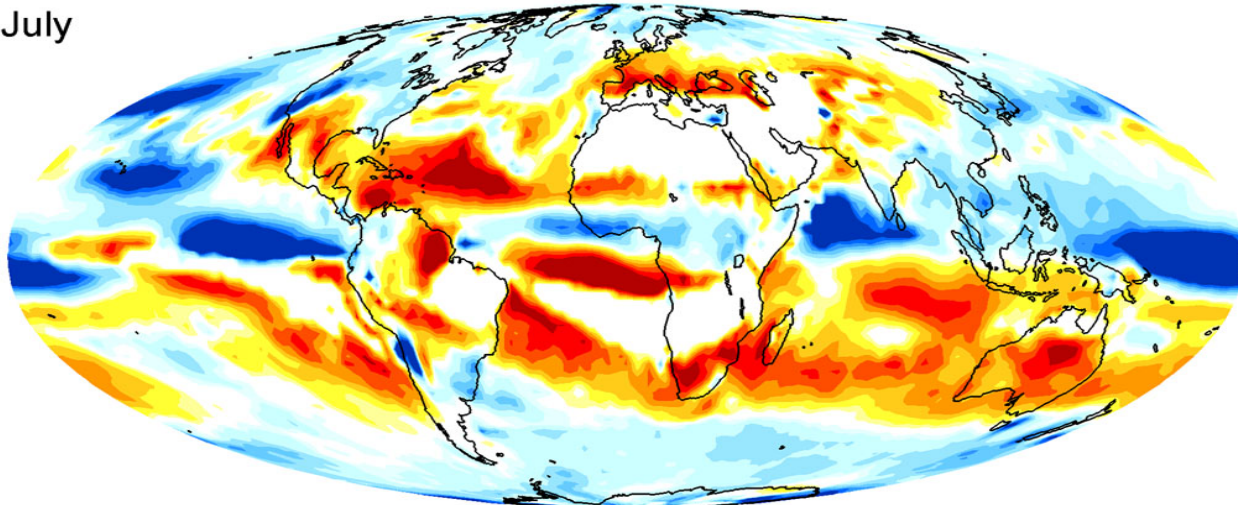
Less rainfall for most of southern Africa

Scenario A1B: Mean percentual Precipitation Change
for 2071-2100 relative to 1961-1990

January



July



© DKRZ / MPI-M/ M&D



RESILIM Program Objectives

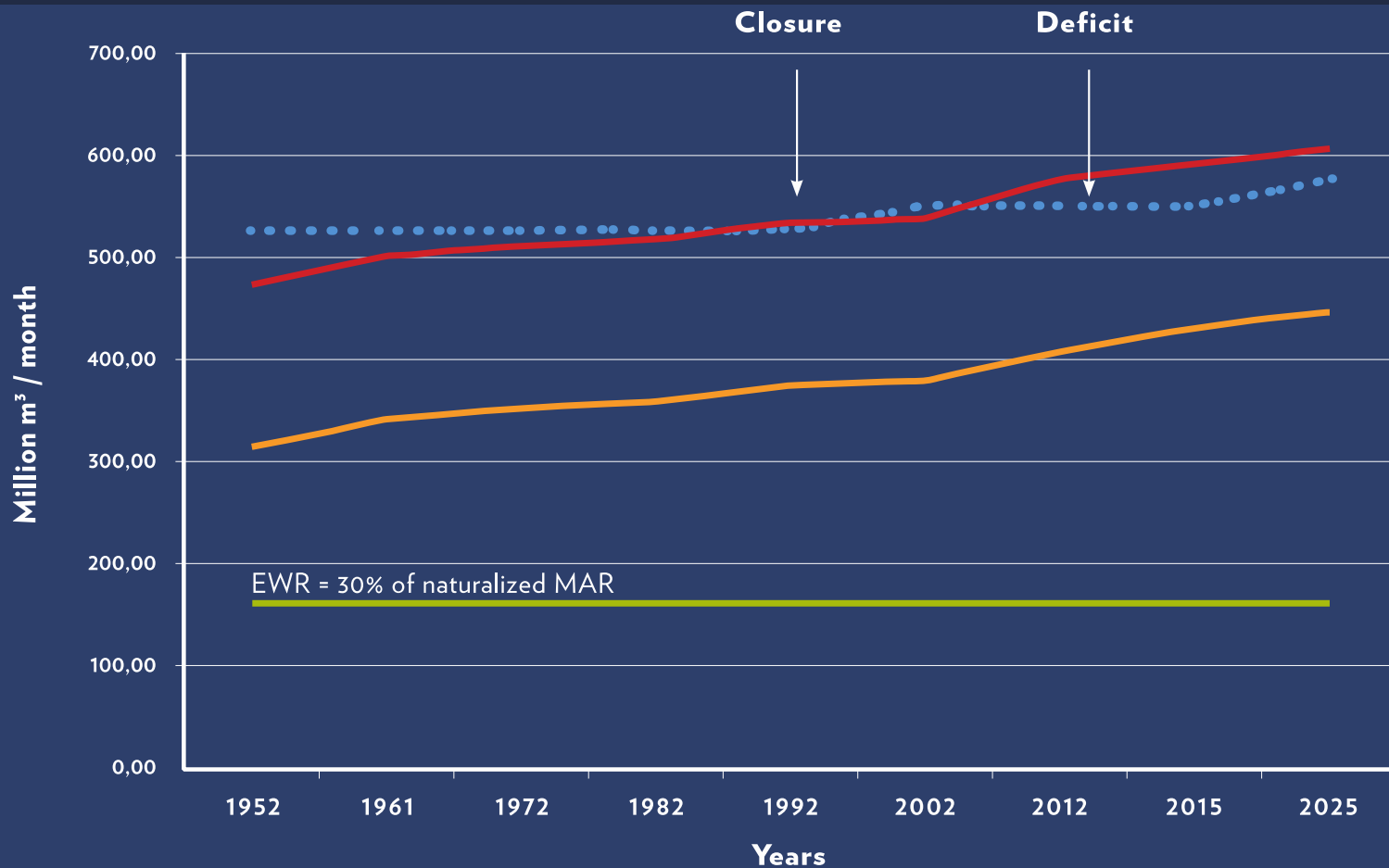
The RESILIM program overall goal is to improve trans-boundary management of the Limpopo River Basin resulting in **enhanced resiliency of people and ecosystems**.

1. Reduce climate vulnerability by promoting the adoption of science-based adaptation strategies for integrated, trans-boundary water resource management.
2. Conserve biodiversity and sustainably manage high-priority ecosystems.
3. Build the capacity of stakeholders to sustainably manage water and ecosystem resources.

The LRB is shared by 4 countries and is characterized by water scarcity



General Water Scarcity in the LRB is viewed in terms of “closure” and deficit

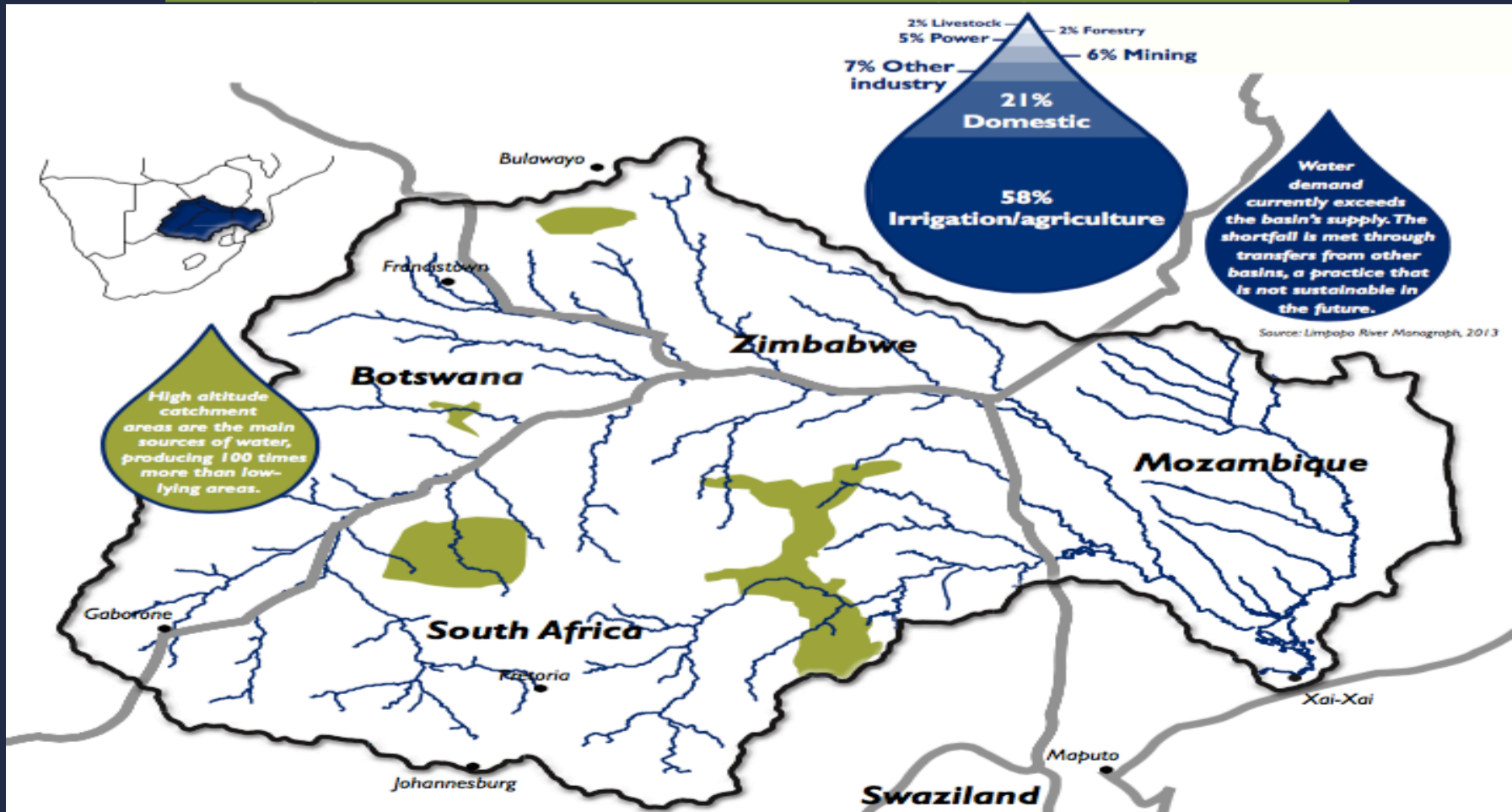


EWR = Environmental Water Reserve
MAR = Mean Annual Runoff

- Total water available
- Total (excl. EWR)
- Total water required
- Total (% of MAR)

Source: OneWorld, with values from:
Aurecon (2013) Limpopo River Basin Monograph
Bigcon (2010) Joint Limpopo River Basin Study Scoping Phase

...Key factors of the Limpopo Basin...



Key facts about the Limpopo River Basin

- Covers 411,000 km² of Botswana, South Africa, Zimbabwe and Mozambique, about the same area as Sweden.
- Home to 18 million people. 15 million in South Africa. 80 percent under age 25. Population is expected to grow 11% by 2040.
- Not one river, but many: tributaries from 27 sub-basins feed the Limpopo. But agricultural run-off, urban waste, acid mine damage, algae and invasive species, salisation and sedimentation compromise water quality in many, particularly the Olifants and Crocodile rivers.
- Along with 500+ bird, 116 reptile and 147 mammal species—including 75% of the world's rhino population—the basin's renowned game parks together represent one of the planet's greatest animal kingdoms.

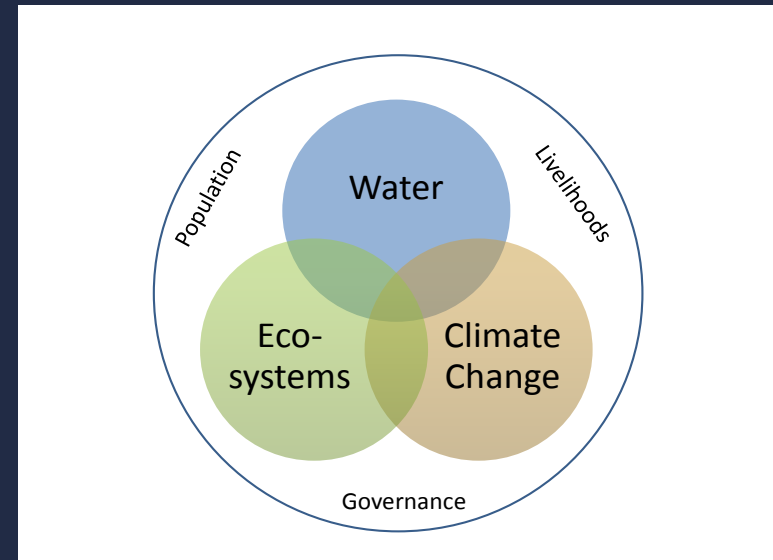
Water, biodiversity and CC – a nexus in the LRB

The LRB is already water scarce – closed status

Dimensions of water, ecosystems and livelihoods are tightly linked and interrelated, a change in one has significant impacts on the others, and vice versa

Few/ no buffers or excesses in this system of linkages in the LRB - small changes in an input pathway usually lead to clearly observable impacts on output pathways or products

External influences: population dynamics and growth (including the economic effects), livelihood needs and the effects of governance.



A systems based approach requires a combination of methodological and synthesized analysis

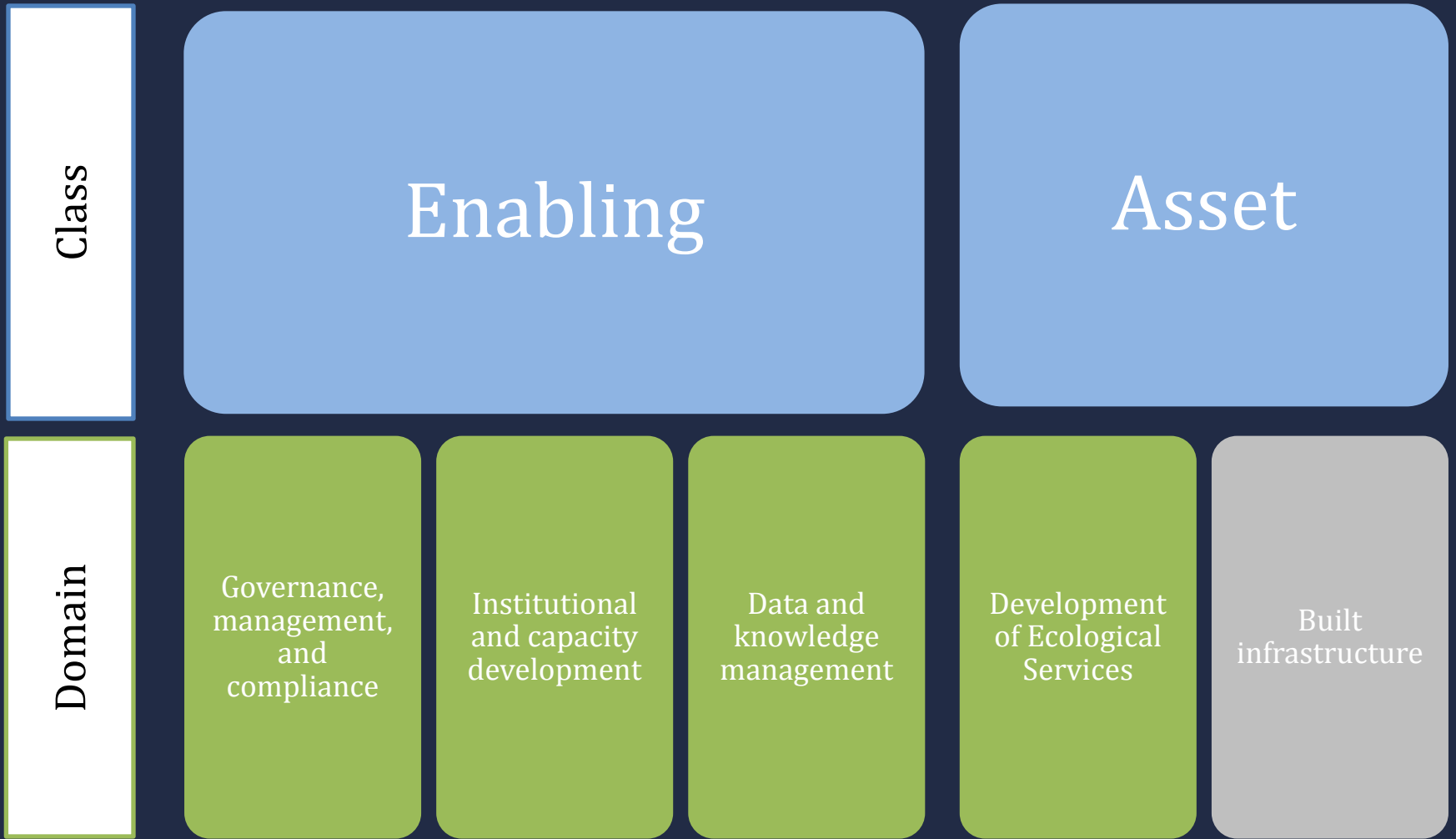
- Risk and Vulnerability Mapping
- 1st to 4th Order Impact Assessments – how does CC cascade through a system?
- Political and Livelihoods Economy Analysis
- Institutional Mapping
- Analysis of the nuances of vulnerability and development of an adaptive capacity framework
- Participatory analysis
- Multicriteria analysis: assessing the dimensions of return on investment



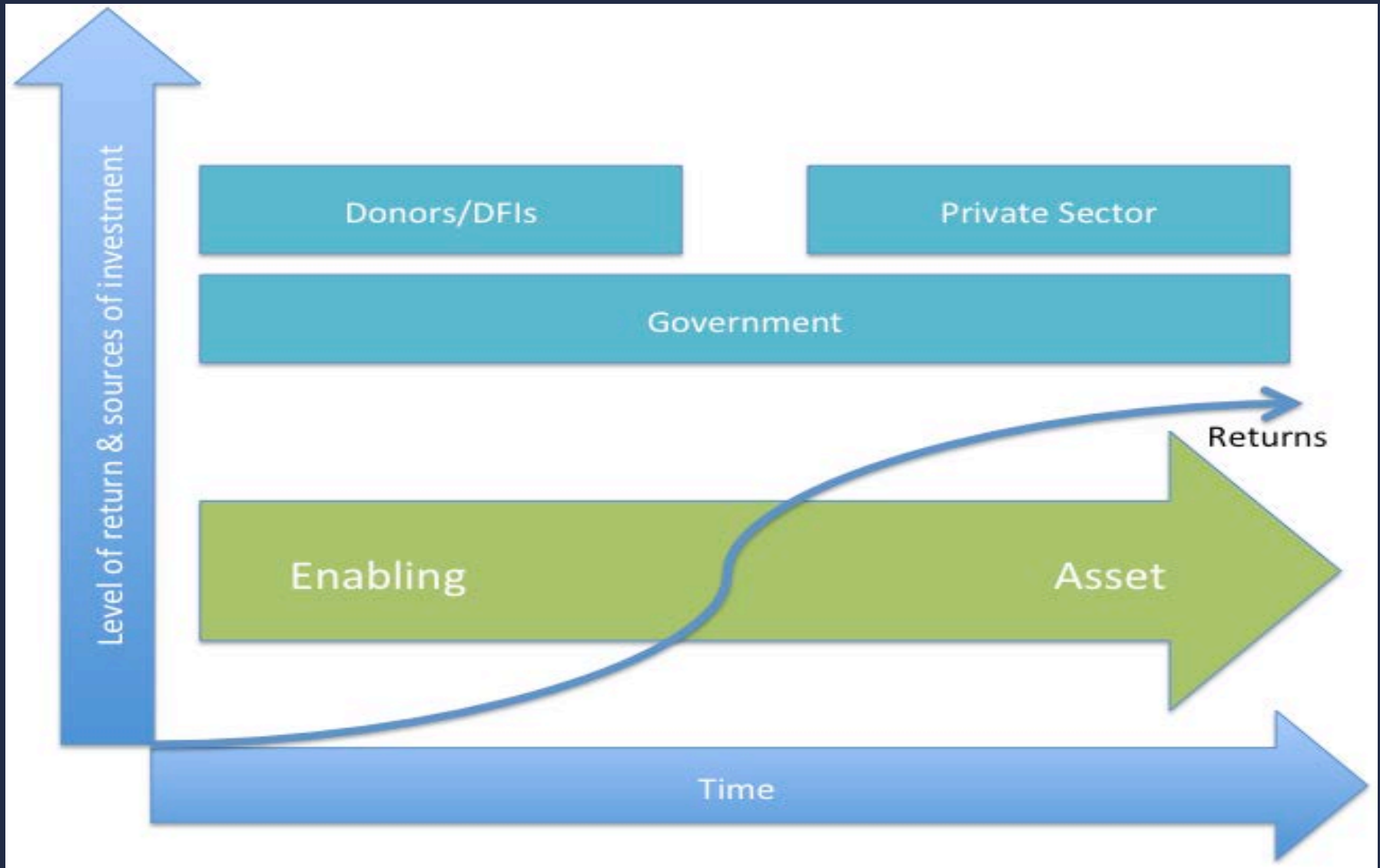
Four Integrated Investment Programs



Investment Domain By Category



Sequencing of Investors and Investments



Resilience in the Limpopo Basin: the Potential Role of the Transboundary Ramotswa Aquifer (RESILIM-TBA)



Overall objectives

- To support a long-term joined vision and cooperation on the shared groundwater resources of the upper Limpopo region
- To understand how to enhance overall water storage, including using the aquifer
- To facilitate joint management and better groundwater governance, focused on coordination, scientific knowledge, social redress and environmental sustainability
- To reduce poverty and inequities and to increase prosperity, livelihoods and food security in face of climate change and variability
- To contribute to the building of trust and transparency related to the use and development of the shared aquifer resource
- To encourage the states to enter into agreements on their shared aquifer(s)

Specific objectives

- A. To increase the recognition of the importance and vulnerability of the transboundary Ramotswa aquifer**
- B. To improve the understanding of the socio-economic importance of the aquifer area and the inequalities in water security across the population**
- C. To improve the understanding of the extent and hydrogeology of the transboundary aquifer resources under present and future climate and population projections**
- D. To assess the feasibility and best options for managed aquifer recharge (MAR) for securing the buffer and controlling the water quality, using wastewater, flood and storm water**
- E. To assess the feasibility and best options for small-scale irrigation (ag-water solutions)**
- F. To establish national and cross-border dialogue and cooperation on the Ramotswa and further encourage international cooperation on transboundary aquifers in the SADC region**
- G. To develop tools for shared and harmonised management and monitoring of the groundwater resources**
- H. To develop human and institutional capacity for shared and harmonised management and monitoring of the groundwater resources**
- I. To publish and disseminate results and findings**

Activities and outputs

Objectives	Activities	Output
A, F	Multi-stakeholder engagement	Report on Joint strategic action plan (SAP), International conference
B	Socio-economic and institutional baseline assessment	Report on Transboundary diagnostic analysis (TDA)
C	Hydrogeological characterisation (air-borne geophysics)	Hydrogeological maps Report on hydrogeology
D	Buffer assessment and MAR solutions	Report on MAR
E	Ag-water solutions	Report on ag-water solutions
G	Hydrogeological model	Calibrated model, Scenario assessments, Report on modelling
G	Joint database	Joint database
H	Training	Training material, Trained staff in relevant organisations
I	Coordination and scientific documentation	Progress reports, Scientific papers



A water-secure world

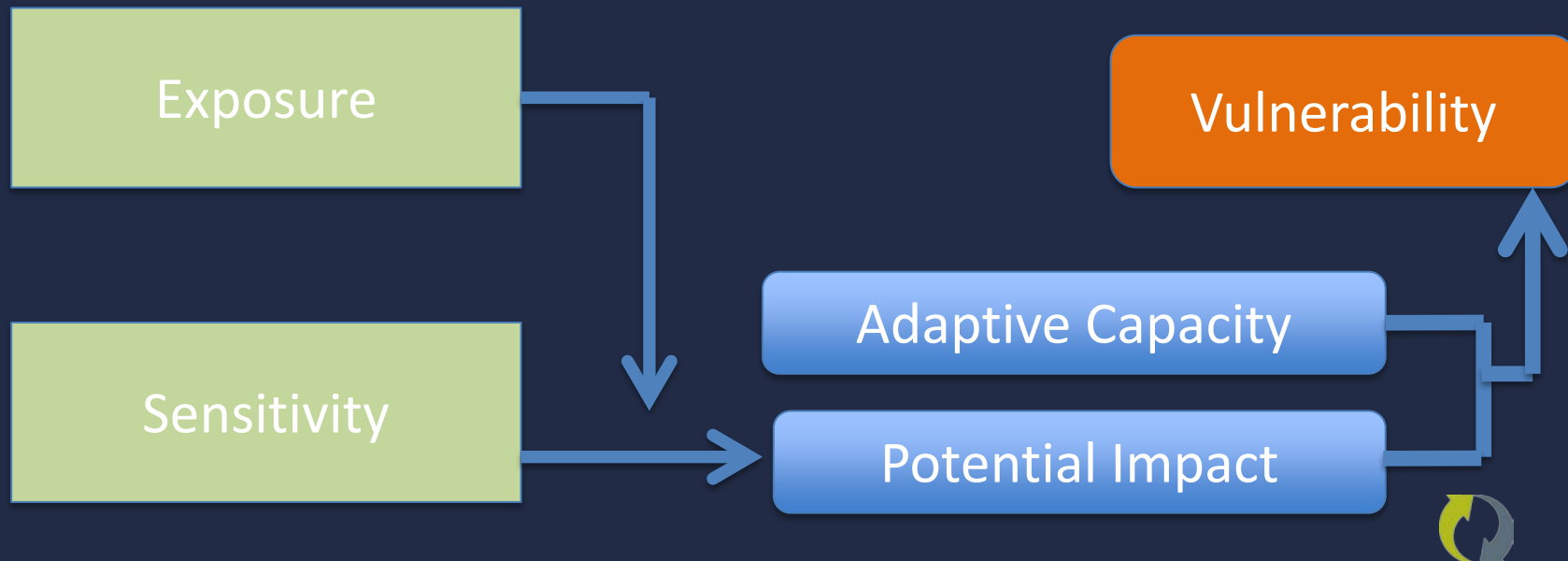
www.iwmi.org

Defining Vulnerability

The assessment of vulnerability includes measures of:

- I. exposure to harm (climate-related risk factors) and;
- II. sensitivity of both people and the environment to this harm
- III. together these show potential impact to harms, and;
- IV. the capacity of human and environmental systems to adjust and respond to these harms, and their consequences.

Source: The Intergovernmental Panel on Climate Change (IPCC)



Three Stages of Analysis

Exposure

- The risk of climate events both now and in the future

Sensitivity

- How sensitive the population and environment are to the current and future climate events

Adaptive capacity

- Ability for the population to adapt to climate change



Impacts cascade through the system; assessing impacts on other components highlights where vulnerability is most concentrated, what the drivers are and identifies the elements of resilience

temperature, rainfall

1st
order





Upper Limpopo – First to Fourth Order Impact Assessment

TEMPERATURE:

Possible increase by 2.5° C, driven by higher heat extremes:

1st Order

Soil moisture declines and there is increased evapotranspiration. Dams on both sides of the rivers have reduced water levels. Groundwater is relied on more heavily, which threatens the springs and may lead to water quality concerns.

2nd Order

There is a decrease in the productivity of ecosystems as temperatures change habitats. Temperature also decreases water availability, further placing the ecosystem under threat. There is severe threat to the ecosystem of the upper catchment due to lower flows, a drying of wetlands and less water storage capacity in the soil.

3rd Order

Reduced agricultural productivity is observed as soils become drier. Small-scale mining is scaled up to account for lost income, reducing the quality of water. Heat stress to organisms decrease the tourism potential of the area, as do water shortages. Potential localized conflict between water users.

4th Order



Pretoria North - First to Fourth Order Impact Assessment

RAINFALL:

Increase in rainfall variability:

1st Order

Low-lying land becomes water-logged in heavy rain events, with poor drainage. This compacts the clay soils and leads to cracking under periods of drought. Wetlands dry out more rapidly in summer.

2nd Order

Heavy rainfall combined with general aridification increases erosion and land degradation. Grazing potential is significantly reduced. Livestock is at risk of pests and disease when area is water logged.

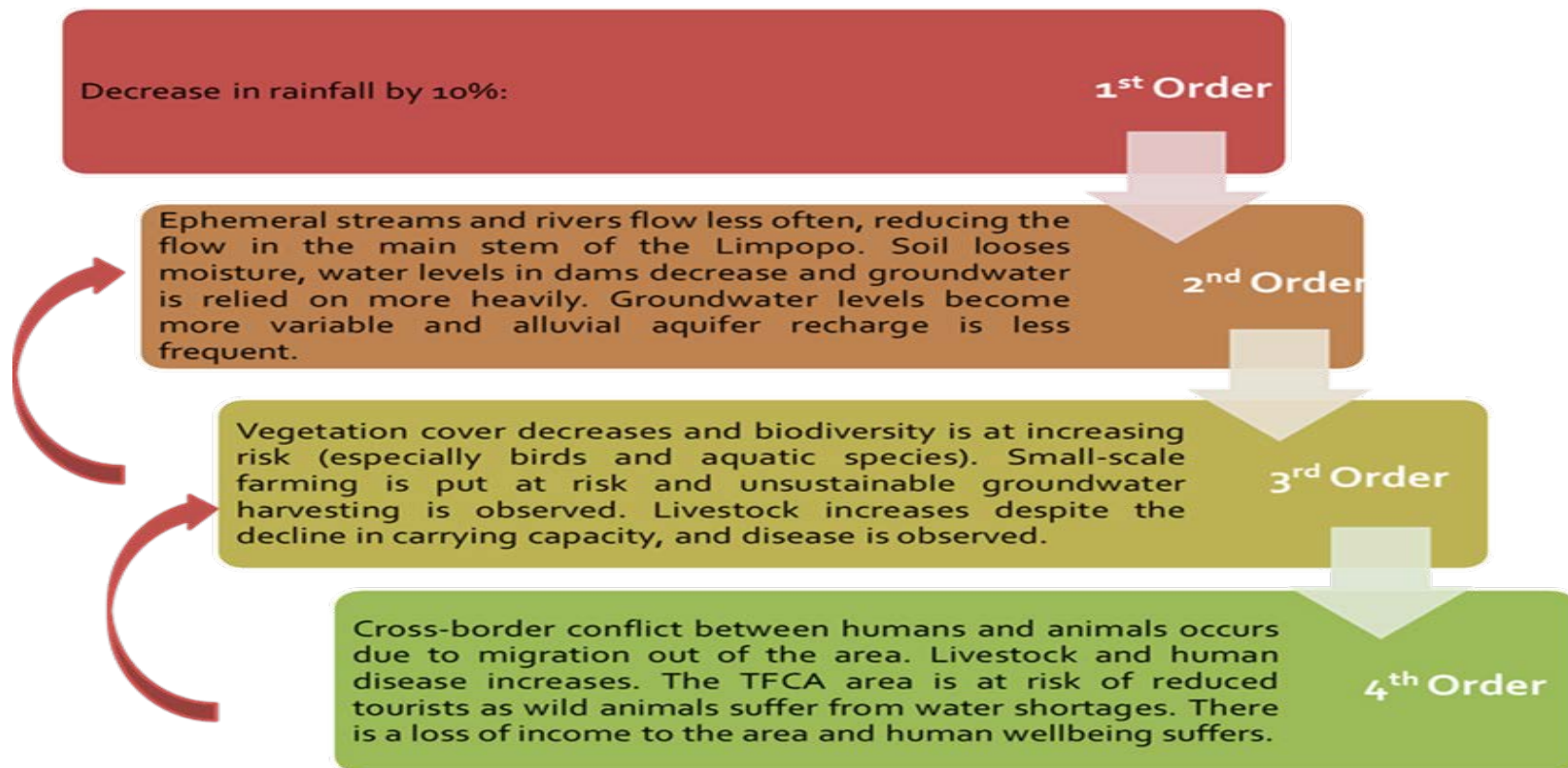
3rd Order

Poorly planned urban settlements are vulnerable to flooding, resulting in high economic and social costs to the area. An increased reliance on social-grants is expected as agricultural and livestock productivity declines. Disaster risk management is required, with costs to the economy. Pollution affects human health as well as ecosystem resilience.

4th Order



Shashe - Limpopo River Confluence - First to Fourth Order Impact Assessment





Upper Umzingwane - First to Fourth Order Impact Assessment

Increased severity and occurrence of drought:

1st Order

Ephemeral streams and rivers flow less often. Dam levels and alluvial aquifer recharge is more variable and generally decreasing. Risks to water quality increase (siltation and acid mine drainage) as flows decrease. Increased risk of wildfires.

2nd Order

Vegetation cover decreases, land becomes unproductive without irrigation in times of drought. Increased land degradation is associated with a greater reliance on livestock. Risk of over abstraction from aquifer to meet human and animal demand. Animal diseases increase.

3rd Order

Livelihoods more limited and crop productivity declines. Subsistence farming is challenged and nutrition suffers. Food security becomes a critical concern. Increasing reliance on mining on the river results in erosion and land mismanagement. Droughts threaten development and increases reliance on social systems. There is migration from the area with cross-border impacts.

4th Order



Soutpansberg - First to Fourth Order Impact Assessment

10% decrease in annual rainfall:

1st Order

Semi-arid areas transition to arid areas, putting pressure on indigenous vegetation. A decrease in rainfall results in a proportionally higher decrease in runoff, affecting the river flow downstream. Soil moisture decreases, erosion is observed and land further degrades.

2nd Order

Biodiversity suffers as water supply decreases. Alien vegetation may increase, reducing water flows further. Ecosystem services (regulation and quality) decrease. Wetlands dry out. Agricultural productivity decreases and reliance on livestock increases. Water quality deteriorates and there are siltation concerns due to erosion.

3rd Order

Reduced runoff becomes a driver of stress in the area, with negative impacts downstream. Siltation decreases productivity of infrastructure. Agricultural livelihoods as well as those reliant on the environment (such as subsistence fishers) become difficult, with increasing poverty and food insecurity.

4th Order



Pafuri Triangle - First to Fourth Order Impact Assessment

Rainfall declines:

1st Order

High rainfall variability leads to severe water stress in this region, with longer periods of low flows in the rivers. Episodic flash floods occur after heavy rainfall. Groundwater levels become more variable and are often decreasing.

2nd Order

Vegetation cover decreases and species range changes. Productivity of grazing is reduced and livestock/game production becomes more variable and at higher risk of drought. There is increased cross-border animal movement and lower rainfed crop yields.

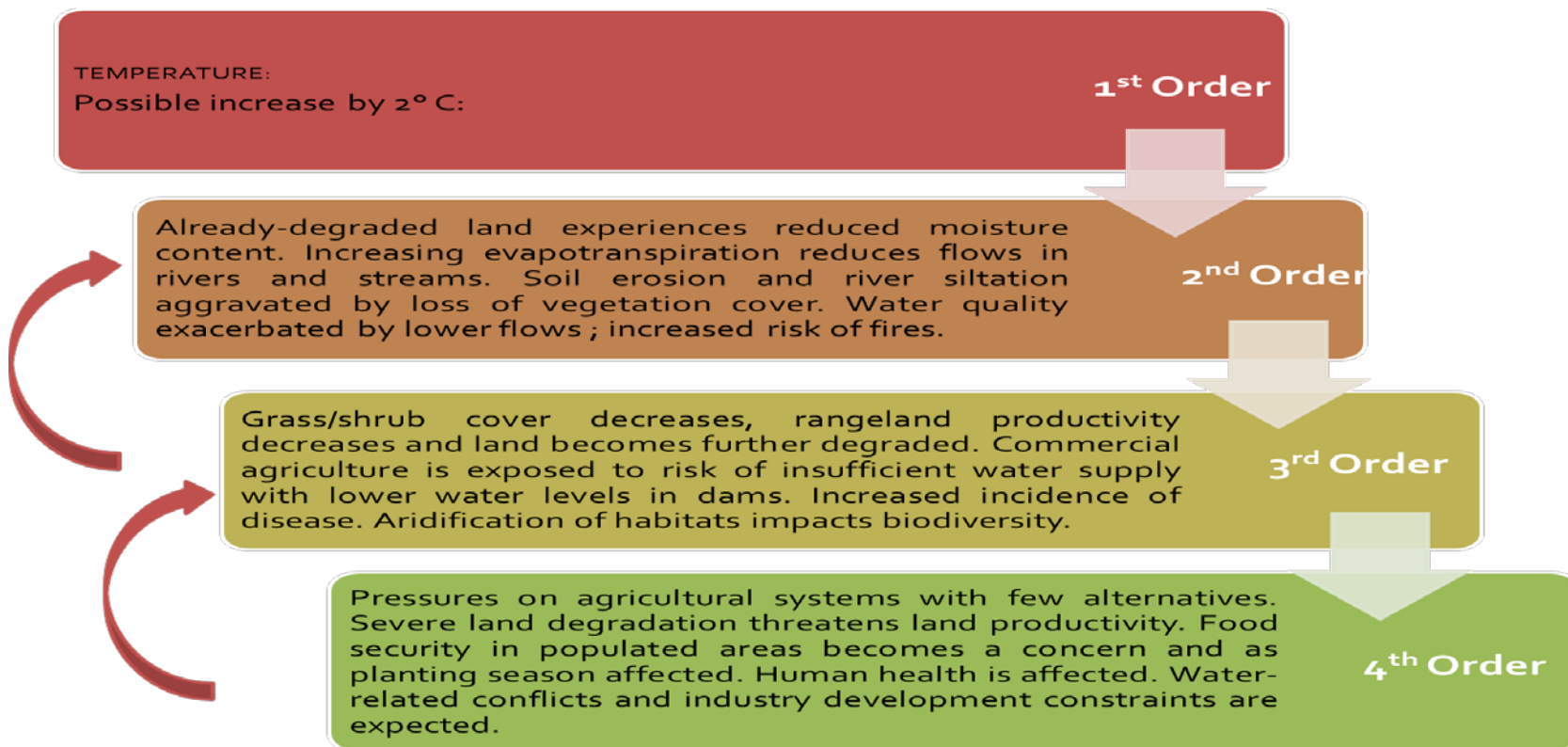
3rd Order

Agricultural livelihoods become marginal, while alternative livelihoods decline as eco-tourism is impacted. Migration becomes an even more significant feature of this transboundary region. Human health is challenged by poor nutrition, migration and transhumance. Collaborative governance becomes of critical importance.

4th Order

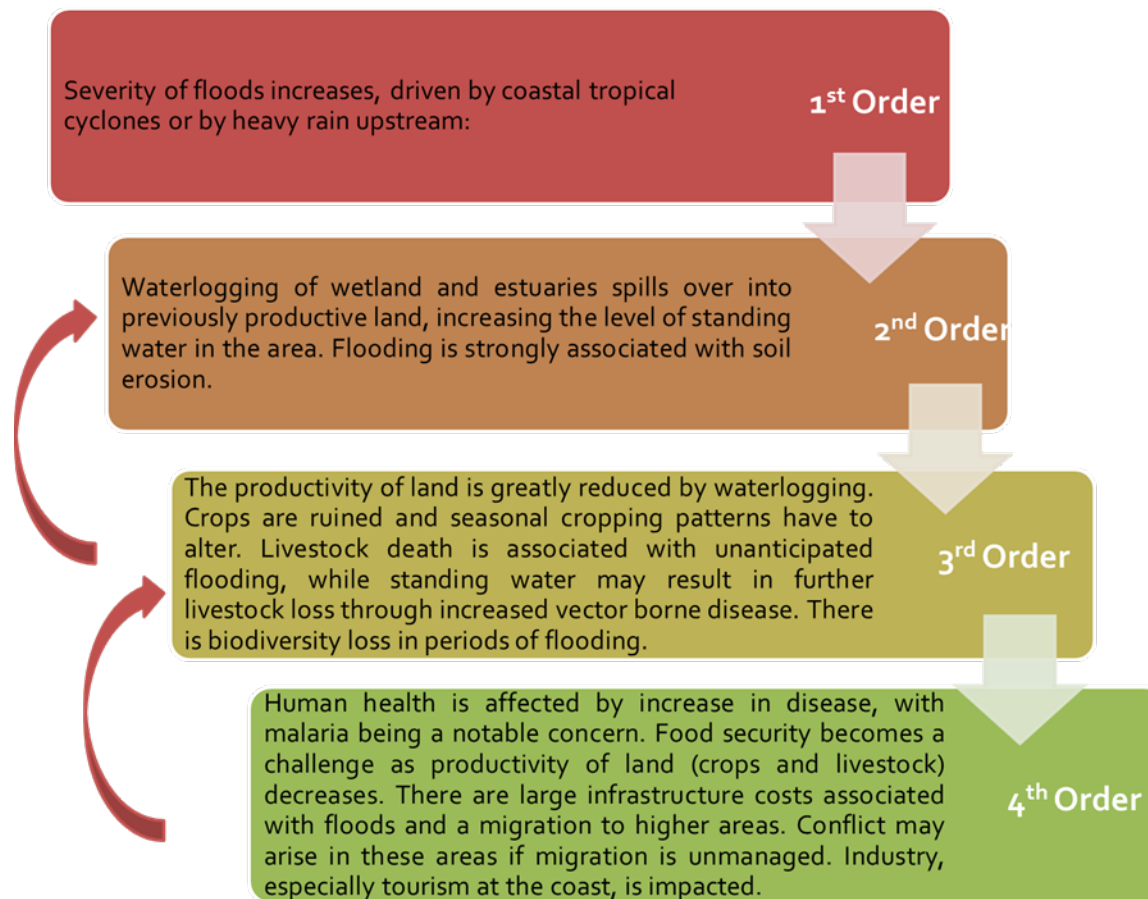


Middle Olifants – Former homeland area of Lebowa First to Fourth Order Impact Assessment





Lower Limpopo - First to Fourth Order Impact Assessment



Degraded land (orange) juxtaposed against high biodiversity, high runoff catchment areas (green) emphasizes the relationship between the high water and land demand on these once-fertile areas.

