The Ecological Reserve means the quantity and quality of water required to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource. This is an allocation of water to sustain a river ecosystem so that it continues to provide the desired ecosystem services, such as water supply and quality, flow regulation and aquatic productivity, to society.

5. Conclusion and linkages

Climate change impacts on South Africa are likely to be felt primarily via effects on water resources. There is substantial uncertainty for rainfall scenarios, and thus neither drier nor wetter scenarios can be excluded. Under a drier future scenario, significant trade-offs are likely to occur between developmental aspirations, particularly in terms of the allocation between agricultural and urban-industrial water use, linked to the marginal costs of enhancing water supply. These constraints are most likely to be experienced in central, northern and south-western parts of South Africa, with significant social, economic and ecological consequences through restricting the range of viable national development pathways. Under a wetter future scenario, trade-offs in water allocation between sectors are likely to be less restrictive, providing greater scope for urban-industrial economic growth and water provision for an intensive irrigated agricultural production model. In both wetter and drier futures, a higher frequency of flooding and drought extremes is expected with cross-sectoral effects on human settlements, disaster risk management and food security. There is a need to explore the socio-economic implications of a range of possible climate-water futures to inform key decisions in development and adaptation planning in South Africa in order to build the climate resilience of vulnerable communities and groups.

International mitigation action could sharply reduce uncertainty relating to changes in hydrology and water supply in South Africa.

The Climate and Impacts Factsheet Series has been developed to communicate key messages emerging from LTAS Phase 1, and to complement the LTAS Phase 1 technical reports and the summary for policy-makers. This factsheet has been developed specifically to provide policy- and decision-makers, researchers, practitioners and civil society with up-to-date information on climate change impacts, adaptation responses and future research needs for the water sector in South Africa.

The information is built upon past and current research, including the National Water Resource Strategy, the National Water Adaptation Strategy process, and new impact modelling for annual and seasonal national runoff and irrigation demand using updated scenarios and the latest downscaled models produced during LTAS Phase 1. For further details see the LTAS Phase 1 full technical report entitled Climate Change Implications for the Water Sector in South Africa.

4. Future research needs

Research is required to support the development of tools, approaches and case studies that inform water planning for long-term climate change. This includes understanding the way in which climate driven changes in the availability of, and demand for, water resources may constrain or enable different development pathways in different parts of South Africa. Of particular relevance are cross-sectoral implications of the allocation of water resources, including groundwater resources. In addition, it would be valuable to explore the changing long-term hydrological implications of climate change for the ecological reserve (including the appropriate definition of the reserve) and the associated catchment management approaches needed to maintain the ecological reserve in different systems (see Box 5).

BOX 5. ECOLOGICAL INFRASTRUCTURE AND THE ECOLOGICAL RESERVE

“Ecological infrastructure is the network of natural lands, working landscapes and other open spaces that are the substrates or underlying foundation on which the continuance or growth of essential ecosystem goods and services depends”.

FACTSHEET SERIES PRODUCED BY
SANBI, DEA and GIZ in consultations with relevant sector stakeholders

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- LTAS Phase 1 Methodology
- Climate Trends and Scenarios for South Africa
- Climate Change and the Agriculture Sector
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Photos by Gigi Laider

1. Background

Because of South Africa’s generally arid to semi-arid climate, less than 9% of annual rainfall ends up in rivers, and only about 5% recharges groundwater in aquifers. In addition, rainfall and river flow are unpredictable in time and unevenly distributed in space, with only 12% of the land area generating 50% of stream flows. Decadal rainfall variability also results in extended dry and wet periods across the country.

The main users of surface water resources are agricultural irrigation, domestic, industrial, mining and power generation, while plantation forestry intercepts and reduces runoff before it reaches the rivers and groundwater. Surface water resources were already over-allocated by the year 2050 in five of nineteen water management areas historically used for water planning and management purposes. Potential demand for water is expected to increase with economic growth, increased urbanisation, higher standards of living, and population growth. Because of the critical importance of water in the South African economy the country has a sophisticated water resources planning capacity, founded on a good understanding of the country’s variable rainfall. This planning capacity will be a key capability for adaptation planning under ongoing and future climate change.

2. Climate change impacts on the water sector

Climate change impacts on water in South Africa could exacerbate existing water-related challenges and create new ones related to climate variability, extreme weather events and changing rainfall seasonality. This would affect a wide range of economic sectors and livelihoods and impact on the development of infrastructure into the future, including through water quality-related issues (see Box 1). Projected impacts are due to changes in rainfall and evaporation rates, further influenced by climate drivers such as wind speed and air temperature as well as soils, geology, land cover and topography across South African water catchments. Hydrological modelling is essential for translating these complex interactions into potential water resource impacts (see Box 2).
Hydrological modelling is used to understand how changes in rainfall and evaporation on the hydrological system in South Africa. The Pitman model approach has strengths related to broader time and spatial scales and for cross-sectoral integrated assessment.

A key impact of climate change will be changes in runoff across the country. Under a wetter future climate scenario, significant increases in runoff would result in increased flooding, human health risks, ecosystem disturbance and aesthetic impacts (see Box 3). Drier future climate scenarios would result in reduced surface water availability, but would not exclude the risk of extreme flooding events. Projections for national runoff range from a 20% decrease to a 60% increase based on an unmitigated emissions pathway, which reflects substantial uncertainty in rainfall projections. Across the country, this ranges from increases along the eastern seaboard and central interior to decreases in much of the Western and Northern Cape.

Areas showing the highest risk from extreme runoff include KwaZulu-Natal, parts of southern Mpumalanga and the Eastern Cape. Other areas show neutral to reduced risk from runoff, with the exception of the central and lower Orange River region (Figure 1). Specific areas of high risk from increased evaporation, decreased rainfall and decreased runoff include the south-west of the country, the central-western areas and to some extent the extreme north. If global emissions are constrained to stabilise at 450 ppm CO₂, the risk of extreme increases and reductions in runoff could be sharply reduced, and the impacts could be reduced by a 5% decrease and a 20% increase in annual runoff, reflecting sharply reduced uncertainty in rainfall projections.

BOX 1. CLIMATE CHANGE WATER QUALITY-RELATED IMPACTS.
- Less irrigation and drinking water could be available due to increasing air and water temperatures.
- Increased periods of drought mean less water is available to dilute wastewater discharges and irrigation return flows resulting in raw sewage discharges into rivers, scouring and erosion of urban streams, increased sediment and pollutant overflow and damage to low lying water and wastewater treatment works disrupting drinking water supplies.
- Human health and ecosystem impacts, associated with increased rainfall intensities, flash floods and regional flooding including overflowing sewers due to sewage pipes blocked with washed-off debris, damage to sewerage infrastructure resulting in raw sewage discharges into rivers, scouring and erosion of urban streams, increased sediment and pollutant overflow and damage to low lying water and wastewater treatment works disrupting drinking water supplies.
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BOX 2. HYDROLOGICAL MODELLING IN SOUTH AFRICA
- Hydrological modelling is used to understand how changes in precipitation, temperatures and carbon dioxide will affect hydrological processes such as runoff, soil moisture and evapotranspiration.
- South Africa has developed considerable expertise and technology in modelling hydrological processes linked to climate variability and change.

BOX 3. EFFECTS OF EXTREME CHANGES IN RUNOFF AS A RESULT OF CLIMATE CHANGE
- Increased erosion and sedimentation, causing loss of fertile topsoil and reductions in the fertility and quality of agricultural productivity as well as disruptions in aquatic ecosystems.
- Increased transportation of water pollutants (petroleum and hazardous substances/chemicals, herbicides, fertilisers and sediments) through surface water, groundwater and soil systems leading to human health risks, contamination of drinking water, ecosystem disturbance and aesthetic impacts on water resources.
- Increased flooding or drought, resulting in loss of life, livelihoods and assets, damage to infrastructure, contamination and/or limitation of water supplies, loss of crops, and community displacement.

BOX 4: PRIORITY FUNCTIONS THAT WOULD BE BENEFICIAL TO THE DEPARTMENT OF WATER AFFAIRS
1. Policy review for enabling flexible frameworks.
2. Flexible and robust infrastructure planning.
3. Maintaining and rebuilding ecological infrastructure in vulnerable systems (see Box 5).
4. Institutional oversight to ensure that water-related institutions build adaptive management capacity.
5. Effective information management and maintenance of monitoring and evaluation systems.
6. Sustainable and locally accessible financial management.

Three types of resilience can be considered for the water sector in the medium and long-term. Development resilience relates to economic and social systems supporting equity and growth. Water resilience builds on integrated planning and is based on water management that responds to hydrological variability. Climate resilience expands on water resilience, but ensures that water management is robust under future climate conditions (Figure 2). Key decisions will benefit from considering the implications of a range of possible climate-water futures facing South Africa. A scenario-based approach is a viable way forward with respect to exploring adaptation options. This is because the current modelling of future climate is uncertain with respect to rainfall variability and seasonality change, but more certain with regard to warming projections.

Figure 1: Median impact of climate change on the average annual catchment runoff for the period 2040–2050 relative to the base scenario average for 1990–2000 for all secondary catchments in South Africa derived from a Hybrid Frequency Distribution (HFD) analysis of all possible global circulation model (GCM) outputs (>6000 scenarios) for an Unconstrained Emissions Scenario (UCB).

Figure 2: Distinction between medium and long-term planning for water development and climate.