



TECHNICAL ANALYSIS TO SUPPORT THE **Adaptation Component** OF SOUTH AFRICA'S SECOND NDC



TECHNICAL ANALYSIS TO SUPPORT THE ADAPTATION COMPONENT OF SOUTH AFRICA'S SECOND NATIONALLY DETERMINED CONTRIBUTION

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Executive Summary

This adaptation technical report presents the evidence informing South Africa's climate change adaptation targets and priorities for 2031 to 2035 articulated in the country's second Nationally Determined Contribution (NDC2) submission ahead of COP30 in November 2025. NDC2 extends and increases ambitions set in the 2021 update to SA's first NDC. The submission of NDCs every 5 years is a requirement of the UNFCCC Paris Agreement. South Africa's policy ambition for the coming NDC2 period is to advance adaptation implementation, building on and extending the legislative developments that have been the primary focus over the past five-years, culminating in the promulgation in 2024 of SA's Climate Change Act. To support the ambition of advancing adaptation implementation where it is needed most, this technical report sets out to review key climate change risks and identify priority adaptation measures for resourcing between now and 2035.

Most South African sectors, provinces and municipalities have already experienced numerous, costly and damaging climate impacts at the current level of 1.3°C global warming above the pre-industrial climate, although attribution studies have only been conducted on some extreme events and a consolidated inventory of these impacts and associated losses and damages does not yet exist in South Africa to underpin a comprehensive assessment. An analysis of the April 2022 rainfall event that caused extreme flooding in Kwa-Zulu Natal (KZN) and the Eastern Cape found that the probability of such a rainfall event occurring has approximately doubled because of human-induced climate change (Pinto et al, 2022). In a 1.2°C cooler world that same intensity of rainfall event would have had a 40-year return period, whereas now it has a 20-year return period. The impacts of that event included: 443 people died; 48 people went missing and remain unaccounted for; over 26,000 dwellings were damaged; 600 schools and 84 health facilities were damaged. Repair costs for damaged infrastructure, roads, water treatment facilities and electrical distribution systems were estimated to exceed R10 billion, and economic losses across the KZN province were estimated at R17 billion (Presidential Climate Commission, 2023). An attribution study of the 2015–2017 'Day Zero' drought in the Western Cape found that such a multi-year low rainfall event is three times more likely because of current levels of human-induced climate change (Otto et al., 2018). The Western Cape Government estimated the impact of this drought on the agricultural sector to be in the order of R5.9 billion losses in the 2017/18 season due to a drop in production and export volumes, resulting in around 30,000 jobs being lost, roughly 15% of agricultural employment in the province (Pienaar and Boonzaier, 2018).

Latest global climate projections suggest that at least one of the next five years will be more than 1.5°C above the 1850–1900 global average, and there is a small chance of one year exceeding 2°C of global warming above pre-industrial levels by 2029 (WMO, 2025). Adaptation planning for the period 2031–2035, the focus of SA's NDC2, must therefore prioritise implementing adaptation measures designed to reduce climate impacts at global warming levels of 1.5–2°C, preparing for loss and damages associated with residual risk that is not sufficiently adapted to, and building capacity for implementing future options to deal with even higher levels of global warming.

Multidimensional vulnerability assessment and mapping across South Africa, overlaid with recorded disaster incidents, shows many parts of KwaZulu Natal, North West, Limpopo and Eastern Cape to be highly susceptible to climate impacts, needing priority support for implementing adaptation (Shifa et al., 2023.). Vulnerability indicators found to be prevalent are lack of access to safe sanitation, clean water and nutritious food. Having these needs unmet, especially in households with young children, elderly, and persons living with disability, reduces people's ability to deal with flooding, heat stress, drought and

other climate stresses and shocks. Adaptation or climate resilient development measures that enhance access to safe sanitation, potable water, and affordable, nutrient-dense food are therefore a priority.

South Africa is experiencing significant climate shifts, with temperatures rising faster than the global average over large parts of the country, leading to more frequent and severe extreme weather events, including droughts, floods, heatwaves and wildfires. Key climate risks and impacts are determined by climatic hazards and the vulnerabilities, exposures and levels of action to respond to climate change. Climate related risks of key concern for South Africa are:

	Water and energy insecurity due to drought-induced shortage of water supply and hydropower. Projections show that many South African settlements will face increasing risk to water access and quality under increased warming.
	Food insecurity, malnutrition and loss of livelihoods due to reduced food production from crops, livestock and fisheries linked to increasing heatwaves and shifting rainfall patterns at critical times in plant seeding, animal breeding and maturation cycles and harvesting periods. Future warming is expected to negatively affect food systems and agricultural livelihoods by shortening growing seasons and increasing water stress with particularly high risk to female-headed households in agricultural districts in South Africa.
	Decreased economic output and increased poverty and unemployment rates due to increased heat and frequency and severity of droughts, storms and flooding undermining livelihoods and business operations, especially in agriculture, fisheries, construction, tourism and logistics.
	Increasing costs of use, maintenance and repair to infrastructure, notably including roads and energy generation and distribution infrastructure, due to projected trends in rainfall, temperature and sea level rise, with cascading impacts associated with disruption to health services, education, financial systems, transport and logistics, and water treatment.
	Increased mortality and morbidity due to increased vector-borne and diarrhoeal diseases linked to increasing rainfall intensity and poor sanitation, as well as heat stress, especially informal settlements. Mortality and morbidity will escalate with further global warming, placing additional strain on South Africa's health and economic systems.
	Extinction of animal, insect and plant species and loss of marine, freshwater and land ecosystem services due to heat, ocean, soil and terrestrial watercourse acidification, wind and water stress, together with habitat fragmentation. South African biodiversity loss is projected to be widespread and escalate with every 0.5°C increase above present-day global warming.
	Growing and widespread economic and non-economic losses and damages to heritage and loss or significant change in cultural resources that contribute to adaptive capacity and resilience, including Indigenous Knowledge, identity, social cohesion, social and kinship reciprocity networks and practices.

	Transboundary, cascading and compounding risks to regional economies, public service provision and governance due to severe, concurrent or successive climate-intensified disasters (floods, droughts, fires, wind, heat) affecting water security, energy security, and human mobility across the southern Africa region and the African continent. Trends in current exposure of people, assets and infrastructure to climate hazards will increase under future warming levels and be affected by rates of urbanisation, infrastructure deficit, and informal settlement growth. Climate change is projected to increase internal and rural-to-urban migration within South Africa and cross border migration in southern Africa, due to the direct and indirect environmental stressors on people's livelihoods and well-being.
	Sustainable, integrated management of water is a top priority for climate adaptation in South Africa because water underpins and mediates much of the risk to food security and human health, as well as ecological health. With many major water resources shared with neighbouring countries, it is a national priority to invest in regional water initiatives and programmes such as the SADC Water Fund, the Climate Resilient Infrastructure Development Facility, WaterNet and SADC Groundwater Management Initiative, strengthening River Basin Organisations and governance arrangements for the cooperative management of transboundary aquifers.

Impacts of climate extremes on transport infrastructure, especially in coastal areas, undermines disaster responses and severely disrupts formal and informal economic activities and livelihoods. Upgrading road, rail and port infrastructure to withstand higher temperatures, heavier rains and strong winds is critical to building South Africa's adaptive capacity. South Africa hosts many cultural and natural World Heritage Sites and Ramsar sites of national and international significance that are projected to be exposed to impacts of extreme sea levels associated with sea level rise and coastal erosion. This is an area where further adaptation planning needs to be targeted.

South Africa faces increasing demand for cooling, with summer demand for air-conditioned cooling expected to increase over an extended period from September to April. High temperatures, low rainfall (especially in the growing season) and flooding that affect school attendance are projected to undermine educational attainment and human capital development in South Africa, unless proactive adaptation measures are forthcoming. The need for low-carbon cooling measures, especially for the elderly, pregnant women, young children and those with severe health conditions (i.e. focussing on care homes, hospitals, ECD centres and schools), particularly in the northern parts of the country, is of the utmost importance for South Africa to adapt. Increasing access to cold storage facilities across food value chains, including small-scale producers and local food vendors is also likely to be needed.

Climate impacts and adaptation efforts are reinforcing, amplifying and generating new existing socio-economic and spatial inequalities. Private adaptation actions taken by businesses and residents are outpacing public adaptation efforts with the risk of undermining cross-subsidisation mechanisms needed to finance public adaptation efforts. Adaptive capacities are highly varied and unequally distributed between municipalities, provincial governments and national departments. Municipalities, with coordination, financing and technical support of provincial and national government, are the frontline workers of climate adaptation and need more personnel who are able to actively assess place-based climate risks and adaptation needs, design context-sensitive and gender-responsive interventions, and monitor adaptation outcomes across sectors and line functions.

Adaptation actions present opportunities to save money, access new technologies and finances, create new jobs, forge new alliances, and increase safety, thereby increasing people's sense of wellbeing. There is an opportunity to spatially redistribute climate impacts and buffer climate shocks by increasing investment in cross-border networked infrastructure and regional coordination bodies and mechanisms. Regional adaptation initiatives involving multiple countries provide opportunities to access international climate finance. Opportunities exist to create local jobs through labour-intensive adaptation measures such as maintenance and ecological restoration of rivers, streams, wetlands and ponds to channel and store water during intense rainfall events, fire management through the creation and maintenance of fire breaks, removing invasive plants and controlled burning, planting indigenous species, constructing and maintaining net structures to stabilize coastal dunes, manufacturing, installing and servicing waterless toilets, and the construction and maintenance of community-based places of safety to gather and coordinate rescue efforts during extreme events such as heatwaves and storms. The adaptation agenda presents an opportunity to redesign and scale out health surveillance, early detection, warning and response systems to curb the escalation of climate-related health impacts, and to proactively adjust working conditions (for example, installing solar powered cooling systems into food markets) to reduce exposure. Adaptation opportunities exist in scaling land, water and marine stewardship programmes that incentivize and resource the restoration and maintenance of ecological infrastructures that support biodiversity. Leveraging these adaptation opportunities requires (re)directing resources, leveraging new resources, building and extending relevant capabilities, and exercising forms of organising that make this kind of localised yet coordinated work possible.

The review of climate change risks, existing adaptation efforts and perspectives of experts in South African adaptation suggest that an ambitious NDC2 for South Africa would build on and extend the goals of the last NDC update to pursue the following adaptation goals:

1	Adapt South Africa's water and sanitation systems to drying conditions and drought and flood intensification, as water underpins human, plant and animal health and all economic and livelihood activities.
2	Enhance disaster risk management, healthcare and sanitation provision, especially in informal settlements, to reduce impacts of flooding and heat stress on most vulnerable households.
3	Upgrade critical transport infrastructure (roads, rail, ports) to maintain functioning under increased rainfall intensity, heat stress, wind speeds and storm surges.
4	Enhance nutritious food access and affordability through support to agricultural and fisheries producers and distributors in adapting to warmer and windier conditions and changes in rainfall.
5	Enhance the provision of climate services, with early warning and impact information made accessible to a wide range of users, tailored to different operational, language, gender, age and disability needs.
6	Enhance ecosystem-based adaptation to heat and water stress, protecting South Africa's natural heritage, biodiversity and improving ecosystem functioning that underpins our cultural identity, food systems, human wellbeing and tourism economy.
7	Capacitate all spheres of government to implement adaptation through enacting and enforcing all provisions of the Climate Change Act.

An eighth adaptation goal was subsequently added during the political process of developing the NDC text, namely “Enhanced efforts to build climate resilient human settlements and resilient infrastructure”.

A list of 36 interventions that contribute towards achieving these goals, as well as a high-level costing of these interventions is provided in [sections 10](#) and [11](#) of the report. Implementing the 36 adaptation options will require an estimated R25 billion per annum over the next 10 years. Three quarters of this investment is required for the nine options in Adaptation Goal 1: *Adapt South Africa’s water and sanitation systems to drying conditions and drought and flood intensification, as water underpins human, plant and animal health and all economic and livelihood activities*. The estimated investment need (R250 billion over 10 years) reflects the 36 priority actions only, not the full extent of South Africa’s climate change adaptation needs or the damage caused by climate change.

The respective options vary greatly in terms of their economic efficiency (cost-benefit) and their projected ability to save lives, but all options are deemed to be worth the investment in terms of protecting valuable assets, nature, human well-being and economic activity. All options require investment in 2026, but one option would involve less public expenditure by removing the need for existing expenditure on contracted portaloos. If fully implemented, the 36 options could save an estimated 158 thousand lives over the next 10 years. In terms of cost-benefit (economic efficiency), the following options emerged as the most cost-effective:

2.4

Extend and upgrade sanitation services in high-risk informal settlements, especially near food vendors, which saved money by displacing expenditure on contracted portaloos;

5.4

SADC integrated regional drought monitoring system;

5.1

Enhance early warning systems (monitoring, warning dissemination and response triggers), building on SAWS multi-hazard EWS.

The ranking exercise and model that combines multi-criteria assessment and cost benefit analysis can be used repeatedly, with a variety of stakeholders. It is recommended that the process be repeated with more decision makers across the technical and political domains, as detailing the practicalities of each option, going through the scoring, deliberating differences and arriving at an agreed set of results is crucial to building buy-in to the implementation of South Africa’s adaptation agenda across multiple sectors.

While most adaptation options fall into the category of ‘public goods’ and are likely to require public or donor money, some of the 36 adaptation options have attributes of ‘private goods’. The incentive for private sector investment is expected to increase as climate change impacts get worse over the next 10 years. Platforms that can blend public and private investment in support of adaptation and climate resilient development are required in South Africa.

Given that South Africa’s 2025/26 budget intends to spend R210 billion on local government’s equitable share, human settlements and water and electricity infrastructure”, R175.7 billion for economic regulation and national infrastructure and R23.7 billion for agriculture and rural development, there is a clear case for ensuring that these allocations do not amplify climate risk or undermine adaptive capacity, and instead that they align with climate resilient development.

SECTION 1

INTRODUCTION

NDCs communicate each country's contribution to meeting the Paris Agreement objectives of limiting global temperature increase to as close to 1.5°C as possible, and not more than 2°C, strengthening climate resilience in light with the Global Goal on Adaptation (GGA), and mobilising increasing financial flows for international support to address climate change. Each NDC must be increasingly ambitious, suitable to the developmental and environmental context and circumstance of the country. The efforts are nationally determined on a 5-yearly cycle, laying out targets and priority measures for equitably reducing the emission of greenhouse gases, increasing carbon sinks, and adapting to reduce climate impacts, especially for the most vulnerable. The NDC should also contain information about the need for and/or provision of finance, technologies and capacity building to enable these efforts. For South Africa, the Adaptation Communication will serve as the adaptation component of the NDC.

SA's first NDC, updated in September 2021, outlined the adaptation priorities for South Africa, ranging from policy, planning, enhancing governance and implementation of adaptation programmes, and laid out details of planned adaptation actions and associated costs for health, agriculture and forestry, human settlements, biodiversity, and water. The updated first NDC lays out five adaptation-related goals for the period 2021 to 2030:



SA's second NDC seeks to progress from developing to implementing the legal frameworks for climate action countrywide. Drafting SA's NDC2 provides an opportunity to align South Africa's adaptation targets with international developments being made on setting targets and indicators for the Global Goal on Adaptation, hoped to be a unifying framework that will drive political action, finance and support for timely adaptation on a large-scale. The goal, as stated in the 2015 Paris Agreement, is to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change, contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal (limiting global temperature increase to well below 2°C or ideally 1.5°C above pre-industrial levels). In light of international emissions of greenhouse gases and mitigation efforts not being on track (with a few notable exceptions, such as Bhutan), the recent global stocktake indicating current NDC commitments putting the world on track for a 2.5 to 2.9°C global temperature increase above pre-industrial levels, and recorded global temperatures exceeding 1.5°C above pre-industrial levels for the first time in 2024, adaptation planning has to prepare for increasingly likely futures above a 2°C global average temperature increase above pre-industrial levels. This is especially the case in South Africa, where the rate of warming has been measured to be faster than the global average. Latest global projections suggest that there is an 86% chance that at least one of the next five years will be more than 1.5°C above the 1850–1900 global average and 70% chance that 5-year average warming for 2025–2029 will be more than 1.5°C (WMO, 2025). There is also now a chance, albeit a small one (1%), that at least one year exceeds 2°C of warming above pre-industrial levels by 2029 (WMO, 2025).

The NDC process is strongly framed by the notion of increasing ambition and equity. The bigger the gap between global mitigation targets and actual measured emissions reductions, the higher the ambition needs to be for adaptation, to cope with and prepare for more extreme climate conditions. Ambition in climate adaptation can be understood on a spectrum from surviving to thriving under increasing levels of warming and associated intensity and frequency of extreme climatic events. Low ambition adaptation seeks to incrementally introduce measures or interventions that maintain the status quo, i.e. avoid the current situation getting worse as the climate changes, based on conservative estimates of future changes in the climate. High ambition adaptation is to adapt in a way that transforms current social and economic systems into ones that are not exploitative, unjust and less unequal, based on recognising a wide range of possible climate futures. High ambition adaptation is centred on human rights, ecological rights and restorative justice in preparing for a highly altered climate system. Building socio-economic systems that actively avoid marginalisation, exclusion and exploitation create greater capacities to adequately adapt to a wider set of climate futures (Porter et al., 2020; Cañizares-Gaztelu et al., 2024).

THE BIGGER THE GAP BETWEEN GLOBAL MITIGATION TARGETS AND ACTUAL MEASURED EMISSIONS REDUCTIONS, THE HIGHER THE AMBITION NEEDS TO BE FOR ADAPTATION TO COPE WITH AND PREPARE FOR MORE EXTREME CLIMATE CONDITIONS.



SECTION 2

METHODOLOGY

To inform the adaptation component of SA's NDC2, the technical work presented in this report began with reviewing the latest available science to **identify key climate risks** to be adapted to in South Africa currently and under various future scenarios of global warming levels through the 2030s and towards the 2050s. This involved a review of existing literature and an expert elicitation process on climate risks facing South Africa, data synthesis and consideration of SA current risk assessments, the clustering of risks by theme or sector, and identification of key emerging risks. Sectoral risks from climate change and key inter- or multi-sectoral risks were identified from peer-reviewed literature on observed impacts and projected risks from climate change between 2014–2025 and synthesised with evidence presented in the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report (AR6). The climate change risks were characterised and ranked based on the synthesised evidence and insights gathered through an expert elicitation process involving an online survey and set of focus group discussions with 30 experts working on South African climate change across research and government institutions. To align with global climate goals specified in the Paris Agreement and ensure consistency with IPCC AR6, climate risk statements expressed in climate change scenario language (such as selected Representative Concentration Pathways (RCPs) or Shared Socioeconomic Pathways (SSPs) scenarios) were converted to specified global warming levels (GWs). This was done using the Climate Analytics Warming Attribution Calculator, with results verified against IPCC AR6 WGI Table SPM.1. When original studies in the source literature did not specify key parameters, standard assumptions were applied, i.e. a pre-industrial baseline of 1850–1900, a projection base period of 1986–2005, and standard projection windows (e.g., 2041–2060 for mid-century). If model selections were not indicated, the full CMIP5 ensemble was used. Observed risks were aligned to GWs using IPCC AR6 WGI Cross-Chapter Box 2.3, Table 1.

A **stocktake of SA's current adaptation strategies**, action plans and implemented actions was then undertaken (activity A2) to review progress and the trajectory of existing adaptation efforts and intentions. The stocktake involved a structured search for and review of websites and documents in the public domain reporting on climate adaptation projects and programmes implemented in South Africa, including but extending beyond those listed in the National Climate Change Response Database. A total of 129 implementation-oriented adaptation projects (i.e. excluding research projects) were identified (see [appendix 1](#) for list). Information was extracted on activities involved, sectoral focus, climate hazards targeted, vulnerable groups targeted, lead actors driving design and implementation, funder, budget allocations, project status, duration, and spatial coverage. The review was then extended to public sector adaptation plans that detail adaptation measures prioritised by sub-national governments. A total of 19 adaptation-specific strategies or plans were identified, 4 provincial and 15 municipal (8 district and 7 local/metro), see [appendix 2](#) for list. These were characterised according to the sectors covered, the time horizon of the plan, the climate risks targeted, and adaptation measures prioritised. The review was further extended through a horizon scanning exercise looking at what is being implemented with international adaptation funding provided through the Green Climate Fund (GCF) and the Adaptation Fund (AF) in countries of a comparable size (defined as a population of over 30 million), economic status and measure of climate vulnerability (according to the ND GAIN index) as

South Africa. A total of 47 projects were identified and reviewed, 44 of which are projects operating within a single country and 3 are regional projects operating in several countries, see [appendix 3](#) for list. Information about the adaptation objectives, priority sectors, climate hazards addressed, adaptation measures, project components, lead implementing actor, target beneficiaries, budget allocations and duration were captured in the review. This provided an opportunity to identify potential gaps in and opportunities for South Africa's adaptation agenda relative to what other countries have been able to tap into international support and resourcing for climate adaptation.

Based on expert inputs gathered via the online survey and four focus group discussions conducted in May 2025, existing, planned and potential adaptation measures were assessed against key current and emerging risks at various levels of global warming to **identify gaps and opportunities for additional adaptation actions**. Thirty-six adaptation options, linked to seven adaptation goals, were identified. High-level cost estimates for the implementation of each of the options (capex and opex) were produced, before the respective **options were ranked** in terms of multi-dimensional impact. This ranking relied on a multicriteria assessment in which the options were scored in terms of six criteria: the employment intensity of the adaptation option (i.e. how many jobs or work-days are created); the greenhouse gas emissions intensity of the adaptation option (i.e. to identify potential co-benefits or trade-offs); contribution to economic growth; avoided loss and damage (e.g. through protecting ecological assets, building social cohesion, creating livelihoods); ease of implementation and risk of maladaptation (i.e. options that are technically or politically difficult to implement, or are associated with high risks of unforeseen adverse consequences are assigned higher negative scores); and the extent to which the option saves lives. In a further step, the thirty-six options were screened in terms of economic efficiency using both the multi-criteria assessment and a cost-benefit analysis. The assumptions underpinning the cost and benefit estimates for each option are described in [section 11.1](#).

As a final step, the **public and private good** attributes of the options were evaluated based on scoring each option against four criteria: saves lives; protects nature; reduces costs; generates revenue, as described in full in [section 13](#) of the report. Understanding the public/private good attributes of each option is deemed important for a subsequent piece of work, led by SouthSouthNorth, to identify potential sources of funding, finance, and capacity-building support (both international and domestic) for implementing the adaptation options.

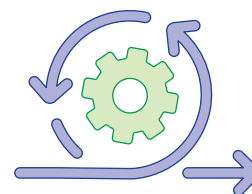
129

Implementation-oriented adaptation projects were identified



19

Adaptation-specific strategies or plans were identified



47

Projects were identified and reviewed



SECTION 3

NATIONAL ADAPTATION PROGRESS

South Africa has been gearing up climate adaptation. With the first sub-national adaptation framework completed in 2006, and the first national adaptation strategy completed in 2020, work has progressed over the years from strategy development and climate risk and vulnerability assessments to increasingly operational adaptation planning and actions. However, progress is very unevenly distributed across the country between national ministries, provinces, municipalities and sectors, and in many cases adaptation plans and actions remain marginal to core spending on infrastructure and services that are not designed and delivered in a climate resilient way. The collapse of water infrastructure and the deterioration of water quality across the country, as documented in the Blue and Green Drop reports in December 2023, has made the adaptation task more difficult in South Africa. The approval of the Climate Change Act in 2024 marks a significant culmination of work on climate change to-date, establishing the legal framework for widespread mainstreaming of integrated climate action across the country, in line with South Africa's international commitment under the Paris Agreement (see timeline in figure 1), but significant deficits persist in both the capacity for adaptation and the level of coordination and integration of adaptation efforts.

Progress has been made on establishing a legislative framework for acting on climate change and setting up institutional arrangements or architecture for planning climate action. This has included developing guidance for climate risk and vulnerability assessments, understanding many of the biophysical, economic and social impacts associated with climate hazards facing South Africa, enhancing climate monitoring systems and climate information services, and making climate adaptation a strategic priority.

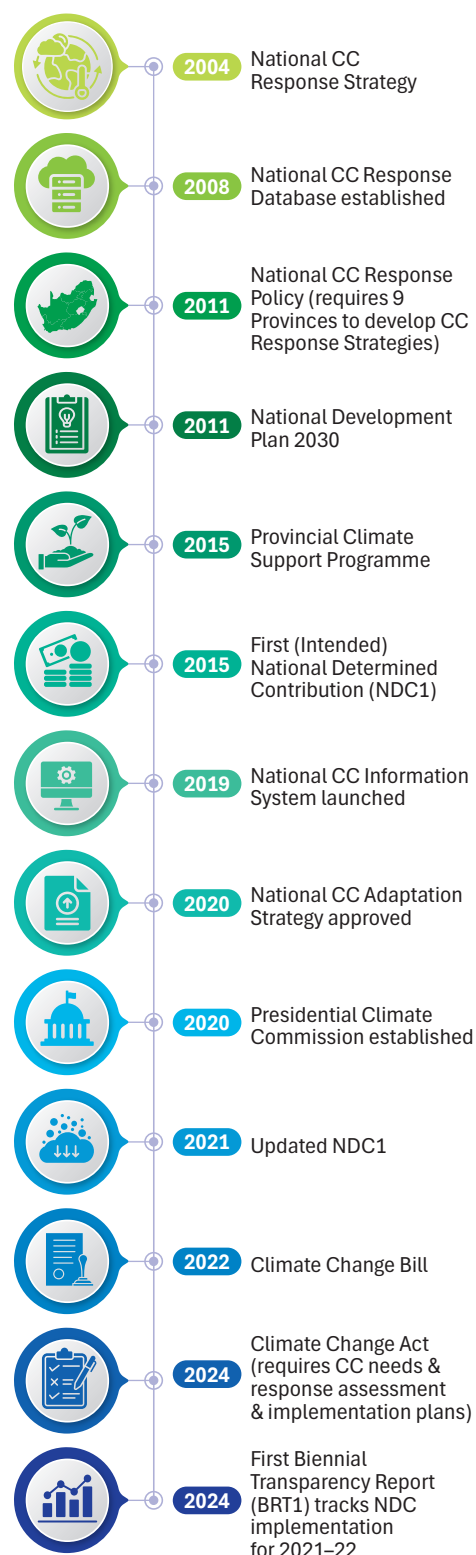


FIGURE 1: Brief timeline of processes, decisions & documents that have shaped South Africa's climate adaptation agenda.

Now the focus is shifting to weighing up and prioritising specific adaptation measures for particular locations and ‘intended beneficiaries’ or ‘affected parties’ across the country. This includes ensuring a set of fit-for-purpose monitoring, evaluation and learning modalities to detect how and for whom adaptation measures are working or not working in order to adjust, add to, and scale up, out or down in a context-sensitive way. This is needed to underpin increasing national and sub-national ambition on climate adaptation, associated with ambitious finance targets for adaptation, both domestic and international.

Under the custodianship of the national Department of Forestry, Fisheries and the Environment (DFFE), the **National Climate Change Adaptation Strategy (NCCAS)**, adopted in 2020, serves as SA’s National Adaptation Plan (NAP) that was submitted to the UNFCCC in 2021. It sets the direction for implementing the National Climate Change Response Policy (NCCRP) that was adopted in 2011. The NCCAS/NAP spells out four strategic objectives, nine intervention areas and twelve intended outcomes that sectoral responses should align with, prioritising the sectors of health, water, biodiversity, agriculture and human settlements for investments in adaptation (see [figure 2](#)). The NCCAS articulates 94 actions required to meaningfully progress climate adaptation in South Africa. The NDC provides an opportunity every 5 years to spotlight and further detail national adaptation priorities and (re)assess resourcing and support needs to achieve the progressive realisation of the NCCAS. South Africa’s first biennial transparency report (BTR1) was submitted to the UNFCCC in December 2024, detailing progress on implementing the NCCAS/NAP as the key adaptation component of the updated NDC1.

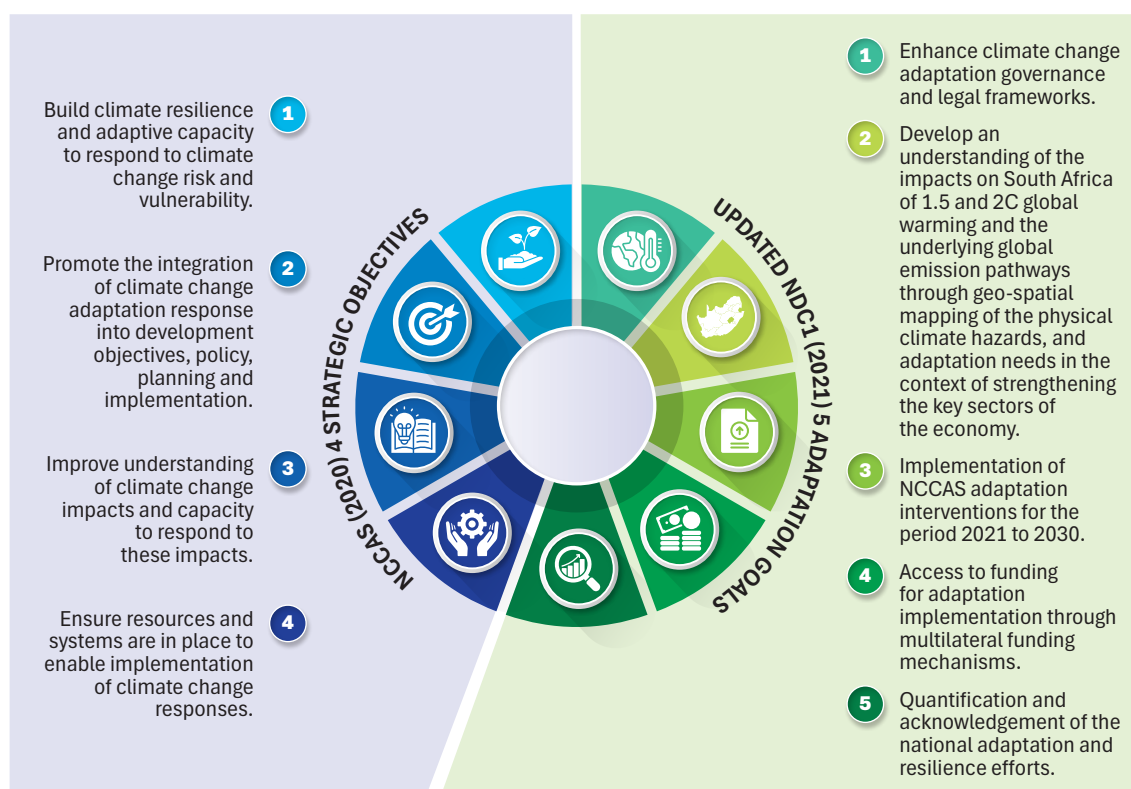


FIGURE 2: Overview of NCCAS (2020) strategic objectives and the updated NDC1 (2021) adaptation goals.

The **Climate Change Act 22 of 2024**, proclaimed in March 2025, establishes a comprehensive legislative framework for climate action in South Africa, providing the legislative basis for implementing the NCCAS. The Act fosters institutional coherence and enhances climate change adaptation governance across the national, provincial and municipal spheres, between government, civil society and the private sector.

It mandates that all government policies and actions align with the Act's objectives to ensure a coherent climate change response in South Africa and a just transition of the economy and society to being climate-resilient and low-carbon, as articulated in the Just Transition Framework developed by the Presidential Climate Commission (PCC). From an adaptation perspective, the Act requires all levels of government to assess, plan for and address climate adaptation needs to chart climate resilient development pathways that reduce poverty, create sustainable livelihoods, and enhance safety and wellbeing for all in South Africa.

Having a vibrant network of actors sharing data and information on climate risks and adaptation actions is vital to the progressive realisation of climate resilience in South Africa. The **South African Climate Change Information System (NCCIS)** has been set up to track progress in building a low-carbon and climate resilient society and economy, offering decision support tools and databases for adaptation. The NCCIS includes the National Climate Change Response Database (NCCRD) and the Tracking and Evaluation (T&E) Portal to monitor progress towards NCCAS objectives and NDC goals, supported by data from national, provincial, and local systems. This provides a valuable foundation from which to meet the increasing need for monitoring climate risks, impacts and adaptation interventions, as a basis assessing Loss and Damage (L&D) and evaluating the efficacy of adaptation efforts. However, large gaps in data and information flows (i.e. collection, processing and transmission), linked to severe capacity constraints in DFFE and the departments and agencies mandated to feed into the relevant databases, need to be addressed to realise the potential of these systems to guide adaptation over time as conditions change. Institutional arrangements are critical for information collection, processing and producing policy-relevant information. A suggestion from the technical dialogue of GST1 is helpful in this regard: "Systematically inventorying the impacts of disasters and climate change can enable better understanding of risks and the effectiveness of adaptation measures" (UNFCCC 2023d: 159). More details were provided in a proposal by Chile, arguing that to improve the evidence base on climate change impacts, countries should implement and maintain arrangements for a national inventory of impacts. Such inventories would complement observations by remote sensing, typically undertaken by national government, with bottom-up collection of data on events and impacts, by local authorities and communities (Chile 2023). All Parties agreed in the GST decision: "Acknowledges that establishing and improving national inventories of climate impacts over time and building accessible, user-driven climate services systems, including early warning systems, can strengthen the implementation of adaptation actions, and recognizes that one third of the world does not have access to early warning and climate information services, as well as the need to enhance coordination of activities by the systematic observation community" (UNFCCC 2023a: 49). South Africa should therefore establish an inventory of impacts with institutional and cooperative governance arrangements in place to iteratively populate such an inventory to strengthen the information base for adaptation and L&D.

A **Climate Change Response Fund (CCRF)** is being designed and established, under the leadership of the PCC and DFFE, together with National Treasury, aimed at bringing together the public and private sectors to invest in climate resilience and deal with the impacts of extreme climate events. It is envisaged that the CCRF will become an effective conduit between the global climate financing architecture and the local funding context, resourcing adaptation and responding to loss and damage needs. Based on a growing need to mobilise funds for adaptation, a **Just Adaptation and Resilience Investment Platform (JARIP)** is also being proposed to coordinate flows of adaptation finance and funding from diverse sources into a coherent and strategic programme of resilience building, with an initial focus on water, agriculture and the built environment, followed by a phase 2 focus on health, biodiversity and ecosystems, and disaster risk reduction and management.

SECTION 4

REVIEW OF ADAPTATION PLANNING & IMPLEMENTATION

4.1 Adaptation projects in SA

A review was undertaken to characterise adaptation projects implemented across South Africa. A total of 129 implementation-oriented adaptation projects (i.e. excluding research projects) were identified (see [appendix 1](#) for list). The projects were examined across multiple dimensions including activities, targeted hazards, vulnerable groups, lead actors, budget allocations, project status, timelines, and spatial dynamics. The mapping of these interventions reveals a diverse and evolving adaptation landscape shaped by the complex socio-ecological challenges facing the country. The highest concentration of projects falls within the Terrestrial Ecosystems sector, followed by Urban and Rural Settlements and Water Resources, reflecting South Africa's prioritization of biodiversity protection, community resilience, and water security. Other sectors like Agriculture and Forestry, Coastal Management, and Health are less represented, indicating areas requiring greater investment.

Adaptation implementation efforts in South Africa exhibit a strong emphasis on ecosystem-based approaches, water conservation innovations, early warning systems, community empowerment, and sustainable livelihoods. Urban adaptation that includes the built environment, institutional strengthening, and fire management are also gaining attention, indicating a broadening understanding of resilience as a multi-dimensional challenge. The projects implemented to-date that were reviewed typically involve a variety of specific activities, including invasive species control, wetland restoration, rainwater harvesting, climate-smart agriculture, disaster risk reduction measures, community capacity building, and policy development. Adaptation efforts increasingly recognize and respond to multiple, intersecting hazards, especially drought, flooding, wildfires, and invasive species threats. Emerging and complex risks such as sea-level rise, extreme heat, and biodiversity loss are beginning to receive focused attention, although issues like food system shocks and climate-induced migration remain under acknowledged and targeted in the design of adaptation projects in South Africa.

In terms of social targeting, local communities are the predominant intended beneficiaries, with a focus on small-scale farmers, women, youth, and coastal communities. However, indigenous peoples, elderly populations, and persons with disabilities are notably underrepresented as target groups for supporting adaptation actions, pointing to gaps in fully intersectional and inclusive adaptation approaches. Lead actors are primarily national and local government agencies, notably the national Department of Forestry, Fisheries and the Environment and the metropolitan municipalities of eThekweni and Cape Town. NGOs, academic institutions, international organizations, and a few private sector entities also play important roles in implementing climate adaptation measures, though the landscape remains heavily public sector-driven, suggesting a need for more multi-actor leadership, with stronger civic leadership and involvement by businesses with a local presence.

Financially, adaptation projects show wide variation, from small-scale interventions costing under ZAR 1 million to major national initiatives exceeding ZAR 1 billion. Funding sources include government budgets, international donors, municipal allocations, and combinations thereof. Larger budgets tend to support water-related infrastructure and urban resilience projects, while many rural or community-based interventions operate with more modest funding. In terms of project progress, 59.8% of initiatives are currently underway, 37.7% have been completed, and a small fraction (2.5%) are in the funding-approved stage, reflecting steady momentum but also the need for stronger implementation pipelines. The timelines of adaptation projects show that efforts have spanned more than two decades, with many projects launched between 2018 and 2021 in response to heightened post-Paris Agreement action. Several large-scale projects are long-term, running up to 2051, particularly those focused on ecosystem restoration and systemic adaptation.

Geographically, Mpumalanga (e.g. Bushbuckridge and Mbombela) and KwaZulu-Natal (e.g. Durban and uMgungundlovu) emerge as major hotspots for adaptation action, alongside projects in the Western and Northern Cape (notably Namaqualand and Cape Town). There is a risk of regional concentration, with less attention being given to more peripheral or underserved areas. Spatially, most adaptation investments in South Africa are rural-focused (52.7% of projects), followed by urban (34%), while peri-urban areas remain significantly under-addressed despite the rapid growth and innate climate vulnerability of the peri-urban, largely 'informal' human settlements sector. The rural emphasis reflects the high dependency of rural livelihoods on natural resources and their heightened vulnerability to climate hazards. Urban adaptation is gaining prominence, but peri-urban resilience needs more strategic focus. Overall, South Africa's adaptation measures demonstrate growing systematization, integration, and foresight, but achieving transformational adaptation and systemic resilience will require closing existing gaps in spatial coverage, social inclusion, leadership diversification, and tackling combinations of hazards in an integrated way.

4.2 Adaptation plans

Having looked at implemented adaptation projects in South Africa, the review was extended to public sector adaptation plans that detail adaptation measures prioritised by sub-national governments. A total of 19 adaptation-specific strategies or plans were identified, 4 provincial and 15 municipal, see [appendix 2](#) for the list. All 19 included a focus on adaptation in the water sector and human settlements, 18 included the health sector as a priority for adaptation, 17 ecosystems, agriculture and forestry, and 10 strategies/plans included adaptation in the coastal zone. Storms, floods, droughts, wildfires, extreme heat, high winds, biodiversity loss, food insecurity, groundwater depletion, coastal erosion and sea-level rise were mentioned as key climate risks of varying levels of concern that are undermining livelihoods, economic activities, infrastructure functioning and amplifying health risks across the jurisdictions. Informal settlements are highlighted as hotspots of climate vulnerability and impacts.

Disaster management, water management, infrastructure maintenance, urban planning, land use management, environmental management, health services and agricultural support functions are identified as key to building adaptive capacities. Interestingly, some identify human resources as a key function in addressing public service capacity constraints that are undermining the implementation of adaptation measures. Many identify enhanced financing and cooperative governance between the three spheres of government, civic and private sector actors as critical to unlocking adaptation action. Priority adaptation measures identified across these 19 sub-national strategies and plans include: ecosystem

restoration for water availability and urban cooling; infrastructure upgrading for flood and heat resilience (especially roads); coastal protection; early warning systems; fire management; enhancing disaster preparedness and response capacity; and heat-resistant building designs and materials. Climate-smart agricultural practices, climate education and public health interventions targeting climate-related diseases and heat stress are also identified as priorities for adaptation in several plans. Adaptation measures for dealing with extreme storms and flooding in the mining industry, as a key economic activity and employer, is mentioned as a priority in one district municipality's climate change response plan. While the sub-national plans, viewed collectively, present a strong case for localised yet often common or shared adaptation needs, a key gap is the lack of specificity provided for targeted, context-sensitive adaptation measures and indications of the efficacy or adequacy of measures against current and projected levels of risk, which hampers resourcing and implementation.

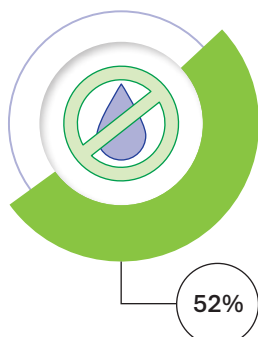
4.3 Adaptation funding: learning from elsewhere

The review was further extended through a horizon scanning exercise looking at what is being implemented with international adaptation funding provided through the Green Climate Fund (GCF) and the Adaptation Fund (AF) in countries of a comparable size (defined as a population of over 30 million), economic status and measure of climate vulnerability (according to the ND GAIN index) as South Africa. The AF, established under the Kyoto Protocol in 2001 and now also serving the Paris Agreement, primarily funds small-to medium-scale adaptation projects (under USD 10 million) in vulnerable developing countries. It employs a Direct Access Modality, allowing national entities to access funding without intermediaries. In contrast, the GCF, created in 2010 under the UNFCCC, supports both adaptation and mitigation, with a mandate to allocate 50% of resources to adaptation and prioritize vulnerable countries such as LDCs, SIDS, and African states. The GCF finances large-scale projects through a variety of international and national entities, including direct access institutions. Funded adaptation initiatives in the following countries were identified and characterised: Ghana; Egypt; Morocco; Mexico; Brazil; Peru; India; Indonesia; Philippines; Vietnam; Uzbekistan and Iraq. A total of 47 projects were assessed, of which 44 are projects operating within a single country and 3 are regional projects operating in several countries, see [appendix 3](#) for list. The funded adaptation measures operate within the economic sectors: Agriculture & Forestry; Water Resources; Terrestrial Ecosystems; Urban & Rural Settlements; Coastal Zone and Health. Most projects cover more than one sector. 87% of projects classify as operating in the Agriculture and Forestry sector, followed by Water Resources (83%) and Terrestrial Ecosystems (79%), with Health as the least addressed sector (19% of projects include adaptation measures in the health sector).

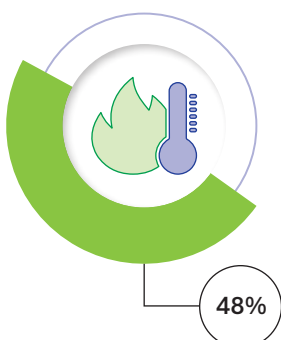


FIGURE 3: Focus areas for adaptation articulated in sub-national strategies & plans.

47 GCF funded adaptation initiatives reviewed



24 address water scarcity, reduced rainfall or increased rainfall variability



22 projects involve adapting to droughts, long dry spells, increased surface temperatures and heatwaves

Of the 47 projects reviewed, 24 address water scarcity, reduced rainfall or increased rainfall variability, 22 projects involve adapting to droughts, long dry spells, increased surface temperatures and heatwaves. Projects in South-East Asian countries, such as the Philippines and Indonesia, focused on addressing cyclones and flood risks. The funding amounts of the projects reviewed ranged from just below one million to USD 750 million, with 28% of projects having total budgets of over USD 41 million. The funding is a mix of grants and co-financing involving public, private and GCF/AF funding. The project with the highest total reported funding of USD 750 million was a regional project involving seven countries (Timor-Leste, Cambodia, Pakistan, Vanuatu, Indonesia, Lao People's Democratic Republic and Papua New Guinea).

When looking at actors leading implementation of these adaptation projects, the review shows multilateral institutions to be the lead actors in 51% of the projects, followed by governments (30%) and private sector companies (19%). The case of Peru provides an interesting example to learn from in relation to designing South Africa's Just Adaptation and Resilience Investment Platform and Climate Change Response Fund. Profonanpe is a private, non-profit environmental fund based in Peru, accredited with both the Adaptation Fund and the Green Climate Fund. Profonanpe's mandate includes mobilizing and managing resources to support projects focused on biodiversity conservation, climate change mitigation and adaptation. Profonanpe's ability to create partnerships across public and private sectors exemplifies the importance of nationally anchored institutions in enhancing direct access to climate finance. It is regarded as Peru's most prominent private environmental fund, reflecting how domestic institutions can strengthen country ownership and institutional capacity in climate finance governance. While public and private finance for medium- to large-scale planned adaptation is critical, it is important to recognise that considerable adaptation measures are financed and undertaken by households, including through upgrading homes – both formal and informal structures – installing erosion, flood and heat defences at the micro scale, sourcing and storing alternative water supplies, switching food choices and alike (Isandla Institute, 2025). This takes some pressure off government and creates fertile ground for supporting locally-led adaptation efforts.

SECTION 5

DISTRIBUTION OF CLIMATE IMPACTS AND VULNERABILITIES

Multiple sources of evidence point to KZN, North West, Limpopo and the Eastern Cape provinces needing to be national priorities for climate adaptation and resilience building efforts (Shifa, Leibbrandt and Gordon, 2023). These provinces show high levels of multidimensional climate vulnerability at the household level, especially due to widespread lack of access to safe water, toilet facilities and high levels of food poverty.

While spatial targeting of adaptation efforts and support is important, the reality is that inequalities of climate vulnerability within provinces and municipalities are high. For example, municipalities in the eastern part of the Eastern Cape show a higher level of climate vulnerability than those in the western part of the province. Gini coefficient estimates of a multidimensional climate vulnerability index for each local municipality reveal a concentration of high inequality in the Western Cape, Gauteng, Northern Cape, and Free State provinces.

Reliable, comparable, spatial disaggregated data on experienced, recorded climate and weather impacts remains elusive and requires further investment to build up a robust picture of the spatial distribution and changes over time. What we currently have is a few, partial snapshots. Stats SA and the National Disaster Management Centre, together with the network of provincial and municipal DMCs have a key role to play in this and need to be resourced and capacitated accordingly.

Based on survey data from the National Income Dynamics Study and the Community Survey, a study of multi-dimensional climate-related vulnerability (using 11 indicators of demographic, economic, housing conditions, and nutrition) finds that:

- 1 The vulnerability indicators affecting the highest proportions of households across South Africa are lack of access to safe sanitation, food poverty, and lack of access to safe water.
- 2 Poor, marginalised social groups in South Africa are more likely to live in hazard-prone areas.

This work extends previous vulnerability assessments based on ward-level data from the national census, by working with data at the individual and household levels to explore multiple intersecting social factors, such as gender, age, disability, primary economic activities, dwelling type and access to piped water, that capture micro variations in vulnerability to multiple climate hazards. The analysis uses data collected from a sample of 28,226 individuals in 2008 and 47,055 individuals in 2017, a nationally representative sample who participated in the National Income Dynamics Study (NIDS), as well as data collected in the 2016 Community Survey (CS) from a nationally representative sample of 1,370,809 dwelling units. The multidimensional vulnerability index results generated from these two data sets show similar patterns of vulnerability across spatial units and population groups, adding confidence to the findings.

When disaggregated between rural and urban areas, the results show that residing in an informal dwelling and food insecurity are key determinants of vulnerability in urban areas (16 and 15% of respondents respectively), while lack of access to safe water (36%) and toilet facilities (55%) and food insecurity (46%)

are key determinants of vulnerability in rural areas. The prevalence of households with young children (less than 10 years old), known to be more susceptible to heat stress and flooding than healthy adults, was shown to be only slightly more in rural than urban settings (24 and 18% respectively). Households primarily involved in vulnerable jobs and with older people were also found to be proportionally slightly higher in rural areas, whereas the proportion of households with disabled people and pregnant women were found to be marginally higher in urban areas.

When disaggregated by income quintile, the findings reveal more significant disparities in vulnerability, especially for food poverty, lack of access to safe toilet and water, and having young children. More households in the lowest income bracket are vulnerable to 7 of the 11 indicators of vulnerability, the notable exceptions being that of having a job that is vulnerable to climate hazards (for which the proportion of households increases with income), and having older people in the household.

Overall, the work highlights that adaptation measures in South Africa need to target the resilient provision of safe water, decent sanitation, and enhance food access and affordability for those households in the lowest income groups, especially those residing in urban informal settlements and those primarily engaged in construction jobs, and those in rural areas heavily dependent on agriculture, fisheries, mining and quarrying.

The municipalities showing the highest multidimensional climate vulnerability scores are: Ngquza Hill; Nkandla; Mbizana; Port St Johns; Big Five Hlabis; Nyandeni; Nongoma; Ratlou; Mfolozi; Ndwedwe; Umhlabuyalingana; Okhahlamba; Inkosi Langalibalele; Ubuhlebezwe; Jozini; Umzumbe; Joe Morolong; uMlalazi; Maphumulo; Dr Nkosazana Dlamini Zuma Municipality.

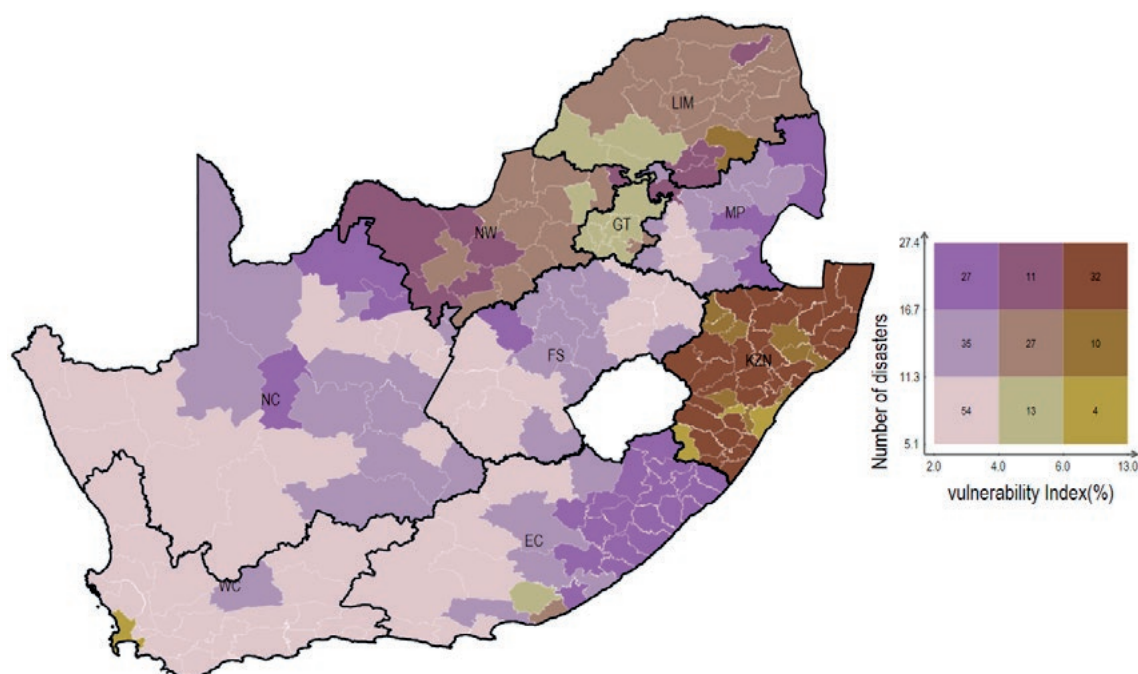


FIGURE 4: Map showing the relationship between the number of climate related disasters recorded in EM-DAT between 2000 and 2014 and a multidimensional climate vulnerability index based on the Stats-SA 2016 Community Survey (Source: Shifa, Leibbrandt and Gordon, 2023, p.36).

Note: A disaster in the Emergency Events Database (EM-DAT) is defined as meeting one or more of the following criteria: 10 or more people dead; 100 or more people affected; the declaration of a state of emergency; a call issued for international assistance. The map highlights the coincidence of climate-related disasters and high multidimensional vulnerability in many parts of KwaZulu Natal, North West and Limpopo, as well as high vulnerabilities in the eastern parts of the Eastern Cape.

SECTION 6

ASSESSMENT OF KEY CLIMATE RISKS

The review of global and domestic climate change risk assessment literature focussing on South Africa, augmented by expert opinions elicited from those working in the South Africa's climate change research and policy sector, reveal the following picture of key climate change risks facing South Africa under current and future levels of global warming, as shown in [figure 5](#).

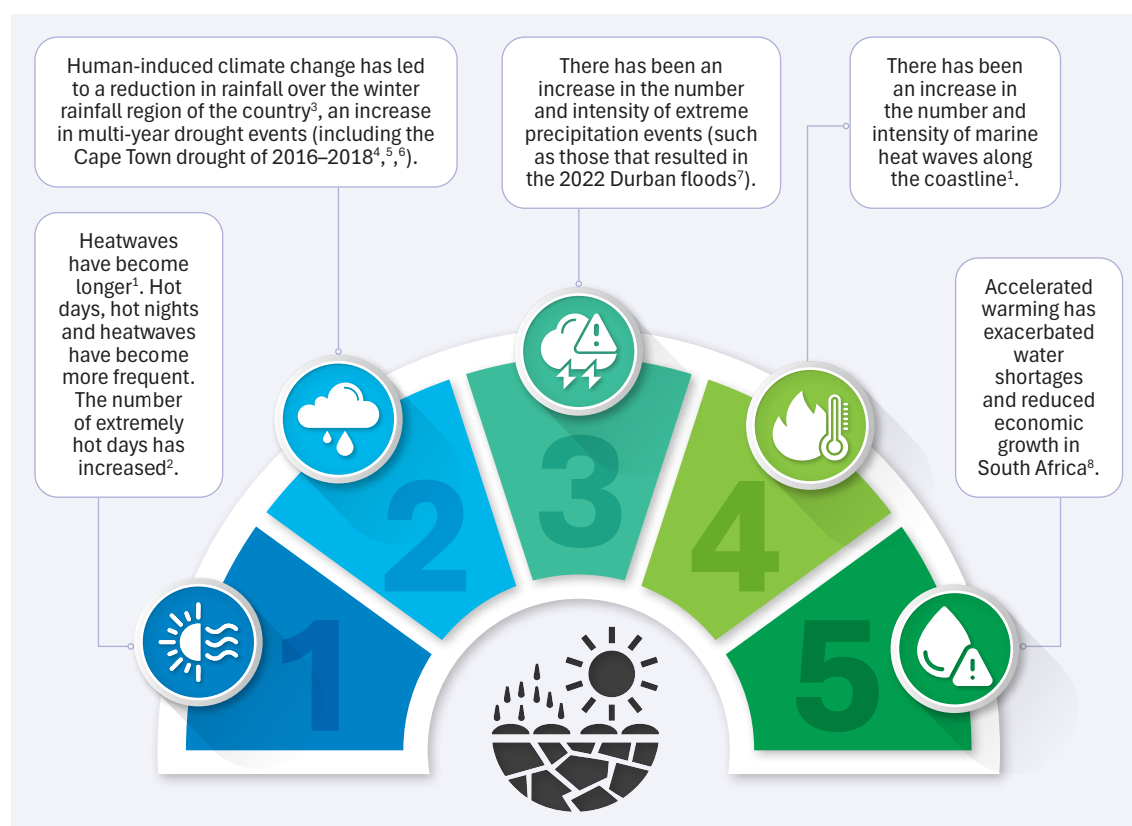


FIGURE 5: Headline review findings of observed climate changes in South Africa evidenced in the scientific literature.

Between 1.5°C and 2°C global warming negative impacts are projected to become widespread and severe with reduced food production, reduced economic growth, increased inequality and poverty, biodiversity loss, as well as increased human morbidity and mortality¹. Limiting global warming to 1.5°C is expected to substantially reduce damages to the South African economy, agriculture, human health, and ecosystems compared to higher levels of global warming.

Under conditions where average Global Warming Levels (GWL) exceed the Paris Agreements targets of 1.5°C or 2°C (referred to as ‘overshoot’, depicted in [figure 6](#)), widespread economic and non-economic losses and damages are expected across key sectors, regions and populations in South Africa including for economy, agriculture, human health, and ecosystems¹, as visually summarised in [figure 7](#). The recovery from ‘overshoot’ will not be linear. It will likely take much longer than the time it took to get to peak warming, and will likely involve irreversible impacts such as species extinction, loss of coral reef systems, and loss of cultural heritage¹.

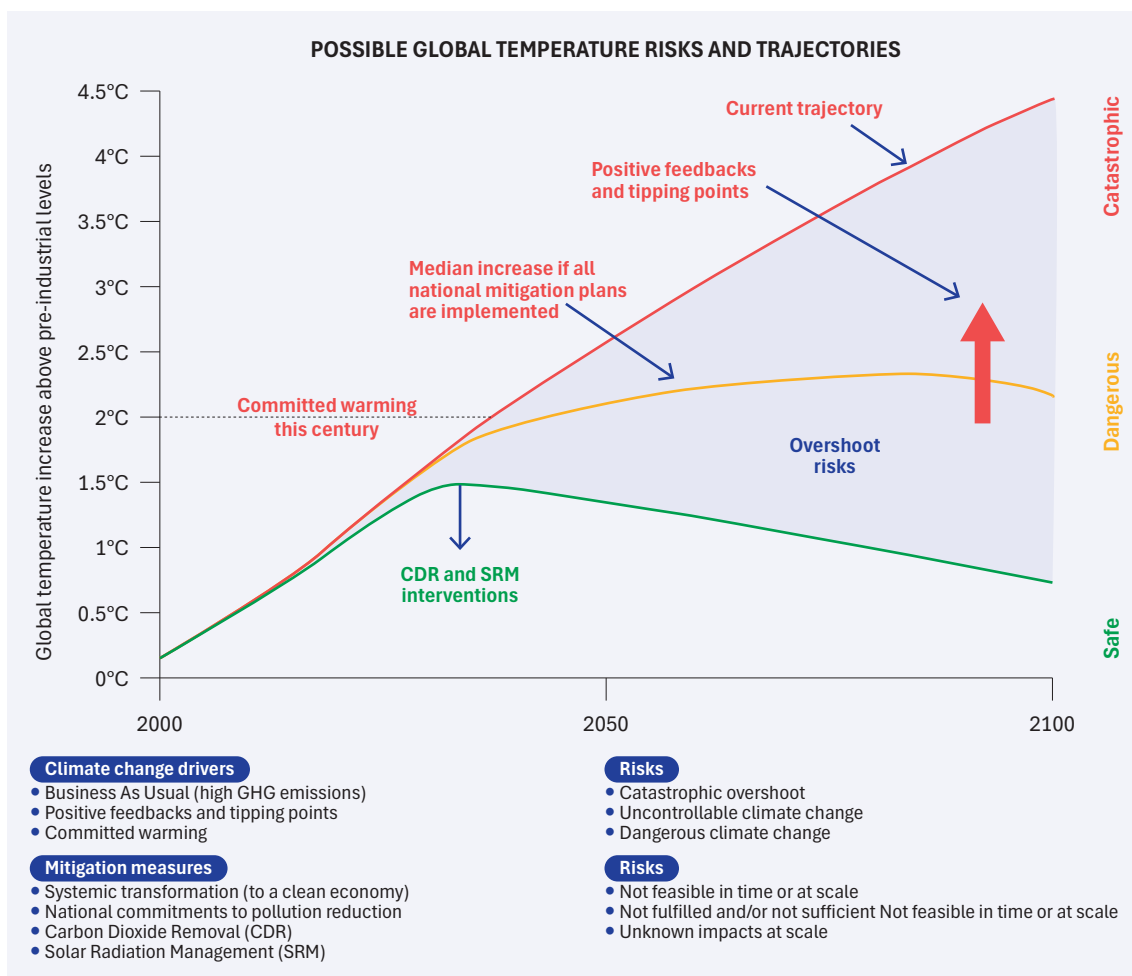


FIGURE 6: Possible global temperature trajectories and associated risks (source: Taylor and Vink, 2021).

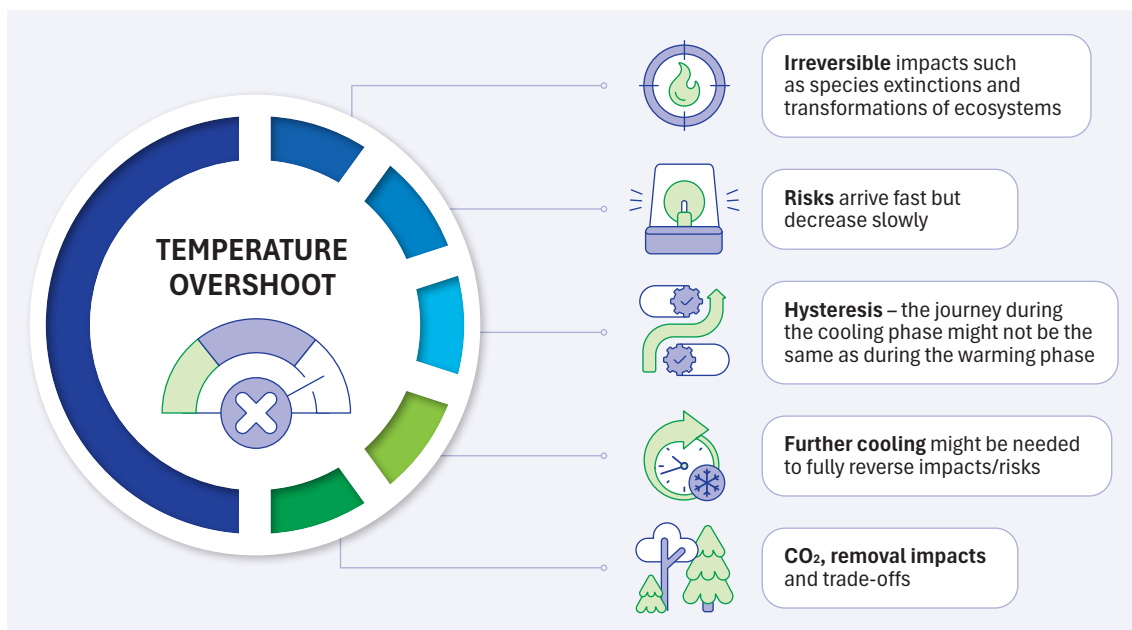


FIGURE 7: Visual summary of major risks associated with temperature overshoot (source: Meyer and Trisos, 2023).

6.1 Sectoral Risks

South Africa faces climate change risks across multiple sectors including: water and sanitation; food systems; economy; health and well-being; ecosystems and biodiversity; human settlements; network infrastructure; energy; education; livelihoods and migration; and heritage, culture and tourism.



Water and Sanitation

Observed Impacts: Water and sanitation in South Africa have been directly impacted by drought and flooding with the impacts cascading to health, tourism, sanitation, and economic output.

Projected Risks: Many South African settlements will face increasing risk to water access and quality under increased warming.

Water and sanitation in South Africa have been directly impacted by drought and floods^{9,10,11,12}. Impacts on water and household level responses to water scarcity in cities have been observed to cascade to affect risks to health, sanitation, economic output and security^{1,6,13,14,15,16,17}. There are further, significant gender-differentiated vulnerability and intersectional vulnerability to climate change impacts on water in South Africa^{18,19,20}. Women and girls face barriers toward accessing basic sanitation and hygiene resources, multiple studies report a negative health outcome, reflecting a water–gender–health nexus²¹. South Africa’s rapidly urbanising population increases the demand for freshwater and is occurring in places that already have stretched water and sanitation infrastructure^{22,23,24}. These conditions, especially during periods of water scarcity, can reduce the frequency and adequacy of hand washing and thereby increase disease transmission. Water availability is not only impacted by changes in precipitation.

Many South African settlements will face increasing water scarcity and flooding under increased warming¹⁹. Increasing temperatures will lead to increased evaporation which could further reduce runoff and increase water losses from dams²³. Increasing temperatures will also impact on demand, particularly for irrigation, but also from urban and industrial users²³. This could also contribute to reduced water security if existing systems are not able to meet these increasing demands. Increasing temperatures will also increase pollution and water quality risks²³.



Food systems

Observed Impacts: Climate change is reducing crop yields and productivity and negatively impacting smallholder and commercial livestock and mixed farming.

Projected Risks: Future warming will negatively affect food systems and agricultural livelihoods by shortening growing seasons and increasing water stress with particularly high risk to female-headed households in agricultural districts in South Africa.

Climate change is reducing crop yields and productivity^{1,25,26,27}, as well as negatively impacting smallholder and commercial livestock and mixed farming^{28,29,30,31}. Future warming will negatively affect food systems and agricultural livelihoods by shortening growing seasons and increasing water stress¹. Vector-borne livestock diseases and the duration of severe heat stress are both projected to become more prevalent under increased warming. Importantly, the income of female-headed households in agricultural districts in South Africa are more vulnerable to precipitation variability than those headed by men^{32,33}.



Economy

Observed Impacts: Climate change has reduced economic growth for South Africa through impact on working hours of low-skilled labour, especially among women in highly exposed sectors leading to impacts on agriculture, tourism, manufacturing and infrastructure; as well as through negative impacts on marine fisheries and financial services.

Projected Risks: Future impacts from climate extremes in heat and rainfall may reduce South Africa's GDP by up to 3%–20% GDP per capita at 2°C GWL and 4.4°C respectively including negative impacts on labour (supply, productivity, capacity and availability) in highly exposed sectors especially among women in low skilled labour.

Climate change has reduced economic growth for South Africa. One estimate suggests gross domestic product (GDP) per capita for 1991–2010 in South Africa was about 5.8% lower than if climate change had not occurred, corresponding to a GWL of approximately 0.85°C above pre-industrial levels³⁴. Impacts manifest largely through losses in agriculture, as well as tourism, manufacturing and infrastructure¹. Estimated extremes could reduce South Africa's GDP by up to 3% per annum at 2°C GWL without strong adaptation measures³⁵. Longer term projections of economic impacts for South Africa are estimated at losses of 20% GDP per capita by the end of the century under approximately 4.4°C GWL. Higher temperatures have negative impacts on labour (supply, productivity, capacity and availability) in highly exposed sectors especially among women in low skilled labour^{36,37}.

Increasingly, analyses are being undertaken to quantify the impacts of climate change and projected risks for South Africa's Financial Sector (Banking and Insurance), notably by the Reserve Bank on lending and monetary policy. Emerging evidence shows climate change risks can have negative impacts on banks' stock performance^{38,39}, and on credit portfolios and banking resilience, for example, rising temperatures can significantly increase financial vulnerabilities, leading to a notable degradation of asset quality and an increase in default likelihood⁴⁰. Weather-related insurance claims in South Africa increased an estimated tenfold between 2012–2022, a period where global warming had reached approximately 1.1°C above pre-industrial levels, with average annual catastrophe (CAT) claims totalling R371 million³⁹. The economic cost of the April 2022 KwaZulu-Natal floods was estimated at R54 billion, with half that total carried by the insurance industry³⁹.

Climate change poses a significant threat to South African marine and freshwater fisheries. Climate-driven impacts have resulted in distribution shifts and declines in abundance of important fisheries targets, with negative consequences to the users dependent on these resources⁴¹. Climate-driven biological changes, including distribution shifts of species of commercial importance such as west coast rock lobster *Jasus lalandii*, sardine *Sardinops sagax* and anchovy *Engraulis encrasicolus*^{42,43,44}, have resulted in severe economic impacts for the users dependent on these resources highlighting the need for dynamic and adaptive approaches to respond to the impacts of climate change⁴⁵. By mid-century under 2°C global warming, maximum catch potential is projected to decrease by 10 to >30% on the western coast of South Africa⁴⁶.



Health

Observed Impacts: Climate variability and change already negatively impacts the health of South Africans through exposure to non-optimal temperatures and extreme weather leading to increased range and transmission of infectious diseases, increased heat-related mortality, increased mental health conditions and suicide, homicide risk, and drought-associated malnutrition. Pregnant women, elderly and children under 5 years are particularly vulnerable to heat exposure.

Future Risks: Mortality and morbidity will escalate with further global warming, placing additional strain on South Africa's already struggling health and economic systems.

Climate variability and change already negatively impact the health of South Africans through exposure to non-optimal temperatures and extreme weather, and increased range and transmission of infectious diseases. Increased levels of mortality between 2.6% and 3.3% have been recorded on days where temperatures for Cape Town, Durban and Johannesburg exceed 18.6°C, 24.8°C and 18.7°C respectively^{47,48}, with the elderly (≥ 65 -years of age group) more at risk. Approximately 43.8% of mortality in South Africa from 1991–2018 was attributable to additional heat exposure due to human-induced climate change, corresponding to a GWL of approximately 0.9°C⁴⁹. In many of South Africa's 52 districts, this equates to dozens of deaths per year. Exposure to extreme heat directly influences emotional control, aggression and violent behaviour, escalating rates of interpersonal violence¹.

High temperatures are strongly associated with poor mental health and suicide in South Africa⁵⁰. Homicides rise by as much as 18% in South Africa when temperatures are above 30°C compared with temperatures below 20°C^{51, 52, 53}. The KZN floods of 2022 negatively affected the mental health of the survivors, with feelings of isolation, hopelessness, grief and a lack of trust in appointed governmental authorities expressed⁵⁴. Growing evidence of heat exposure on health outcomes shows increased odds of preterm birth with increase in heat exposure and during heat waves^{55, 56, 57}. Similarly, high heat exposure increases the risk for stillbirths, congenital anomalies and gestational diabetes mellitus⁵⁶. The odds of any obstetric complication increased during heat waves^{55, 56, 57}.

Climate change impacts on health can be direct (e.g., heat stress), indirect (e.g., malnutrition through impacts on agriculture) or vicarious (e.g., anxiety disorders, depression through social media)^{1,54,58,59}. Climate change impact pathways are also diverse and complex, for example, infectious diseases have been aggravated by climate change via 1,006 unique pathways⁶⁰. Observed impact pathways include increase in ambient temperature, causing, for example, a significant rise in morbidity and mortality; heavy rainfall leading to changes in the prevalence and occurrence of vector-borne diseases; drought-associated malnutrition; and exposure to dust storms and air pollution leading to the potential exacerbation of respiratory diseases^{1,59,61,62}.

Mortality and morbidity will escalate with further global warming, placing additional strain on South Africa's already over-stretched health and economic systems. Altered emissions and meteorological factors will influence air quality, as will changes in human behaviour that affect exposure to air pollution. Under a business-as-usual scenario RCP8.5 of climate change, it has been projected that changes in meteorology alone over South Africa will lead to an increase in PM2.5 mass concentrations^{61,63}. Mental health, a key component of health, will be severely impacted by increased warming⁶⁴. Psychiatric disorders including mood, anxiety, sleep, trauma and stressor related disorders are likely to increase⁶⁴.



Ecosystems and biodiversity

Observed Impacts: Increasing CO₂ levels and climate change in South Africa are undermining marine biodiversity, reducing lake productivity, and changing animal and vegetation distributions as temperatures are approaching species physiological limits, with heat extremes driving mass mortality events in birds and bats and changes in vegetation impacting fire regimes.

Projected Risks: South African biodiversity loss is projected to be widespread and escalating with every 0.5°C increase above present-day global warming. This will dramatically undermine South Africa's cultural and natural heritage for future generations and compromise the tourism sector of the economy.

Increasing CO₂ levels and climate change are destroying marine biodiversity, reducing lake productivity, and changing animal and vegetation distributions. For example, increasing temperatures may have contributed to the declining abundance and range size of South African birds⁶⁵, including Cape Rockjumper (*Chaetops frenatus*) and protea canary (*Serinus leucopterus*), from increased risk of reproductive failure^{66,67}. Over half of the dwarf succulents in South African Karoo may lose >90% of their suitable habitat⁶⁸. For hot and dry regions (e.g. Northern Cape), there is strong evidence that increased temperatures are having chronic sublethal impacts, including reduced foraging efficiency and loss of body mass^{69,70}, and are approaching species physiological limits, with heat extremes driving mass mortality events in birds and bats⁷¹. Vegetation change linked to climate change and increasing atmospheric CO₂ has had an indirect impact on animals. Increased woody cover has decreased the occurrence of bird, reptile and mammal species that require grassy habitats^{72,73}. Vegetation changes interacting with climate and land use change have impacted fire regimes in South Africa. Increased grass cover in arid regions introduced fire into regions where fuel was previously insufficient to allow fire spread, such as the arid Karoo in South Africa^{74,75}. A southern shift of mangrove species has been observed in South Africa⁷⁶ with loss in total suitable coastal habitats for mangroves and shifts in the distribution of some species of mangroves and a gain for others⁷⁷. South African biodiversity loss is projected to be widespread and escalating with every 0.5°C increase above present-day global warming.



Human settlements

Observed Impacts: Exposure of people, assets and infrastructure to climate hazards, particularly floods and heatwaves, is increasing in South Africa, affecting access to economic opportunities, transportation of goods and services (including health and education), and human mobility.

Projected Risks: Trends in exposure of people, assets and infrastructure to climate hazards will increase under future warming levels, affected by rates of urbanisation, infrastructure deficit, and informal settlement growth.

Exposure of people, assets and infrastructure to climate hazards is increasing in South Africa compounded by rapid urbanisation, infrastructure deficit, and growing population in informal settlements¹. These urbanisation trends are compounding increasing exposure to climate hazards, particularly floods and heatwaves^{78,79,80,81}. Economic opportunities, transportation of goods and services, and mobility and access to essential services in South Africa, including health and education, are greatly hindered by flooding¹. Secondary cities and smaller towns are particularly vulnerable to the impacts of climate change where they have lower adaptive capacity, especially with regards to budget allocations, human resourcing in key local government departments, and infrastructure deficits^{9,82 83,84,85}.



Network Infrastructure, Transport and Electricity

Observed Impacts: Costs associated with repairs to infrastructure from climate-related damages are escalating, especially in transport networks and coastal zones.

Projected Risks: Annual national-level cost of the impacts of climate change in South Africa in the 2050 decade will vary between US\$116.8 million (at 2.0°C GWL) and US\$228.7 million (at 2.4°C GWL), rising to as much as US\$522.0 million if no adaptation measures are taken. Projected trends in rainfall and temperature are expected to increase costs of use, maintenance and repair to infrastructure. For example, disruptions to power and energy generation and distribution infrastructure can have cascading impacts associated with disruption to electricity provision to health outcomes (hospitals), education (schools), financial systems, transportation assets, telecommunications, agriculture (irrigation), air conditioning, heating, and water treatment. South Africa faces an increase in cooling demand with seasonal increases for cooling demands are expected to increase over an extended summer period (September to April).

Cost estimates for the rehabilitation or reconstruction of transport infrastructure for the City of Cape Town have been estimated at R20 billion, mainly from fires and coastal flooding⁸⁶. Repairing the road infrastructure damage caused by the devastating floods in KwaZulu-Natal in 2022 was estimated at R6 billion⁸⁶. Annual national-level cost of the impacts of climate change in South Africa in the 2050 decade will vary between US\$116.8 million (at 2.0°C GWL) and US\$228.7 million (at 2.4 °C GWL), rising to as much as US\$522.0 million if no adaptation measures are taken^{87,88}. Proactive adaptation could potentially half these costs at 2.0°C GWL⁸⁷.

Risk of damage and loss of coastal infrastructure from sea level rise, storm surges, and extreme weather events^{89,90,91}. Coastal critical infrastructure is expanding, more social and physical systems are increasingly exposed to climate-induced hazards⁸⁹. The interconnectedness and interdependencies of critical infrastructure systems increase their systemic instability and fragility, resulting in greater dynamic risk and cascading impacts^{89,92}.

The impacts of climate change on energy infrastructure holds potentially significant consequences for cascading impacts associated with disruption to electricity provision to hospitals, schools, financial systems, transportation assets, telecommunications, irrigation, air conditioning, heating, and water treatment, and affects many other aspects of daily life^{93,94}. Rising temperatures are already limiting the cooling capacities of South Africa's power generating stations³⁵.

Rising temperatures are likely to alter future demand for electricity, increasing peak load demands during hotter summers³⁵. Projected trends in rainfall and temperature are also expected to increase costs of maintenance and repair to power and energy infrastructure, in addition to disrupting supplies and transmission^{35,95}. Generation capacity, availability, and intermittency of renewable energy sources are strongly climate dependent – and may be impacted by climate change⁹⁶. For example, hydropower potential for South Africa may decrease by up to 20% for most of the country and up to 40% in the Western Cape and Northern Cape provinces relative to 1981–2000 by 2041–2060 under RCP4.5 (~1.96°C GWL)⁹⁴. The water-energy nexus under climate change poses a significant risk to achievement of sustainable development goals (SDGs) as increased temperature and drought episodes have implications for water availability, which in turn affects energy production in countries dependent on hydropower, pump-storage or coal-generated electricity in South Africa. Relatively few comprehensive papers have been published on the impacts of climate change on energy systems as a whole⁹⁷.

South Africa faces an increase in cooling demand^{97,98,99}. Decreased rainfall and higher temperatures (including heat waves) have led to significant water restrictions and increased demand for water and energy for cooling across all sectors³⁵. Seasonal increases for cooling demands are expected to increase over an extended summer period (September to April)³⁵.



Education

Projected Risk: High temperatures, low rainfall and flooding, especially in the growing season affect school attendance are projected to undermine educational attainment and human capital development in South Africa.

Climate variability and change undermine educational attainment. High temperatures, low rainfall and flooding, especially in the growing season affect school attendance¹⁰⁰. Early life undernutrition associated with low harvests or weather-related food supply interruptions can impair cognitive development^{1,101}. Children born in 2020 in South Africa, will face unprecedented lifetime exposure to climate extremes¹⁰², and will be exposed to 3–4 times more heatwaves in their lifetimes compared to people born in 1960; this exposure increases to 9–10 times more heatwaves for emission reduction pledges, limiting global warming to 2.4°C¹⁰³. While there can be expected a substantial impact on learners' cognitive ability at higher levels of warming^{104,105,106}, and particularly for the associated extreme heatwaves^{107,108,109}, there is currently no quantitative assessment of the current and projected impacts of heat on education outcomes and human capital development.



Livelihoods and Migration

Observed Impacts: Higher temperatures and precipitation extremes have been linked to increased rural out-migration, especially among low-income groups in South Africa.

Projected Risk: Climate change is projected to increase internal and rural-to-urban migration within South Africa and cross border migration in southern Africa, due to the direct and indirect environmental stressors on people's livelihoods associated with the impacts of climate change.

Higher temperatures and precipitation extremes linked to increased rural out-migration, especially among low-income groups in South Africa^{110,111}. For those stuck in place and for those on the move, there is a need to address immobility and the intersecting social determinants – including gender – that influence who can move and who cannot in response to the impacts of climate change^{112,113,114,115,116}.

Climate change is projected to increase migration, especially internal and rural to urban migration within South Africa due to the direct and indirect environmental stressors on people's livelihoods associated with the impacts of climate change^{1,117,118,119}.



Heritage, Culture and Tourism

Observed Impact: South Africa's cultural and natural heritage has been affected by climate hazards, including heat, rainfall variability, sea level rise and coastal erosion resulting in the loss of flora and fauna, decreasing visitation rates of tourists to South African national parks.

Projected Risks: South Africa hosts many cultural and natural World Heritage Sites and Ramsar sites projected to be exposed to impacts of extreme sea levels associated with sea level rise and coastal erosion.

South Africa's cultural and natural heritage is already at risk from climate hazards, including heat, rainfall variability, sea level rise and coastal erosion that will increasingly affect loss of cultural resources and heritage. Extreme heat days have increased across South African national parks since the 1990s¹²⁰. This reduces animal mobility, decreasing animal viewing opportunities¹²¹. Tourists and employees also fear heat stress¹²¹. Extreme weather events such as droughts, floods and extreme heat in the Kruger National Park have led to the loss of flora and fauna and infrastructure that supports tourism and has disrupted tourists' activities¹²². Visitation rates to South African national parks, based on mean monthly temperatures, are projected to decline 4% with 2°C global warming¹²³. Sea level rise and increased intensity of storms is projected to reduce beach tourism due to beach erosion^{124, 125}. For example, over 80% of Cape Town's 2019/2020 Blue Flag beaches are now under threat from rising sea level and coastal erosion¹²⁶. South Africa hosts many cultural and natural World Heritage Sites and Ramsar sites projected to be exposed to impacts of extreme sea levels associated with sea level rise and coastal erosion¹²⁷. Climate change is directly affecting environmental indicators for Indigenous Knowledge systems, reducing the efficacy and reliability thereof^{128,129,130}.

6.2 Inter-sectoral Risks

Risk from one sector can spill over and cascade to other sectors. Climate change risk can be severe for just one sector¹³¹. Recent extreme variability in rainfall and river discharge across Africa has had largely negative impacts on water availability and on water-dependent sectors^{1,132}. Water stress is also projected to be a key driver of migration due to its impacts on livelihoods of smallholder farmers, especially internal migration^{1,116,117}. But climate impacts on one sector – such as water – can cascade to affect others including energy and food; or impacts on food can cascade to impacts on health and wellbeing. South Africa is significantly dependent on its international neighbours for water. South Africa's water use, and ecosystem practices, also impact shared ecosystems and neighbouring countries^{133, 134, 135, 136, 137, 138, 139}. Climate change alters transboundary flows that are essential for people and nature, including flows of water, people, energy, and food^{135,136,140,141,142,143,144}. Climate change impacts on water either in South Africa or for any of its neighbours may therefore undermine regional plans to rapidly expand hydropower generation and irrigation infrastructure and compound the overall water-energy-food-nature nexus risk¹³⁹. For example, hydropower revenues in the Orange River basin could be anywhere between 30% lower to 50% higher than current revenues under the driest and wettest climate scenarios¹⁴⁵. This presents severe challenges to planning and highlights the need to adopt transboundary and nexus approaches to fully understand trade-offs between decisions made for water, energy, food and nature for South Africa^{13,140}.

Key Risks facing South Africa from current and future impacts of climate change are determined by more than climatic hazards, and are affected by vulnerabilities, exposures and responses to climate change. Risks become particularly severe under specific conditions of vulnerability that make the impacts of climate change negatively affect some groups more than others and where risks interact^{146,147} (See [Appendix 4](#) for Key Risk elaboration, linking risk statements to hazard conditions, vulnerabilities and exposures, and response options to reduce risks). Key inter-sectoral risks of concern in South Africa are shown in [figure 8](#).



FIGURE 8: Key inter-sectoral risks of concern in South Africa.

6.3 Hazards, vulnerabilities, exposures and responses affecting climate change risk in South Africa

The greatest gains for risk reduction in South Africa can be achieved through reducing vulnerability to climate change and investing in effective and feasible adaptation options.



Hazards

South Africa is affected by multiple climate hazards that impact key sectors in diverse ways. The main hazards affecting South Africa include increases in extreme heat, drought, extreme rainfall and floods, tropical cyclones, sea level rise, coastal flooding, coastal erosion, marine heatwaves, and variability and declines in total rainfall¹. These hazards can compound with each other to increase overall risk as well as initiate cascading impacts across multiple sectors, geographies and populations.



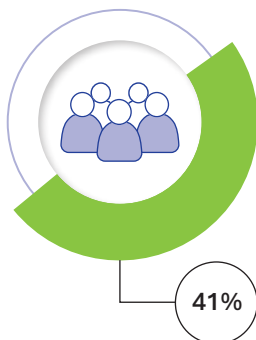
Vulnerabilities

South Africa is particularly vulnerable to climate change because key regions and population groups (e.g., women, children, elderly, (dis)ability, low-income, Indigenous groups, and migrants¹⁴⁷) face negative impacts from climate change that combine with historical socio-economic processes, as well as differences in resource access and livelihood changes that are also affected by climate change^{1,8,147}. Climate risk is unevenly distributed and so is the power to respond. While higher than most other African countries¹⁵², South Africa's adaptive capacity is constrained by multiple capacity, finance, institutional, infrastructural and development deficits that intersect and compound with each other to constrain risk reduction potentials^{153–158}. South Africa faces the compounding challenges of climate change, which intersects with and directly and indirectly affect the country's persistent triple challenges of poverty, employment, and equality, within a constrained fiscal environment, stagnant economic growth and high unemployment^{83,84,129,133,159–166}. South Africa commonly faces the 'wicked problem' of service delivery to the historically disadvantaged populations, addressing persistent infrastructure backlogs, rapid urbanisation, informality and high unemployment^{23,24,133}. The greatest gains in well-being in urban areas can be achieved by prioritising climate risk reduction for low-income and marginalised communities including people living in informal settlements¹⁶⁷. Infrastructure can also create harmful social and environmental impacts, increase vulnerability to climate-related hazards and leave an unsustainable burden of debt^{168,169}. Where multiple dimensions of vulnerability intersect (for example for low-income, rural, pregnant women), the impacts of climate change can be particularly severe¹⁴⁷.

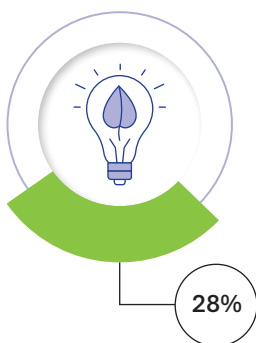


Exposures

Under climate conditions and particularly under extreme climate events there can be differential exposure on timing, intensity, spatial extent and frequency of the climatic conditions affected by human caused climate change. Where these dimensions intersect with critical dimensions of vulnerability, e.g., the timing of climate impact on growing season of crops, or the spatial extent and intensity of a drought on livestock, the risk can increase.



Fewer than half of South Africans have heard of climate change



South Africa's national climate change literacy rate



Responses

Where climate change *responses* are unable to reduce the impacts of climate change or where adaptation or mitigation responses are inappropriate, maladaptation increases vulnerability and susceptibility to future risk. Expectations for leadership in adaptation are set in the recent Afrobarometer survey that shows most South Africans place primary responsibility for climate change response on their own government and then on individuals, rather than placing responsibility on historical emitters¹⁷⁰. While South Africa has well-developed national adaptation strategies and a Climate Change Act¹⁷¹, resilience building and planned adaptation implementation has not progressed much beyond policy formulation and high-level planning. South Africa lags internationally in terms of institutional responses, with the majority of the reported responses occurring autonomously in households, often through local level and behavioural changes^{8,172}.

Concerning household level responses to climate change, South Africa is one of just five African countries in which fewer than half (41%) of its citizens have heard of climate change¹⁷³. South African provincial climate change literacy rates constitute some of the lowest sub-national rates on the continent, varying from as low as 15% in KwaZulu-Natal to 41% in Mpumalanga^{8,173}. Rates are lower among women than men in South Africa (24.5% vs 31.9%), a concerning statistic seeing as women are often more vulnerable to climate impacts^{8,173}. Ranked at 29 out of 33 countries surveyed in Africa, South Africa's national climate change literacy rate is only 28%¹⁷³. This suggests that household level responses to climate change are not factoring in the elevated risks associated with human caused climate change which can lead to reactive, short-term or maladaptive responses. Yet, public works programmes can build climate resilience by targeting soil, water and ecosystem conservation and carbon sequestration, such as South Africa's Working for Water Programme that restores river catchments to reduce fire risk and increase water supplies^{174,175}.

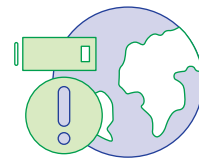
SECTION 7

PROJECTIONS FOR THE 2030s

Latest global climate projections suggest that at least one of the next five years will be more than 1.5°C above the 1850–1900 global average, and there is a small chance of one year exceeding 2°C of global warming above pre-industrial levels by 2029 (WMO, 2025). Recent estimates suggest the long-term global average could exceed +1.5°C by early to mid-2030s if current emissions trends continue, and that 2°C could be exceeded between the 2040s and 2060s, depending on global mitigation efforts (Forster et al., 2025). It is therefore urgent that South Africa ramps up and scales out implementation of adaptation options that proactively reduce risks created by 1.5°C GWL over the next 5 years, and by 2°C GWL over the next 15 years. Because of existing limitations in monitoring and evaluation, it remains unclear how adaptation measures implemented to-date, operating at the current 1.3 GWL, will fare under further warming to 1.5 and 2°C. Context-relevant evidence of adaptation efficacy remains limited and needs to be gathered in a systematic way to assess how the efficacy changes at various levels of warming and associated trends in drying and increasing rainfall intensity. But this cannot hold up implementation, it requires learning-by-doing.

Adaptation planning for the period 2031–2035, the focus of SA's NDC2, must therefore prioritise implementing adaptation measures designed to reduce climate impacts at global warming levels of 1.5–2°C, preparing for loss and damages associated with residual risk that is not sufficiently adapted to, and build capacity for implementing future options to deal with even higher levels of global warming.

RECENT ESTIMATES SUGGEST THE LONG-TERM GLOBAL AVERAGE COULD EXCEED +1.5°C BY EARLY TO MID-2030S IF CURRENT EMISSIONS TRENDS CONTINUE



SECTION 8

CLIMATE-RELATED LOSS AND DAMAGE

Most South African sectors, provinces and municipalities have already experienced numerous, costly and damaging climate impacts at the current level of 1.3°C global warming above the pre-industrial climate, although attribution studies have only been conducted on some of them and a consolidated inventory of these impacts and associated losses and damages does not yet exist in South Africa.

Kwa-Zulu Natal rainfall event



Repair costs estimated to exceed R10 billion

An analysis of the April 2022 rainfall event that caused extreme flooding in Kwa-Zulu Natal (KZN) and the Eastern Cape found that the probability of such a rainfall event occurring has approximately doubled because of human-induced climate change (Pinto et al, 2022). In a 1.2°C cooler world that same intensity of rainfall event would have had a 40-year return period, whereas now it has a 20-year return period. The impacts of that event included: 443 people died; 48 people went missing or are unaccounted for; over 26,000 dwellings were damaged; 600 schools and 84 health facilities were damaged (Presidential Climate Commission, 2023). Repair costs for damaged infrastructure, roads, water treatment facilities and electrical distribution systems were estimated to exceed R10 billion, and economic losses across the KZN province were estimated at R17 billion.

Western Cape 'Day Zero' impacts



R5.9 billion agricultural sector losses

An attribution study of the 2015–2017 'Day Zero' drought in the Western Cape found that such a multi-year low rainfall event is three times more likely as a result of current levels of human-induced climate change (Otto et al., 2018). The Western Cape Government estimated the impact of this drought on the agricultural sector to be in order of R5.9 billion losses in the 2017/18 season due to a drop in production and export volumes, resulting in around 30,000 jobs being lost (Pienaar and Boonzaaier, 2018).



30,000 jobs lost

As yet, there is very little data collected and collated on non-economic losses and damages (NELD) experienced due to climate events in SA. This is a major gap. An evidence base for South Africa to negotiate a fair share of any international L&D funds is yet to be established and requires investment. Getting the international Loss and Damage Fund, established in 2023, well-resourced with effective mechanisms to claim and disburse monies in a timely manner to those worst impacted is a priority for South Africa. Domestically, South Africa is in the process of designing and setting up a National Climate Change Response Fund (CCRF) to address the climate adaptation funding gap by mobilizing public and private finance into a dedicated fund to resource coping and adaptation measures in preparation for more extreme climate- and weather-events.

SECTION 9

PROMOTING JUST ADAPTATION AND CONTRIBUTING TO THE GLOBAL GOAL ON ADAPTATION

South Africa is actively developing both the idea and practices of just adaptation, within the framework of a Just Transition. This strongly factors into how South Africa is approaching the increasing level of ambition in the NDC process. Social and environmental justice of climate adaptation in South Africa, and South Africa's Just Transition more broadly, is understood to encompass procedural, distributive and restorative justice, including between nations, generations and diverse intersectional identity groups.

As a signatory to the Paris Agreement, South Africa is committed to playing its part in establishing and working to achieve the Global Goal on Adaptation (GGA) to enhance adaptive capacities, strengthen resilience and reduce vulnerabilities to climate change across regions, nations, sub-national and local areas. South Africa has committed to making a fair and ambitious contribution to a globally coordinated, long-term set of responses to enhance the collective wellbeing of all people, protect livelihoods and economies, and preserve and regenerate ecosystems within changing climate conditions through planned, proactive adaptation, guided by the UAE Framework for Global Climate Resilience (adopted at COP 28 in 2023, in decision 2/CMA.5 on the GGA and also decision 1/CMA.5, the outcome of the first GST). A total of 11 targets have been adopted internationally, 4 related to the process of adapting and 7 relating to key themes, as tabulated below.

TABLE 1: Global Goal on Adaptation (GGA) targets (4 process targets and 7 thematic targets).

#	PROCESS TARGETS	THEMATIC TARGETS
1	By <u>2030</u> all Parties have conducted up-to-date assessments of climate hazards, climate change impacts and exposure to risks and vulnerabilities and have used the outcomes of these assessments to inform their formulation of national adaptation plans, policy instruments, and planning processes and/or strategies, and by <u>2027</u> all Parties have established multi-hazard early warning systems, climate information services for risk reduction and systematic observation to support improved climate-related data, information and services.	Significantly reduce climate-induced water scarcity and enhance climate resilience to water-related hazards towards a climate-resilient water supply, climate-resilient sanitation and towards access to safe and affordable potable water for all.
2	By 2030 all Parties have in place country-driven, gender-responsive, participatory and fully transparent national adaptation plans, policy instruments, and planning processes and/or strategies , covering, as appropriate, ecosystems, sectors, people and vulnerable communities, and have mainstreamed adaptation in all relevant strategies and plans.	Attain climate-resilient food and agricultural production and supply and distribution of food, as well as increase sustainable and regenerative production and equitable access to adequate food and nutrition for all.

#	PROCESS TARGETS	THEMATIC TARGETS
3	By <u>2030</u> all Parties have progressed in implementing their national adaptation plans, policies and strategies and, as a result, have reduced the social and economic impacts of the key climate hazards identified in the assessments.	Attain resilience against climate change related health impacts, promote climate-resilient health services, and significantly reduce climate-related morbidity and mortality, particularly in the most vulnerable communities.
4	By <u>2030</u> all Parties have designed, established and operationalized a system for monitoring, evaluation and learning for their national adaptation efforts and have built the required institutional capacity to fully implement the system.	Reduce climate impacts on ecosystems and biodiversity and accelerate the use of ecosystem-based adaptation and nature-based solutions, including through their management, enhancement, restoration and conservation and the protection of terrestrial, inland water, mountain, marine and coastal ecosystems.
5		Increase the resilience of infrastructure and human settlements to climate change impacts to ensure basic and continuous essential services for all and minimize climate-related impacts on infrastructure and human settlements.
6		Substantially reduce the adverse effects of climate change on poverty eradication and livelihoods , in particular by promoting the use of adaptive social protection measures for all.
7		Protect cultural heritage from the impacts of climate-related risks by developing adaptive strategies for preserving cultural practices and heritage sites and by designing climate-resilient infrastructure, guided by traditional knowledge, Indigenous Peoples' knowledge and local knowledge systems.

The adaptation component of SA's NDC2 seeks to show how the nationally prioritised adaptation interventions make a fair and ambitious contribution to the 11 GGA targets laid out in the UAE Framework for Global Climate Resilience, accelerating adaptation implementation in the coming decade to meet urgent and immediate needs and close adaptation gaps linked to current and projected global warming levels.

SECTION 10

ADAPTATION GOALS AND INTERVENTIONS

Each NDC needs to strengthen the ambition of national actions to move beyond business-as-usual to unlock the kinds of system changes needed for net zero GHG emissions and minimised climate change impacts, losses and damages. A collective, nationally coordinated effort to scale up adaptation implementation needs to address four primary drivers of climate risks facing South Africa:

	Insufficient and unequal access to clean water, electricity and nutritious food is further exacerbated by climate stresses and shocks, notably rising temperatures, drying trends and more intense storms. This creates a need to diversify supplies, enhance storage and distribution networks, and invest in demand management strategies. Transboundary trade and regional supply chains of water, energy and food connect South Africa with its neighbours, although regional integration remains weak for jointly managing shared climate risks. There is an opportunity to spatially redistribute climate impacts and buffer climate shocks by increasing investment in cross-border networked infrastructure and regional coordination bodies and mechanisms. Regional adaptation initiatives involving multiple countries also provide opportunities to access international climate finance.
	Growing informal settlements of over 4,000 and 14 million people in and around towns and cities with inadequate public services and high levels of unemployment, place more people at high risk of climate extreme events, notably floods, heatwaves, droughts and wildfires. Opportunities exist to create local jobs through labour-intensive adaptation measures such as maintenance and ecological restoration of rivers, streams, wetlands and ponds to channel and store water during intense rainfall events, fire management through the creation and maintenance of fire breaks, removing invasive plants and controlled burning, and the construction and maintenance of community-based places of safety to gather and coordinate rescue efforts during extreme events.
	Heat stress and changing patterns of infectious and communicable diseases are placing additional burden on an already overstretched public health system, driving down productivity and driving up numbers of hospitalisations and deaths. The opportunity is to redesign and scale out health surveillance, early detection, warning and response systems to curb the escalation of climate-related health impacts, and to proactively adjust working conditions (for example, installing solar powered cooling systems into food markets) to reduce exposure.
	Biodiversity loss and declines in the functioning of key terrestrial, aquatic, coastal and marine ecosystems is undermining nature-based tourism and associated jobs and is reducing carbon storage. Increasing heat stress, wind intensity and drying conditions are adding to threats from unsustainable harvesting, poaching, and habitat fragmentation through land use changes, notably for agriculture and urbanisation. This is especially acute in the succulent, grassland and fynbos biomes of the Northern Cape, Mpumalanga, Eastern Cape and Western Cape. Adaptation opportunities exist in scaling out land, water and marine stewardship programmes that incentivize and resource the restoration and maintenance of ecological infrastructures that support biodiversity.

Building on the goals laid out in the NDC1 update, progress made to date captured in the first biennial transparency report (DFFE, 2024), and contributing South Africa's fair share to achieving the 11 targets set out for the Global Goal on Adaptation, proposed adaptation goals to consider for the second NDC period, 2031 to 2035, are presented in [figure 9](#).



FIGURE 9: Seven proposed adaptation goals to be consulted on for inclusion in NDC2.

Actions taken to achieve these goals should be socially inclusive and gender responsive, ensuring that women, men and people who identify as fluid or non-binary of all ages and with different physical and mental abilities have opportunities to engage and contribute in ways that are meaningful to them. This could include, but is not limited to, citizen science to monitor heat stress in homes, workplaces, education and health facilities, training in suitable response options for when early warnings of extreme weather and climate events are issued, the identification and co-design of suitable community-based places of safety to gather when people are displaced by extreme events like storms and fires, and siting cooling measures and cold storage facilities to safeguard vulnerable people and perishable food goods during heatwaves.

Interventions to progress towards the seven adaptation goals are listed in the tables below, aligned with the progressive implementation of South Africa's NCCAS. These interventions have been sourced through the review of policies, strategies, plans and funded adaptation projects (described in [section 4](#)), as well as an expert elicitation process that involved administering an online survey and hosting a series of focus groups with experts working on climate adaptation in South Africa. The list of interventions is not exhaustive and underrepresents new, cutting-edge options that have not yet been widely tested but might be needed to reduce emerging risks and combinations of risks. The numbers suggested for various options are those used to cost the options and estimate benefits, as described in [section 11](#). These numbers simply are a starting point for consultation, based on a balance between need and capacity to implement, but can and should be revised based on negotiated levels of ambition. The effectiveness of each of these measures under increasing levels of warming will be context specific, based on levels of access and adoption, the quality of design, implementation and maintenance. This efficacy, and the reasons for it, need to be monitored and understood as a basis for adjustment and augmentation to create climate resilient development pathways that are responsive to uncertainties, experimentation, learning and complex interactions and feedback loops (Taylor, 2024). This is a critical area for ongoing collaborative work across the research, policy and practice domains to build a coherent, ongoing action-learning cycle for climate adaptation across South Africa.

The political process that the NDC document went through yielded an eighth adaptation goal that was added to the seven put forward in this report. Goal 8 is “Enhanced efforts to build climate resilient human settlements and resilient infrastructure”. The interventions proposed to achieve this goal are to: develop the Human Settlement Climate Change Adaptation Strategy/Climate Change Response Strategy and/or Plan; conduct climate risk and vulnerabilities on Priority Human Settlement and Housing Development Areas (PHSHDA); support ecological infrastructure interventions as part of building the climate resilient infrastructure. The explicit emphasis placed on understanding and proactively reducing climate change risks within priority human settlements and housing development areas aligns with the findings of the risk assessment presented in [section 6](#), as a way to spatially target multi-hazard and multi-sectoral assessment of cascading risks and crowd adaptation interventions into areas with high densities of low-income residents in need of enhanced public infrastructure and services to reduce damaging and costly climate impacts. Many of the adaptation interventions likely to be prioritised and mobilized to achieve goal 8, if adequate resources are made available, are listed and costed under adaptation goals 2, 3 and 7. However, a next iteration of NDC technical work needs to further unpack what needs to be done to achieve goal 8 and include any relevant additional actions in the multi-criteria and cost benefit assessments.

THE POLITICAL PROCESS THAT THE NDC DOCUMENT WENT THROUGH YIELDED AN EIGHTH ADAPTATION GOAL THAT WAS ADDED TO THE SEVEN PUT FORWARD IN THIS REPORT. GOAL 8 IS “ENHANCED EFFORTS TO BUILD CLIMATE RESILIENT HUMAN SETTLEMENTS AND RESILIENT INFRASTRUCTURE”.



Adaptation goal 1

ADAPT SOUTH AFRICA'S WATER AND SANITATION SYSTEMS TO DRYING CONDITIONS AND DROUGHT AND FLOOD INTENSIFICATION, AS WATER UNDERPINS HUMAN, PLANT AND ANIMAL HEALTH AND ALL ECONOMIC AND LIVELIHOOD ACTIVITIES.

INTERVENTIONS TO ACHIEVE GOAL 1		TYPE OF ADAPTATION MEASURE	EXTENT OF ADAPTATION 2026-2035	EXPLANATION OF EXTENT OF ADAPTATION
1.1	Support municipalities develop updated Water Preparedness Plans and Water Safety Plans	Water institution reform	50 institutionalised and resourced plans (5 per year)	50 most exposed municipalities have plans that are institutionalised and capacitated. Part of the MTSR roll out. Part funded by municipalities themselves (but has opportunity cost on fiscus).
1.2	Programmes to reduce water losses & non-revenue water (NRW)	Water institution reform	18 financially accountable water utilities (municipalities and water boards)	Metro Trading Services Reform (MTSR) improves billing and allocation of revenue to plug leaks is implemented in 8 Metros and 10 Secondary Cities.
1.3	Enhanced water monitoring (flows, quality, consumption)	Water institution reform	200 water dashboards	Water dashboards that include storage, consumption and quality monitoring in 200 municipalities.
1.4	Restore catchments & wetlands, removing invasive alien plants (IAPs)	Ecological infrastructure	1,000 km ² of strategic and infested catchments cleared and maintained	Strategic Water Resource Areas (SWRA) account for 124,075 km ² of South Africa surface area but provide 24 954 million m ³ (50%) of the country's mean annual run-off. Those SWRA's above major dams that are infested offer the chance to enhance water security.
1.5	Revise water allocations, restrictions & pricing	Water institution reform	Provincial authorities (DWAS), catchment management agencies, water user associations and irrigation boards engage in annual water pricing reviews	Assumes that 5% of the SA-Towards Inclusive Economic Development (SA-TIED) shortfall for the water sector of R49 billion per year falls under this adaptation option.
1.6	Water augmentation & diversification schemes, focussing on reuse & groundwater	Water infrastructure – built	Infrastructure in place to ensure 98% assurance of supply from all major water schemes and compliance with SDG6. Only 30% compliance in next 10 years, with this element accounting for 10% of the lower (climate adapting) SA-TIED budget.	Water insecurity is a cause of systemic climate vulnerability. The proportion of the population with access to reticulated potable water declined to 88.7% by 2021 (StatsSA, 2022). Over the same period the quality of water resources declined rapidly. The DWS's Blue and Green Drop reports, released in 2023, indicated that of the 958 water supply systems across South Africa, 29% were in a "critical" state of disrepair – up from 18% in 2014.

INTERVENTIONS TO ACHIEVE GOAL 1		TYPE OF ADAPTATION MEASURE	EXTENT OF ADAPTATION 2026–2035	EXPLANATION OF EXTENT OF ADAPTATION
1.6	Water augmentation & diversification schemes, focussing on reuse & groundwater (continued)	Water infrastructure – built (continued)	Infrastructure in place to ensure 98% assurance of supply from all major water schemes and compliance with SDG6. Only 30% compliance in next 10 years, with this element accounting for 10% of the lower (climate adapting) SA-TIED budget. (continued)	A reported 46% of water supply systems recorded “poor or bad” microbiological water quality in 2022, up from 5% in 2014. The net result is that South Africa has been unable to unlock the full “social and economic value” of water and sanitation access. The SA-tied analysis applied the “Beyond the gap” analysis (which included climate change impacts) showed a R90 billion water investment shortfall per annum (55% increase on existing budget allocation). But where other adaptation measures were in place (e.g. a shift to renewable energy and adoption of composting toilets) the shortfall on South Africa’s water infrastructure would be reduced to R49 billion per annum. The NDC costing assumes that any water investment shortfall increases climate vulnerability. Some of the expenditure envisaged by SA-TIED study is covered by other adaptation options in the NDC. Assumed that 10% the SA-TIED shortfall is carried by this adaptation option in the next 10 years.
1.7	Innovate with low-flow and waterless sanitation solutions	Built environment and spatial planning	1 million waterless sanitation systems installed with a focus on schools, creches and sport halls that currently depend on portaloos. Displaces 50,000 contracted portaloos over 10 years.	1 million waterless sanitation systems installed with a focus on schools, creches and sport halls that currently depend on portaloos. Assumptions that dependence on contracted portaloos can be reduced by 50,000 portaloos over 10 years. This saves money spent currently on portaloos cost R15,000 per toilet per year.
1.8	Expand water stewardship programmes	Ecological infrastructure	1000 water stewards employed	Focus on areas not covered by youth employment and drain clearance programmes. Cost 50% covered under “Expand maintenance programmes to remove blockages (e.g. invasive plants, solid waste, wind-blown sand)” and expanded youth employment programmes (below). Includes partnership between water stewards and the Land Care Programme.
1.9	Invest in SADC, transboundary water management arrangements	Water institution reform	All existing transboundary schemes stress tested for climate change. Lesotho Highlands Phase 2 is implemented.	Half of Lesotho Highlands Water Project (LHWP) Phase 2 implemented in the next 10 years. Half the supplied water deemed critical for climate change vulnerability reasons (i.e. 25% of LHWP Phase 2 costs).

Adaptation goal 2

ENHANCE DISASTER RISK MANAGEMENT, HEALTHCARE AND SANITATION PROVISION, ESPECIALLY IN INFORMAL SETTLEMENTS, TO REDUCE IMPACTS OF FLOODING AND HEAT STRESS ON MOST VULNERABLE HOUSEHOLDS.

INTERVENTIONS TO ACHIEVE GOAL 2	TYPE OF ADAPTATION MEASURE	EXTENT OF ADAPTATION 2026-2035	EXPLANATION OF EXTENT OF ADAPTATION
2.1 Emergency shelters designated & kitted to be community rescue & care hubs, cooling centres & temporary accommodation for flood-displaced people tailored to needs of marginalised groups in high-risk municipalities	Climate preparedness	100 existing shelters are better resourced to cope with increasing frequency of climate disasters.	Use of existing municipal buildings (sport halls, libraries, community halls) but these are further equipped and personnel trained to deal with displaced people.
2.2 Training and support to community-based organisations providing care services to young children, elderly and people living with disabilities	Health and well-being	2,000 existing social workers and support staff receive training to reduce pressure on first responders (200 per year).	200 social workers and support staff receive training per year.
2.3 Enhance clinical resources to diagnose and treat water- and vector-borne diseases	Health and well-being	700 clinics (20% of all state-run clinics) have specialised staff and tests over 10 years.	R250,000 per clinic per year.
2.4 Extend and upgrade sanitation services in high-risk informal settlements, especially near food vendors	Built environment and spatial planning	1,000 (100 per year) municipal sanitation blocs upgraded to displace portaloo and pit latrines (100 per year) over and above those in 1.7 (above). An additional 53,000 portaloo displaced (5,300 per year).	Informal settlement bucket systems contaminating storm water. Portaloo are a major drain on municipal resources. Assumed that 53,000 contracted portaloo, costing R15,000 per toilet on average, are displaced in informal settlements.

Adaptation goal 3

UPGRADE CRITICAL TRANSPORT INFRASTRUCTURE (ROADS, RAIL, PORTS) TO MAINTAIN FUNCTIONING UNDER INCREASED RAINFALL INTENSITY, HEAT STRESS, WIND SPEEDS AND STORM SURGES.

INTERVENTIONS TO ACHIEVE GOAL 3		TYPE OF ADAPTATION MEASURE	EXTENT OF ADAPTATION 2026–2035	EXPLANATION OF EXTENT OF ADAPTATION
3.1	Expand maintenance programmes to remove blockages (e.g. invasive plants, solid waste, wind-blown sand)	Water infrastructure	7,000 km of rivers and stream frontage roads, bridges and culverts come under local stewardship to prevent storm damage at a cost of R100,000 per kilometre per year.	Half implementation of Transformative Riverine Management Programme (3,500 km) and an additional 3,500 km implemented across the country over 10 years. Full Umgeni Programme (TRMP/ Sihlanzimvelo extended to 7,000 km of river in the catchment) would cost R375 million per annum for 20 years. If this were to be rolled out along all catchments critical to flood management, a national budget of R1.875bn per annum would be required. Ecological Infrastructure for Water Security (EI4WS) noted the 2020/21 allocations to ecological infrastructure incubate drought risk and increase the burden on the central fiscus. The Department's Natural Resource Management (NRM) arm manages the expanded public work's programmes, "Working for" (Water, Wetlands, Ecosystems, Fire) that collectively aimed to create 16,315 jobs in 2020/21.
3.2	Coastal dune rehabilitation	Ecological infrastructure	50 km of dunes restored and maintained at critical points along South Africa's coastline in next 10 years.	Estimates based on the City of Cape Town programme at three critical sites (10 km of coastline in total) costs R25 million per year (up front capital costs annualised over 20 years). Modest but meaningful project for the country would cost R125 million per year.
3.3	Flood and erosion defences	Water infrastructure	500 km of widened channels, reinforced riverbanks engineered drainage.	50% covered by 3.1 (above) "Expand maintenance programmes to remove blockages (e.g. invasive plants, solid waste, wind-blown sand)" project above.
3.4	Secure road and rail infrastructure against heat stress	Built environment and spatial planning	Upgrade 1% of the 158,000 km of paved roads and invest similar quantum in rail repairs and upgrades.	South Africa has 750,000 km of roads. Water sector interventions cover flooding and SA is committed to spending R120bn a year on roads. Temperature impacts on tarred roads is documented at cost of R6million per kilometre for 1% of the 158,000 km of paved roads. A similar quantum is estimated for preparing and restoring South Africa's rail network, which is in a state of disrepair.
3.5	Managed retreat and relocation of key infrastructure from high-risk zones	Built environment and spatial planning	1000 built assets (electricity sub-stations, transport nodes, public buildings) relocated or surrendered at average cost of R3 million per asset.	Assumes some compensation and/or resettlement is required for approved buildings and the reconstruction of public infrastructure at risk.

Adaptation goal 4

ENHANCE NUTRITIOUS FOOD ACCESS AND AFFORDABILITY THROUGH SUPPORT TO AGRICULTURAL AND FISHERIES PRODUCERS AND DISTRIBUTORS IN ADAPTING TO WARMER AND WINDIER CONDITIONS AND CHANGES IN RAINFALL.

INTERVENTIONS TO ACHIEVE GOAL 4		TYPE OF ADAPTATION MEASURE	EXTENT OF ADAPTATION 2026-2035	EXPLANATION OF EXTENT OF ADAPTATION
4.1	Support to develop, adopt & market drought-resistant crop varieties & heat tolerant livestock and aquaculture species	Resilient food systems	30 drought/heat resistant agricultural varieties and associated practices (crops and livestock) are adopted by farmers on a commercial basis.	Involves investment in scaling the outcomes of existing research through extension officers and rural development programmes at a cost of R2 million per variety.
4.2	Enhance market access for small-scale producers	Resilient food systems	Upgrades of 10 informal settlement markets with solar powered electricity and sanitation over 10-year period.	Estimates based on planned upgrade of Gugulethu meat market at R2 million per market.
4.3	Improve irrigation efficiency	Resilient food systems	Drip irrigation technologies 40% subsidised by the state as part of the Consolidated Agricultural Support Programme.	3000 hectares of drip irrigation 40% subsidised over 10 years. Conversion to drip irrigation is assumed to cost R60,000 per year.
4.4	Training and accreditation of sustainable land management and sustainable fishing and aquaculture practices	Climate preparedness	100 courses run. All extension officers have attended courses on climate resilient agriculture and enhancing soil carbon after 10 years.	Effective use of agricultural colleges and extension officers. 100 courses at R300,000 per course.
4.5	Enhance access to tailored climate information	Climate preparedness	Collation and translation of climate model findings.	Ability to digitally deliver latest climate information to municipalities and public on demand.
4.6	Affordable climate risk insurance schemes	Climate preparedness	R1 billion state guarantee to private insurers based on their extended reach.	Public-private sector engagement to extend insurance market to displace some of the current DRR activities. Assumed to increase reach of agricultural insurance to 2,000 additional farmers that would not have otherwise accessed insurance.
4.7	Support with shade netting infrastructure	Resilient food systems	State subsidised shade-cloth by 40% to 100 proven farmers and 100 community vegetable gardens each receive 150 m ² of shade-cloth.	Used to support 50 proven small-scale farmers and 50 established vegetable gardens. Replaced every 5 years. Only 40% of shade-cloth paid by State. R4,500 per 150 metres delivered to site.

Adaptation goal 5

ENHANCE CLIMATE SERVICES, WITH EARLY WARNING AND IMPACT INFORMATION MADE ACCESSIBLE TO A WIDE RANGE OF USERS, TAILORED TO DIFFERENT OPERATIONAL, LANGUAGE, GENDER, AGE AND DISABILITY NEEDS.

INTERVENTIONS TO ACHIEVE GOAL 5		TYPE OF ADAPTATION MEASURE	EXTENT OF ADAPTATION 2026–2035	EXPLANATION OF EXTENT OF ADAPTATION
5.1	Enhance early warning systems (monitoring, warning dissemination and response triggers), building on SAWS multi-hazard EWS	Climate preparedness	Coordination of existing EWS systems (oceans, cold, flooding, heat) with municipal early warning systems and digital communication.	Digital system created for push-messages to citizens from existing EWS systems. Linked to local government disaster risk reduction efforts.
5.2	Train community leaders in climate information interpretation and response measures	Climate preparedness	Material prepared and 50 three-day courses provided over first 5 years.	Some overlap with training as offered to extension officers. Goal of 5 officials/ community leaders from each local municipality and metro (213 in total) to have attended a 3-day course.
5.3	Develop a national inventory of impacts to complement EWS with bottom-up data collection, DFFE coordinating and supporting efforts by local authorities and communities	Climate preparedness	Enhanced national inventory to include work from and by informal settlements.	2000 ground responders are equipped and trained to feed environmental risk (flooding, drought, fire, wind) damage into the national inventory at a cost of R300,000 per responder per year, assuming the programme draws on some existing personnel.
5.4	SADC integrated regional drought monitoring system	Climate preparedness	Every province to have a 'handshake' reporting system with SADC Climate Services Centre (CSC).	Annual meeting between provincial departments of Agriculture and Environmental Affairs and the SADC CSC team to ensure integrated monitoring systems.

Adaptation goal 6

ENHANCE ECOSYSTEM-BASED ADAPTATION TO HEAT AND WATER STRESS, PROTECTING SOUTH AFRICA'S NATURAL HERITAGE, BIODIVERSITY AND IMPROVING ECOSYSTEM FUNCTIONING THAT UNDERPINS OUR CULTURAL IDENTITY, FOOD SYSTEMS, HUMAN WELLBEING AND OUR TOURISM ECONOMY.

INTERVENTIONS TO ACHIEVE GOAL 6		TYPE OF ADAPTATION MEASURE	EXTENT OF ADAPTATION 2026-2035	EXPLANATION OF EXTENT OF ADAPTATION
6.1	Redesign national-scale agricultural extension programme to support sustainable rangeland management and fire management	Resilient food systems	2,000 extension officers trained and mobilised with investment in the Landcare programme.	South Africa's 2,000 extension officers repurposed and re-mobilised around climate resilient agriculture through the provision of training at R40,000 per head every year. Extension officers 'learn by doing' through increased investment of R800 million per year in the Landcare programme.
6.2	Review ecological reserve determinations for surface and groundwater catchments	Water institution reform	New ecological reserves set with an additional effort.	Building on existing work, ecological reserves are set and integrated into water licencing with DWS oversight and enforcement.
6.3	Double the national team working on invasive alien plant (IAP) monitoring	Ecological infrastructure	Same as "restore catchments & wetlands, removing IAPs".	DFFE national team to gain an additional 24 people.

Adaptation goal 7

CAPACITATE ALL SPHERES OF GOVERNMENT TO IMPLEMENT ADAPTATION THROUGH ENACTING AND ENFORCING ALL PROVISIONS OF THE CLIMATE CHANGE ACT.

INTERVENTIONS TO ACHIEVE GOAL 7		TYPE OF ADAPTATION MEASURE	EXTENT OF ADAPTATION 2026–2035	EXPLANATION OF EXTENT OF ADAPTATION
7.1	Develop and implement Sector Adaptation Strategies and Plans, consistent with NCCAS	Climate preparedness	Sector plans contain standardised approaches and a better integrated climate change adaptation component that is adopted by provinces.	Additional work done by government/ external party to screen sector plans for climate change and work with provinces to ensure alignment.
7.2	Network of project preparation facilities supporting municipalities' access suitable financing for robust adaptation interventions	Climate preparedness	GreenCape/SSN or another entity to oversee 5 project preparation facilities comprising a network of experts.	PPUs to be funded externally and to attract high-level expertise. Former UK FCDO model (run by SSN in Africa) provides an example. 25 experts in total. Each PPU to spend R2.5 million a year on project preparation.
7.3	Climate jobs register with a focus on youth and gender inclusion	Climate preparedness	Presidential Employment Stimulus programme to create 10,000 job years in 10 years.	Presidential Employment Stimulus programme to focus on 'climate resilient development' jobs through their existing model and in collaboration with Harambi. Focus on the PES themes of 'agriculture and land reform', 'forestry, fisheries and the environment', 'health', 'public works and infrastructure'
7.4	Fully functioning adaptation Monitoring, Evaluation and Learning (MEL) system for routine BRT and GST reporting	Climate preparedness	MEL system upgraded.	R10 million invested every year for 10 years to integrate and communicate on emissions and risks.



SECTION 11

COST ESTIMATES AND RANKING OF SOUTH AFRICA'S NDC OPTIONS 2026–2035

This section summarises the applied methodologies and the results of work that (i) put costs to the adaptation options submitted as part of South Africa's second Nationally Determined Contribution (NDC2) and (ii) ranked the same options using multi-criteria analysis (MCA) and a cost-benefit analysis (CBA) and (iii) described the options in terms of their public/private good attributes.

South Africa's climate transition will be risky (Huxham, Anwar & Nelson, 2019), and it is not the case that all adaptation options offer equal value for money. Strategic Intervention 8 of the NCCAS sets the ambition to: "Enable substantial flows of climate change adaptation finance from various sources". This represents an important progression from previous lists of adaptation options that contained little reference to costs or the constraints of available budgets. The case for "common but differentiated" climate responsibilities remain as strong as ever and there is a critical need for the pledges of loss and damage compensation and climate finance to be honoured in support of well-articulated NDCs. This document quantifies the scale of the investment required to fund and finance South Africa's adaptation effort (2026–2035) in support of integrating climate change adaptation into fiscal and financial planning. It builds on the assumption that scaling public and private investment in South Africa's climate change adaptation will require officials responsible for public expenditure and private finance having a sense of what adaptation options will cost and their respective merits in terms of cost and benefits.

South Africa spent an average of R188 billion per year between 2022 and 2023 on climate change responses, the bulk of which came from private financiers in the form of loans for renewable energy generation, as shown in [figure 10](#) (de Aragão Fernandes et al., 2025). Only 11.3% (ZAR 21.2 billion) of the climate finance tracked for the 2022–2023 period supported adaptation interventions in South Africa. South Africa requested \$8bn per annum from the international community in its first NDC submission. The \$8 billion request was, however, assumed to be for public finance and grants and not bank loans. Scaling loan finance is contingent upon generating financial returns, but financial returns are not possible from all forms of climate change adaptation, most obviously those generating public goods or preventing negative externalities. If climate change investment is to significantly reduce climate change risk in South Africa, there is a clear need to (i) increase the amount private finance (ii) provide greater complementarity between private finance, concessionary finance, South Africa's budget allocations and donor contributions, and (iii) ensure both public and private investments are better directed in terms of generating impact. In seeking to align South Africa's A-NDC2 with the realities of effective public and private investment, both cost and cost-benefit ratios for 36 climate adaptation options are provided.

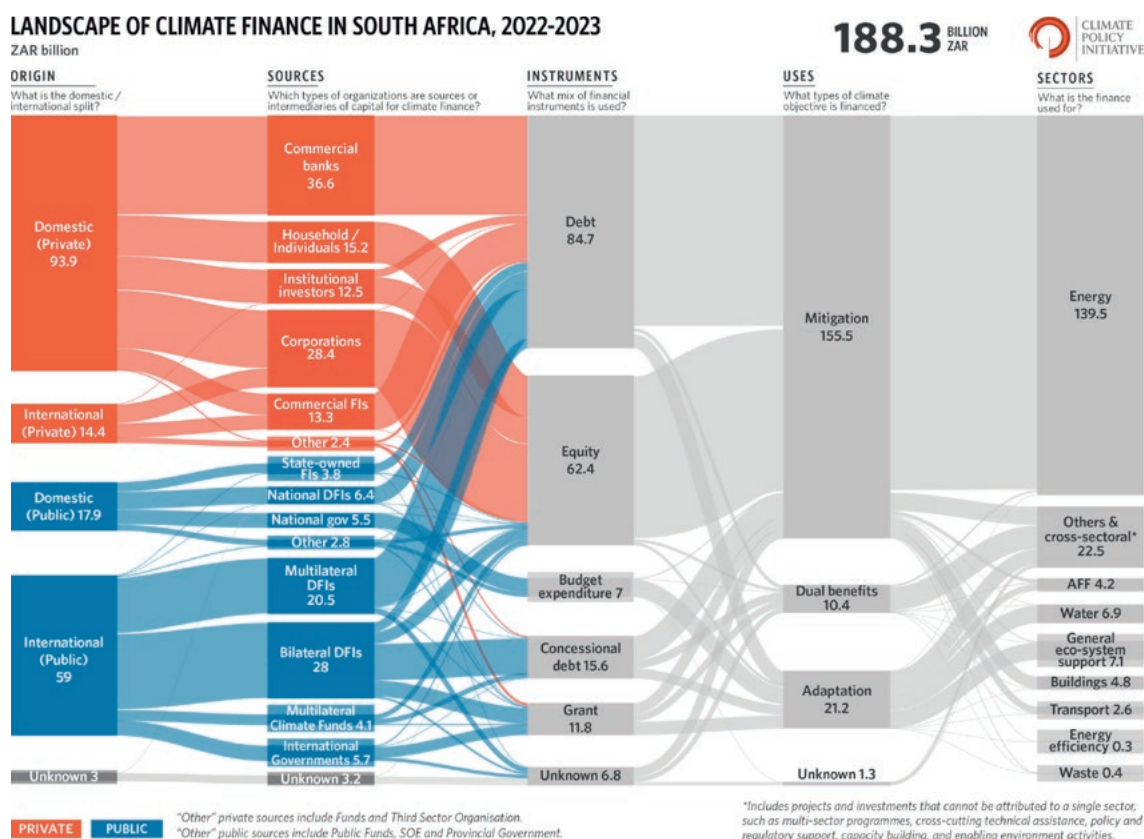


FIGURE 10: South Africa’s climate finance landscape for 2022–2023 period (source: de Aragão Fernandes et al., 2025).

11.1 Determining adaptation costs

It is important in any climate change costing exercise, that cost estimates be clear on what is being costed. For example, is the cost of climate change adaptation based on the investment required to save every climate change related death; 90% of those deaths; the same level of economic growth or development that would be attained if there was no anthropogenic climate change? Do we know the full impact of climate change loss (the “damage function”) in the future? Even when adaptation costs are understood to relate to climate change response measures (as is the case in this document), the types of costs that are included and the physical scale and temporal boundaries of the response measures need to be clear.

11.1.1 What is being costed?

Costed in this document is the investment in implementation incurred between 2026 and 2035 of the 36 adaptation projects (clustered under 7 adaptation goals) and programmes presented in [section 10](#). The 36 adaptation projects and programmes reflect an emphasis on water security, aligned with the key risks identified in [section 6](#). The water security focus is supported by research on near-term climate change impacts in South Africa: the risks of drought, flooding, dam siltation, carbon dioxide fertilisation of water-intensive invasive alien plant species in water catchments, and declining water quality under warmer temperatures are well documented in the literature and already concatenating with poorly maintained water infrastructure to create acute difficulties in South Africa’s water sector (DEA, 2011; Pegram and Tandi, 2022).

Only the cost of implementing the 36 options over the next 10 years is captured. We did not seek to capture the cost of climate change impacts on South African society or economy. Nor does this study report the full investment needed to adapt to climate change in South Africa under various scenarios. Estimates exist, but the full extent of health sector needs, road infrastructure costs and losses in investor confidence attributable to climate change, for example, is not known with any degree of accuracy or included¹: a macro-economic study estimated that climate change would reduce South Africa's GDP by 1.5% (–3.8% to 0.3%) by 2050, a median reduction of 0.3% per year or roughly R21.6 billion per year in 2015 (Cullis et al., 2015). A more recent study estimated GDP losses attributable to climate change to be between 3.33%–5.03% by mid-Century (R160–R240 billion per year) (CMCC, 2022).

Attention was given to establishing the detail of each adaptation option. For example, through a process of consultation, the following descriptions were added to the adaptation options.

Adaptation option 1.1 *Support municipalities develop updated Water Preparedness Plans and Water Safety Plans* was understood to involve the 50 most exposed municipalities having plans that are institutionalised and capacitated at a cost of R4 million per plan.

Adaptation option 3.1 *Expand maintenance programmes to remove blockages (e.g. invasive plants, solid waste, wind-blown sand)* was understood to involve the roads, bridges, culverts in the riparian zones of 7,000 km of stream and river frontage come under local stewardship to prevent storm damage, at a cost of R100,000 per kilometre per year.

Adaptation option 6.1 *Redesign national-scale agricultural extension programme to support sustainable rangeland management and fire management* was understood to involve South Africa's 2,000 extension officers retrained and mobilised around climate resilient agriculture through the provision of training at R40,000 per head every year. Extension officers 'learn by doing' through increased investment of R800 million per year in the Landcare programme.

These options and descriptions can be consulted on, debated and updated with each iteration of further NDC work, with the associated criteria scoring and estimation of costs and benefits then being adjusted in line with the updated option descriptions and new data and information that becomes available from relevant monitoring and research studies. The assumptions made in costing adaptation have been clearly and transparently stated to facilitate making the costing estimates both transparent and more replicable. There is room, however, for continual improvement. It is suggested that a three-year research programme on costing adaptation and losses and damages in South Africa is initiated. Such a programme would address the complex issues, reduce the range of estimates and could feed into preparations for the third NDC.

¹ Much of the adaptation literature is vague on whether adaptation is intended to prevent all, most, or some of the anticipated climate change damage or if this is even possible.

11.1.2 Costing assumptions

In this estimation of the cost of implementing South Africa's 36 priority adaptation options, the following assumptions were applied:

- 1 The full public and private cost (including salaries and maintenance) was estimated for each of the 36 adaptation options and seven adaptation goals. Where the options involved an extension or scaling of existing projects, only the cost over and above what is already being invested was counted. This aligns with the World Bank's "Beyond the Gap" approach, i.e. identify objectives, identify policy choices, identify exogenous factors, estimate investment requirements for achieving policy objectives (Rozenberg and Fay, 2019).
- 2 The baseline from which the investment gap is estimated was set at the state of adaptation in South Africa in 2025.
- 3 While consideration was given to what could be achieved within the 10-year timeframe, the State's capacity to implement adaptation was not introduced as a binding constraint on investment. A 'capable state', by international norms, is assumed in estimating what adaptation projects could be implemented in South Africa between 2026–2035.
- 4 In keeping with the NCCAS, the focus was on 'climate resilient development'. New investments that decrease exposure to multiple climate risks have been included. Recognising the difficulty in predicting actual climate impact in terms of timing and damage, no effort was made to apply a strict definition of 'additionality' in the sense of only including investments directly attributable to climate change.
- 5 Options that duplicate other options were screened out, but individual options were costed without full regard for overlaps and synergies with other options that might reduce the investment need (this represents a deviation from the "Beyond the Gap" framework). In practice, adaptation options should be clustered in 'programmes of action' that unlock synergic impacts, but this requires high levels of intergovernmental cooperation. The adaptation options belonging to similar programmes, were tagged allowing for a parallel costing of 'programmes of action' alongside the costing of adaptation goals.
- 6 Where available, the cost estimates were based on precedents and existing research. Where no precedents existed, proxies and assumption-based estimates were applied and listed in the appended spreadsheet.
- 7 In estimating the indicative cost of the adaptation options, no 'time value of money' was included, meaning there are no discount rates or inflation rates, and all options are assumed to require investment in year 1 (discounted costs and lags in the flow of adaptation benefits were introduced as part of the cost-benefit analysis (CBA).
- 8 Where currency conversions were required, \$1 (United States of America Dollar) was assumed to represent ZAR18 (South African Rand), but this exchange is adjustable in the cost-benefit analysis.

11.2 Ranking adaptation options

To strengthen the investment case in South Africa's adaptation efforts, it was important to understand at least two things about the adaptation options:

- 1 The economic efficiency of adaptation options in terms of reducing climate change risk. To achieve this the adaptation options were ranked in terms of a set of criteria and their cost-benefit respectively. This was deemed important in the instance that adaptation budgets are constrained, and investment trade-offs are required.
- 2 The public good/private good nature of the adaptation options. This was deemed important to understand where to go looking for the required investment.

11.2.1 Ranking adaptation options in terms of economic efficiency

Cost-benefit analysis (CBA) – the ratio of benefits that emerge from a monetary unit of investment – is the conventional way of ranking investment options in terms of their economic efficiency. It provides a measure of 'bang for buck'.

The application of CBA to climate change adaptation is not, however, straightforward. While the cost of adaptation is relatively easy to appraise – typically by counting budgeted capital and operating expenditure over time – appraising the benefits of climate change adaptation is not easy (Cartwright et al., 2013). The conventional means of quantifying benefits in a climate change CBA would be to calculate the GDP losses that are prevented through effective adaptation.

This is an unsatisfactory approach to calculating adaptation benefits for several reasons:

- Projecting the benefits of adaptation requires a sense of how GDP will be influenced by future climate change damages as represented by a 'damage function'. Damage functions can be useful at the scale of the global economy but tend to misrepresent both the GDP loss and the extent of knowledge we hold about future GDP losses at the country or local scale. Recognising that climate change increases uncertainty regarding a range of economic and social contingencies that can be attributed to the change, is important for effective decision making. Decisions can still be taken knowing that we don't know the precise nature, timing or locations of climate change impacts, and acknowledging this uncertainty can lead to better decisions.
- Compounding the difficulties with applying 'avoided GDP losses' as the measure of climate adaptation benefit, is the reality that GDP represents a poor reflection of what a lot of people value in South Africa, and particularly what they value when confronting climate change risks. Not only does GDP fail to detect some informal economy activity, but GDP tends not to impute the value of ecological assets that provide an important buffer, especially for poorer communities that lack insurance.
- GDP tends not to reflect attributes such as social cohesion and inequality that are critical to adaptation and the ability of people to respond after a climate disaster. On top of this, the success of an adaptation option is often dependent on intangible factors such as political support, technical complexity or adoption by local communities. Projecting these influences into GDP impacts of adaptation can be difficult, and in this sense, GDP compresses too much important information into a single metric, losing valuable information in the process (Vatn and Bromley, 1997).
- It is possible to capture some of these influences in Computer Generated Equilibrium models of a macro-economy, but running these models to gauge GDP impact takes time and money. They cannot be run frequently or iteratively and are therefore limited in their ability to support adaptive management and decision making.

The above are not new considerations when applying cost-benefit analyses. The appraisal of South Africa's NDC2 adaptation options took these considerations into account by applying a multi-criteria assessment.

11.2.2 Multi-criteria assessment of adaptation options

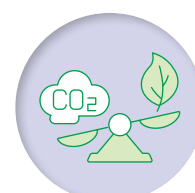
Prior to running the cost benefit analysis, each of the 36 adaptation options was scored 1–5 in terms of six criteria deemed important for climate change adaptation options, but which are difficult to capture in a CBA. The six criteria comprised:

- 1 **The employment intensity of the adaptation option.** How many jobs or work-days does it create? Unemployment is high in South Africa and unemployed people not only lack the income with which to buffer themselves from climate change risk, but they often fall outside of the formal and planned public response to climate change and lack the professional and labour market social networks on which they can draw in coping with climate change.
- 2 **The greenhouse gas emissions intensity of the adaptation option.** Whilst adaptation and mitigation are typically separated in UN policy, some of the best adaptation options also sequesterate or reduce greenhouse gas emissions. Options that sequesterate or displace emissions were scored more highly under this criterion than emissions or energy intensive options.
- 3 **Economic growth.** South Africa is committed to a 'just transition' and confronts the difficult task of reducing the country's emissions, building climate resilience and coping with climate change impacts while trying to alleviate poverty and reduce inequality. Balancing these priorities is easier in a growing economy and adaptation options that grow the economy through investment, work creation or efficiencies are scored more highly under this criterion.
- 4 **Avoided loss and damage.** Damage functions are difficult to project or quantify exactly. However, options that are known to protect ecological assets, community cohesion and livelihoods are scored highly under this criterion.
- 5 **Ease of implementation and risk of mal-adaptation.** All scores under this criterion were negative. South Africa has struggled with implementation of infrastructure and economic development programmes over the past 15 years. Adaptation options that are technically or politically difficult to implement, or which contain high risks of unforeseen adverse consequences, were given higher negative scores than 'low-regret' or familiar options.
- 6 **Saves lives.** Adaptation options that are likely to save lives were scored highly in the multi-criteria assessment.

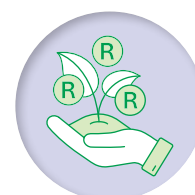
The six criteria deemed important for climate change adaptation options



The employment intensity of the adaptation option



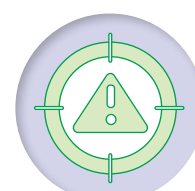
The greenhouse gas emissions intensity of the adaptation option



Economic growth



Avoided loss and damage



Ease of implementation and risk of mal-adaptation



Saves lives

The scores accorded to the options were summed and divided by a total of 30, so that each adaptation option could be ranked in terms of its merits under the 6 criteria. In the appraisal of NDC adaptation options, the scores assigned to the 36 options were evaluated in their own right to come up with a project ranking. In addition, the scores were used to weight the 'human benefit score' given to the adaptation options in the CBA, creating an interaction between the MCA and the CBA that allowed the CBA to accommodate a wider array of influences than monetary costs and benefits.

For the CBA the calculation of 'benefits' arising from the respective adaptation options was done by estimating the proportion of the South African population that would be impacted in some way by the intervention:

- The South African population was set at 65 million.
- The percentage of this population that had their lives saved by the adaptation intervention over a 10-year period (typically 0.001%–0.02%) received a weighting of 1.
- The proportion of population that received a significant positive impact (through protection of their livelihood, a reduction in risk to them and their assets) received a weighting of 0.5 (typically 2.5%–20%).
- The proportion of the population that received a moderate positive impact received a weighting of 0.2.
- The balance of the population that received only a minor impact from the adaptation intervention (an indirect impact for example) received a weighting of 0.1, this applied to 55%–75% of South Africa's population across all options.

The 'human-benefit index' used to represent the benefits of climate change adaptation in this analysis, was calculated by summing the weighted population numbers for each option. For example:

If an adaptation option (such as 50 institutionalised and resourced Municipal Water Preparedness Plans aimed to reduce the impacts of droughts, floods and ageing infrastructure in a hotter and drier country) was anticipated to reach 40% of the population (i.e. 26 million people), and its saved the lives of 0.01% of that population every year, significantly positively impacted 5% of the population, imparted a moderate positive impact on 20% of the population and had a minor positive impact on the balance of 75%, then the gross HBI score for that impact would be calculated by (for example):

$$HBI = (1 \times (40\% \times 65,000,000) \times 0.01\%) + (0.5 \times (40\% \times 65,000,000) \times 0.5\%) + (0.2 \times (40\% \times 65,000,000) \times 0.20\%) + (0.1 \times (40\% \times 65,000,000) \times 75\%)$$

$$\text{Gross HBI} = 3,642,340$$

The gross HBI was then modified by multiplying it by the MCA score (where the MCA score does not include "lives saved" as this is already counted in the HBI) and the number of years out of 10 that the benefits accrue. Some options are recognised as having leads times between commencement in January 2026 and the flow of benefits. In these instances, the number of years over which benefits can accrue (between January 2026 and December 2035) has been reduced.

To run the CBA model, experts and decision makers were required to think about and decide on the following with regards to benefits:

- The lead time from initial investment in January 2026 until the flow of benefits. Benefits can commence any time from year 1 to year 5. Given that the 36 adaptation options were selected for their near-term impact, it is assumed that 5 years is the longest it could take for benefit to commence.
- The size of the country's population.
- The percentage of the country population that is in any way impacted by the adaptation intervention.
- The proportion of the affected population that i) have their lives saved by the intervention, ii) have their lives significantly improved by the intervention, iii) have their lives moderately improved by the intervention, iv) have their lives improved in a minor or indirect way by the adaptation intervention.

With regards to costs, experts and decision makers were required to:

- Enter the total cost of the adaptation option over the 10-year period. The model did not require a distinction between capital and operating costs.
- Decision makers were required to select a social discount rate applied to all costs (with a default rate of 6% per annum) and an exchange rate.

This approach to ranking adaptation options allowed for a diverse set of qualitative and quantitative considerations to be brought to bear on the appraisal of options. Asking those using the model to decide, collectively, on MCA scores or the 'percentage of the population impacted' by an adaptation option is not an exact science; the process exposes the MCA and CBA outcomes to subjectivity. It is quite likely that a different set of decision makers 'in the room' would have arrived at a slightly different option ranking. The advantage of a model that is free and quick to run, is that it can be used frequently and differences of opinion regarding the merits of options can be surfaced and their implications on option ranking deliberated. In the process, a deeper level of shared knowledge regarding the options and how they might be implemented emerged. It is proposed that subjectivity is always a feature of risk projections and analyses, especially when unknown or novel drivers are at play. In the process of allocating 'scores' under the MCA criteria and the 'proportion of the population' under the CBA, individuals were encouraged to disagree and deliberate. The scrutinizing of adaptation options was considered important for gaining insight into the options and their likely impact. This should be further extended in future iterations of the NDC work.

SECTION 12

RESULTS

12.1 Adaptation costs

The total value of the 36 investable projects in the next 10 years is estimated at R250.22 billion; R25 billion (\$1.39 billion) per year. Costs are recorded for respective adaptation options and for the seven adaptation goals reported in the draft A-NDC. This is roughly 1% of South Africa's total public sector expenditure of R2.4 trillion (2025/26). [Table 2](#) aggregates these costs per adaptation goal (seven goals) and [Appendix 5](#) provides costs for each of the 36 options.

TABLE 2: Cost of adaptation goals 2026–2035.

AGGREGATED ADAPTATION GOALS	TOTAL COST 2026–2035 (ZAR)
 Goal 1: Adapt South Africa's water and sanitation systems to drying conditions and drought and flood intensification, as water underpins human, plant and animal health and all economic and livelihood activities.	197.0 billion
 Goal 2: Enhance disaster risk management, healthcare and sanitation provision, especially in informal settlements, to reduce impacts of flooding and heat stress on most vulnerable households.	1.9 billion
 Goal 3: Upgrade critical transport infrastructure (roads, rail, ports) to maintain functioning under increased rainfall intensity, heat stress, wind speeds and storm surges.	30.8 billion
 Goal 4: Enhance nutritious food access and affordability through support to agricultural and fisheries producers and distributors in adapting to warmer and windier conditions and changes in rainfall.	1.3 billion
 Goal 5: Enhance climate services, with early warning and impact information made accessible to a wide range of users, tailored to different operational, language, gender, age and disability needs.	6.0 billion
 Goal 6: Enhance ecosystem-based adaptation to heat and water stress, protecting South Africa's natural heritage, biodiversity and improving ecosystem functioning that underpins our cultural identity, food systems, human wellbeing and our tourism economy.	9.1 billion
 Goal 7: Capacitate all spheres of government to implement adaptation through enacting and enforcing all provisions of Climate Change Act.	4.2 billion
TOTAL	R250.216 billion
TOTAL PER YEAR	R25.022 billion

South Africa's water sector emerges as requiring the bulk of South Africa's adaptation investment in the next 10 years ([Figure 11](#)).

One adaptation option, “2.4 Extend and upgrade sanitation services in high-risk informal settlements, especially near food vendors” involved a net saving of money by displacing the mal-adaptive practice of contracted portaloos in informal settlements. Displacing 53,000 contracted portaloos over 10 years with water and sanitation upgrades would obviate the need for an estimated R795 million of public expenditure on portaloos and results in a net saving of R45 million over 10 years.

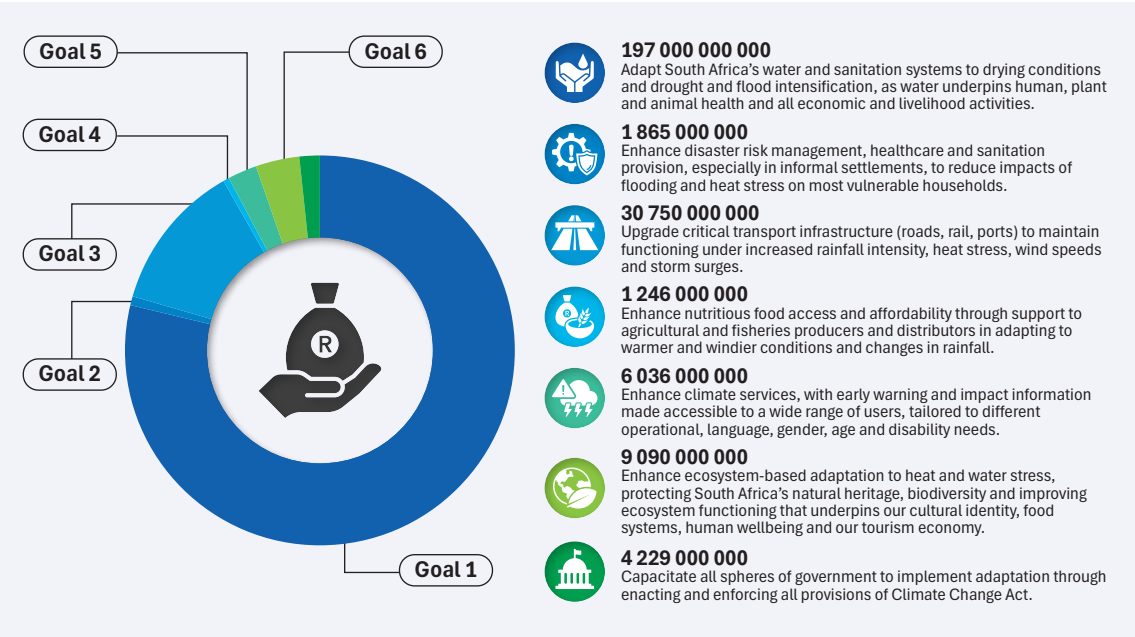


FIGURE 11: Proportional cost of adaptation goals 2026–2035 (ZAR).

As discussed in the assumptions underpinning the costing (see [section 11.1.2](#)), adaptation options should not be dealt with separately, as individual interventions, but should be clustered in ‘programmes of action’ that unlock synergic impacts. Doing so this requires high levels of intergovernmental cooperation. The 36 adaptation options costed across all seven goals were clustered into 7 programmes of action, namely: water institutional reform; ecological infrastructure; built/engineered water infrastructure; built environment and spatial planning; climate preparedness; health and well-being; and resilient food systems. [Figure 12](#) shows the combined costing of options in each programme of action, presenting a different breakdown to the combined costing per adaptation goal (as shown in [table 2](#)).

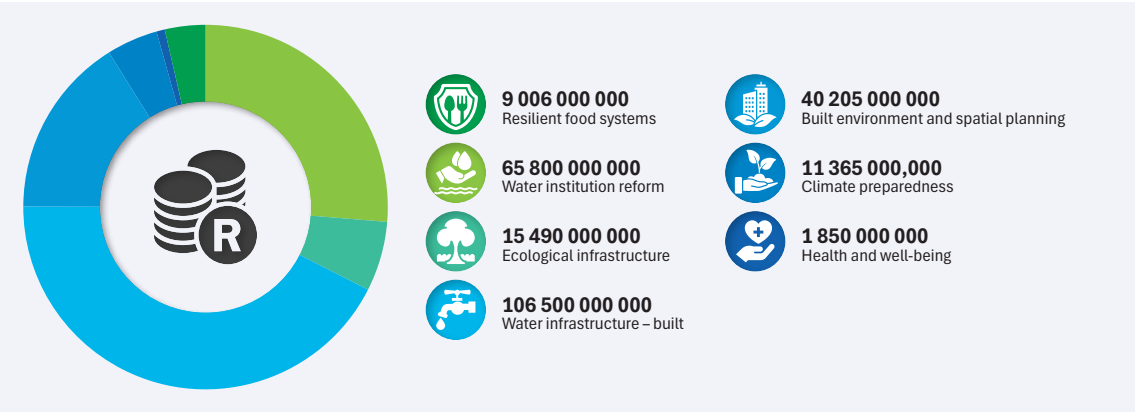


FIGURE 12: Adaptation cost by ‘programmes of action’ (PoA) 2026–2035 (ZAR).

12.2 Multi-criteria assessment

The MCA allows for a scoring of each option against the six criteria identified as being important when appraising adaptation options in South Africa (including lives saved). When decision makers scored each option (1–5) against each criterion the top options emerged as being:

- 1.8 Expand water stewardship programmes
- 3.1 Expand maintenance programmes to remove blockages (e.g. invasive plants, solid waste, wind-blown sand)
- 3.2 Coastal dune rehabilitation
- 3.3 Flood and erosion defences
- 4.3 Improve irrigation efficiency
- 6.1 Redesign national-scale agricultural extension programme to support sustainable rangeland management and fire management
- 7.3 Climate jobs register with a focus on youth and gender inclusion

The highest scoring adaptation goal was Goal 3 – Upgrade critical transport infrastructure (roads, rail, ports) to maintain functioning under increased rainfall intensity, heat stress, wind speeds and storm surges.

The MCA makes no consideration of the cost of implementation.

12.3 Human benefit and lives saved

In terms of human benefit – the measure of the number of people impacted and the extent to which their lives are enhanced (or saved), options 1.3 Enhanced water monitoring (flows, quality, consumption); 3.4 Secure road and rail infrastructure against heat stress; 5.1 Enhance early warning systems (monitoring, warning dissemination and response triggers), building on SAWS multi-hazard EWS; and 1.6 Water augmentation & diversification schemes, focussing on reuse & groundwater emerge as the most favourable options (see [figure 13](#)).

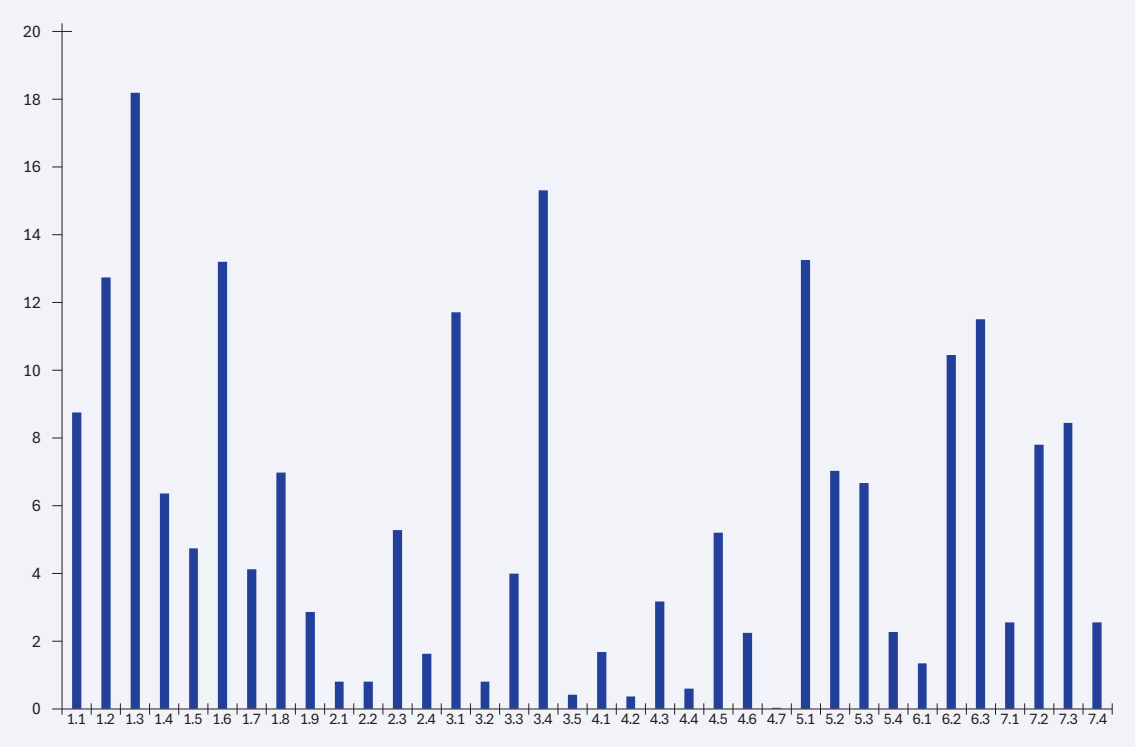


FIGURE 13: Human benefit score (millions) per adaptation option weighted by MCA scores. The description of each numbered adaptation option can be found in section 10, pages 42–49.

The CBA model generates estimates of ‘lives saved based on a South African population of 65 million people. If all 36 adaptation options are fully implemented, the adaptation programme will save an estimated 158.5 thousand lives over the ten-year period. The adaptation options are not designed to tackle climate health impacts (an area of climate change impact that is receiving current attention, but which has been historically under-acknowledged due to difficulties with attribution). But given that an estimated 2,000 people drown in South Africa every year, 14,000 people perish on the countries roads and 15,000 children are treated for malnutrition in South African hospitals every year (estimates of deaths range from 1,000 to 11,000 per year), the ability of the 36 fully implemented adaptation options to prevent 15,500 deaths per year seems reasonable.

The option projected to save the most lives over the 10-year period is:

- 2.4** Extend and upgrade sanitation services in high-risk informal settlements, especially near food vendors (estimated 20,800 lives);
- 7.2** Network of project preparation facilities supporting municipalities’ access suitable financing for robust adaptation interventions (estimated 14,625 lives saved);
- 5.1** Enhance early warning systems (monitoring, warning dissemination and response triggers), building on SAWS multi-hazard EWS (estimated 13,000 lives over 10 years).

12.4 Cost-benefit

By comparing the ratios of Human Benefit scores of the 36 options over the 10-year period (adjusted for the MCA weighting without “lives saved”) and the discounted costs, the analysis was able to rank the 36 adaptation options in terms of their costs and benefits.

Based on this analysis adaptation option 2.4 Extend and upgrade sanitation services in high-risk informal settlements, especially near food vendors, an option that saves the South African government money by displacing expenditure on portaloos, emerges as the most cost-effective. Because it saves money, option 2.4 has a negative cost-benefit ratio and does not show up in [figure 14](#). This is followed by adaptation option 5.4 SADC integrated regional drought monitoring system which does not save many lives but also does not cost very much. The same insight applies to the third most efficient adaptation option 5.1 Enhance early warning systems (monitoring, warning dissemination and response triggers), building on SAWS multi-hazard EWS. The fourth most cost-effective option, based on this analysis, is 7.1 Develop and implement Sector Adaptation Strategies and Plans, consistent with NCCAS.

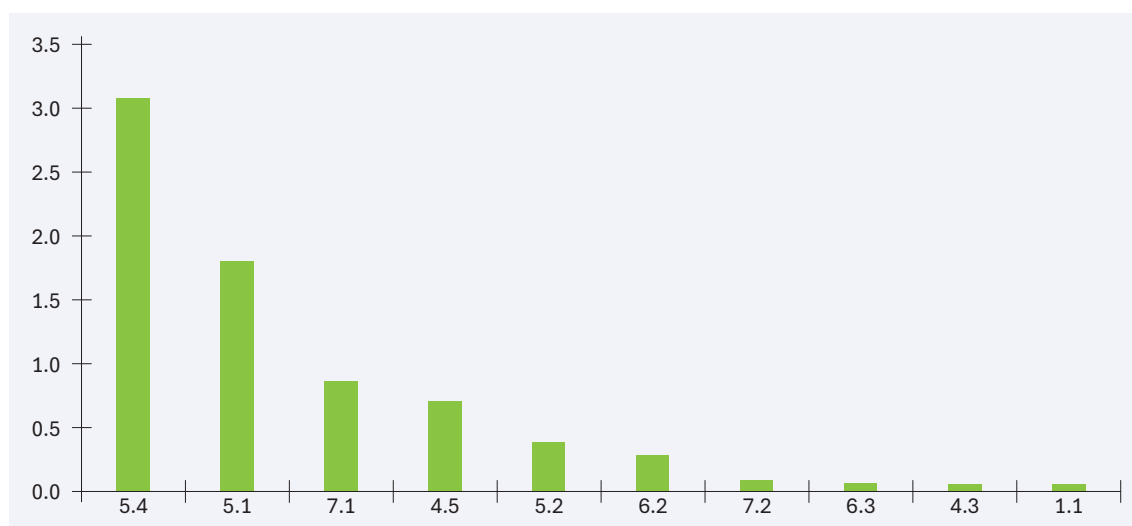


FIGURE 14: Benefit cost ratios of the 10 most cost-effective adaptation options.

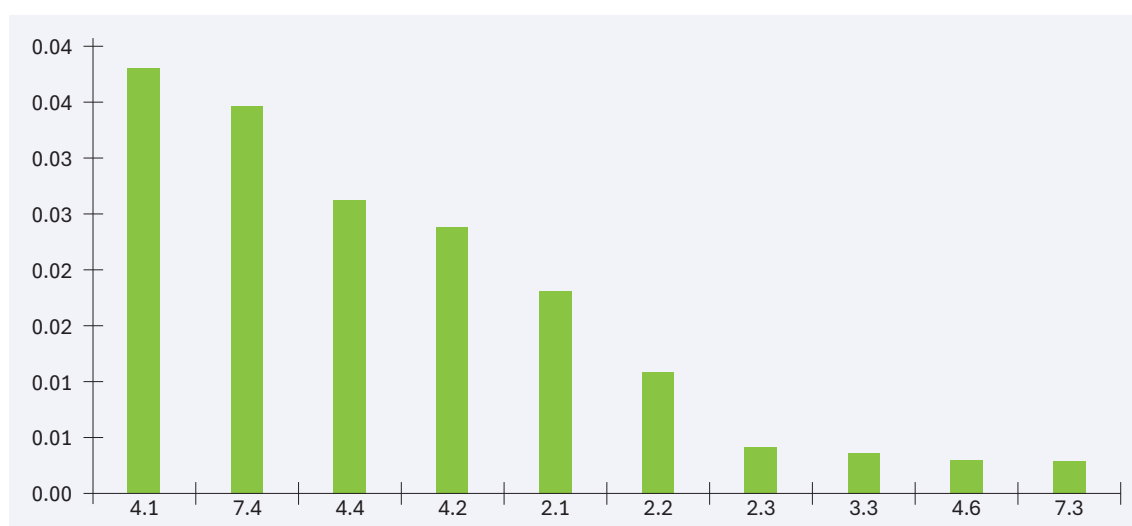


FIGURE 15: Benefit cost ratios of the 11-20 most cost-effective adaptation options.

12.5 Summary results

The table below shows all 36 adaptation options listed with the Human Benefit Index, Benefit Cost Ratio, and Discounted 10-year cost (in ZAR millions) values calculated for each option, as well as the overall ranking of each option.

TABLE 3: Calculated Human Benefit Index, Benefit Cost Ratio, Discounted 10-year costs, and overall ranking of the 36 adaptation options.

ADAPTATION OPTION		HBI	BCR (COSTS DIVIDED BY 1000)	DISCOUNTED 10YR COST (MILLIONS)	RANK
1.1	Support municipalities develop updated Water Preparedness Plans and Water Safety Plans	8.75	59.469	147.20	9
1.2	Programmes to reduce water losses & non-revenue water (NRW)	12.74	0.962	13 248.16	27
1.3	Enhanced water monitoring (flows, quality, consumption)	18.20	2.524	7 212.89	23
1.4	Restore catchments & wetlands, removing invasive alien plants (IAPs)	6.35	0.863	7 360.09	20
1.5	Revise water allocations, restrictions & pricing;	4.74	0.263	18 032.21	32
1.6	Water augmentation & diversification schemes, focussing on reuse & groundwater	13.21	0.183	72 128.85	34
1.7	Innovate with low-flow and waterless sanitation solutions	4.11	0.290	14 168.17	29
1.8	Expand water stewardship programmes	6.98	2.369	2 944.03	18
1.9	Invest in SADC, transboundary water management arrangements	2.87	0.294	9 752.12	30
2.1	Emergency shelters designated & kitted to be community rescue & care hubs, cooling centres & temporary accommodation for flood-displaced people tailored to needs of marginalised groups in high-risk municipalities	0.80	18.132	44.16	15
2.2	Training and support to community-based organisations providing care services to young children, elderly and people living with disabilities	0.80	10.879	73.60	17
2.3	Enhance clinical resources to diagnose and treat water- and vector-borne diseases	5.27	4.090	1 288.02	19

ADAPTATION OPTION		HBI	BCR (COSTS DIVIDED BY 1000)	DISCOUNTED 10YR COST (MILLIONS)	RANK
2.4	Extend and upgrade sanitation services in high-risk informal settlements, especially near food vendors	1.61	-48.668	-33.12	1
3.1	Expand maintenance programmes to remove blockages (e.g. invasive plants, solid waste, wind-blown sand)	11.70	2.271	5 152.06	22
3.2	Coastal dune rehabilitation	0.81	0.878	920.01	31
3.3	Flood and erosion defences	3.98	3.605	1 104.01	28
3.4	Secure road and rail infrastructure against heat stress	15.31	1.156	13 248.16	26
3.5	Managed retreat and relocation of key infrastructure from high-risk zones	0.40	0.181	2 208.03	33
4.1	Support to develop, adopt & market drought-resistant crop varieties & heat tolerant livestock and aquaculture species	1.67	37.913	44.16	13
4.2	Enhance market access for small-scale producers	0.35	23.850	14.72	16
4.3	Improve irrigation efficiency	3.16	59.623	52.99	14
4.4	Training and accreditation of sustainable land management and sustainable fishing and aquaculture practices	0.58	26.235	22.08	12
4.5	Enhance access to tailored climate information	5.20	706.577	7.36	5
4.6	Affordable climate risk insurance schemes	2.24	3.040	736.01	25
4.7	Support with shade netting infrastructure	0.01	0.147	39.74	36
5.1	Enhance early warning systems (monitoring, warning dissemination and response triggers), building on SAWS multi-hazard EWS	13.26	1802.086	7.36	3
5.2	Train community leaders in climate information interpretation and response measures	7.02	381.603	18.40	7

ADAPTATION OPTION		HBI	BCR (COSTS DIVIDED BY 1000)	DISCOUNTED 10YR COST (MILLIONS)	RANK
5.3	Develop a national inventory of impacts to complement EWS with bottom-up data collection, DFFE coordinating and supporting efforts by local authorities and communities	6.67	1.510	4 416.05	24
5.4	SADC integrated regional drought monitoring system	2.27	3080.653	0.74	2
6.1	Redesign national-scale agricultural extension programme to support sustainable rangeland management and fire management	1.33	0.206	6 476.88	35
6.2	Review ecological reserve determinations for surface and groundwater catchments	10.44	283.783	36.80	6
6.3	Triple the national team working on IAP monitoring	11.51	65.179	176.64	10
7.1	Develop and implement Sector Adaptation Strategies and Plans, consistent with NCCAS	2.55	866.434	2.94	4
7.2	Network of project preparation facilities supporting municipalities' access suitable financing for robust adaptation interventions	7.79	84.620	92.00	8
7.3	Climate jobs register with a focus on youth and gender inclusion	8.45	2.872	2 944.03	21
7.4	Fully functioning adaptation MEL system for routine BRT and GST reporting	2.55	34.657	73.60	11

SECTION 13

PUBLIC – PRIVATE GOOD NATURE OF ADAPTATION OPTIONS

The 36 adaptation activities listed in this study that are not yet being supported by the South African government. As such they demand the question about where the funding or finance to implement them might be found. This question becomes definitive in the context of claims by the South African government that public investment is under intense fiscal constraint, with 22% (R424.9 billion or \$23.6 billion) of all revenue collected in South Africa went towards debt servicing in 2024 (National Treasury, 2025). The source of likely funding depends on the nature of the option, but raising this funding requires challenging of the idea of fiscal constraint which is more bluntly stated by governments around the world as, 'We don't have any money for this'. There is a clear case for the South African government issuing debt – ideally in the form of long-term bonds – for activities that support economic growth, create jobs or protect economic value in ways that enable the collection of sufficient revenue (from rates and taxes) to service the debt. The key, for all publicly funded adaptation options, is to spend the public funds in ways that give rise to this revenue (and do not increase inflation). Current public and private investment frameworks underestimate the potentially catastrophic impact of climate change on government revenue and budgets unless adaptation is financed. There is an imperative for South Africa to spend more on climate resilient development (including climate change adaptation) and to develop the capacity to spend this money well.

Effective climate resilient development expenditure by South Africa would signal to investors and financiers the rationale behind the country's climate change response and enhance the flow of international development assistance and private finance for the same activities by reducing the risk for these investors. As a minimum, South Africa needs to scrutinise its existing budget allocations for actions that amplify climate change risk and begin the process of scaling-back these allocations.

If investment in climate change adaptation is to be 'blended' in this way then a sense of which goods private financiers are likely to find attractive is necessary, recognising that the private sector will always favour 'large', 'low risk' (or familiar), 'high financial return' options. Clearly, not all adaptation options fit this description and some options, particularly those that do not generate the type of financial revenue that attracts financiers (short-term and easily appropriated revenue), will be dependent on conventional public sector or donor support. Understanding this and distinguishing between adaptation options based on whether they are likely to be funded by public or private money, is important for those charged with implementation. To achieve this distinction, the 36 options have been ranked in terms of criteria related to their public or private good nature.

- **Saves lives** – adaptation options that save lives are at the heart of any climate change response for obvious reasons. It is well documented that poorer people, often living informally and beyond the reach of formal planning and assistance programmes are disproportionately exposed to climate change risk. Protecting lives is often cast as the moral obligation of governments and essential to maintaining economic productivity. It does not, however generate economic revenue under normal circumstances. For this reason, adaptation options that save lives are cast as public goods in this analysis.
- **Protects nature** – nature and functional ecosystems is essential for life and the foundation of all economic activity. While protecting nature is good for the economy, it seldom generates the type of financial revenue favoured by investors (outside of the tourism sector). On the contrary, destroying the web of nature and converting it into tradable commodities (timber, food, minerals) is the basis for much ‘return on investment’ in South Africa’s commodity-dependent and extractive economy. In this analysis activities that protect nature are cast as predominantly public goods.
- **Reduces costs** – many adaptation options reduce the economic impact of climate change over time. Understanding ‘who’ they reduce costs for, ‘how’ and ‘when’ is important to knowing whether an option is a public or a private good and in some instances the saving of money can be akin to the generating of revenue. In this analysis adaptation options that reduce costs are characterised as a quasi-private good.
- **Generates revenue** – adaptation options that generate revenue are likely to be attractive to the private sector and, provided this revenue exceeds the cost of the option, can be thought of as private goods.

By scoring the options 1–10 in terms of the above criteria and contrasting the scores of the first two options relative to the second two options, it is possible to gain a sense of who is most likely to fund or finance the option.

Some options (e.g. 4.5 *Affordable climate risk insurance schemes*) emerge as candidates for private investment, while others (e.g. 2.4 *Extend and upgrade sanitation services in high-risk informal settlements, especially near food vendors*) are clearly public goods for which the investment will have to be led by governments and donors. Whether the adaptation projects in this study are public or private good is illustrated in **Figure 16**, which shows that the bulk of the options display public good attributes; they are more likely to save lives and prevent ecological damage than they are likely to prevent financial loss or generate revenue.

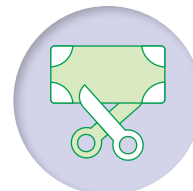
36 options have been ranked in terms of criteria related to their public or private good nature



Saves lives



Protects nature



Reduces costs



Generates revenue

Public – Private Good (0–0.5 = public; 0.6–1 = quasi-public; 1.1–1.5 = quasie-private; >1.5 = private)

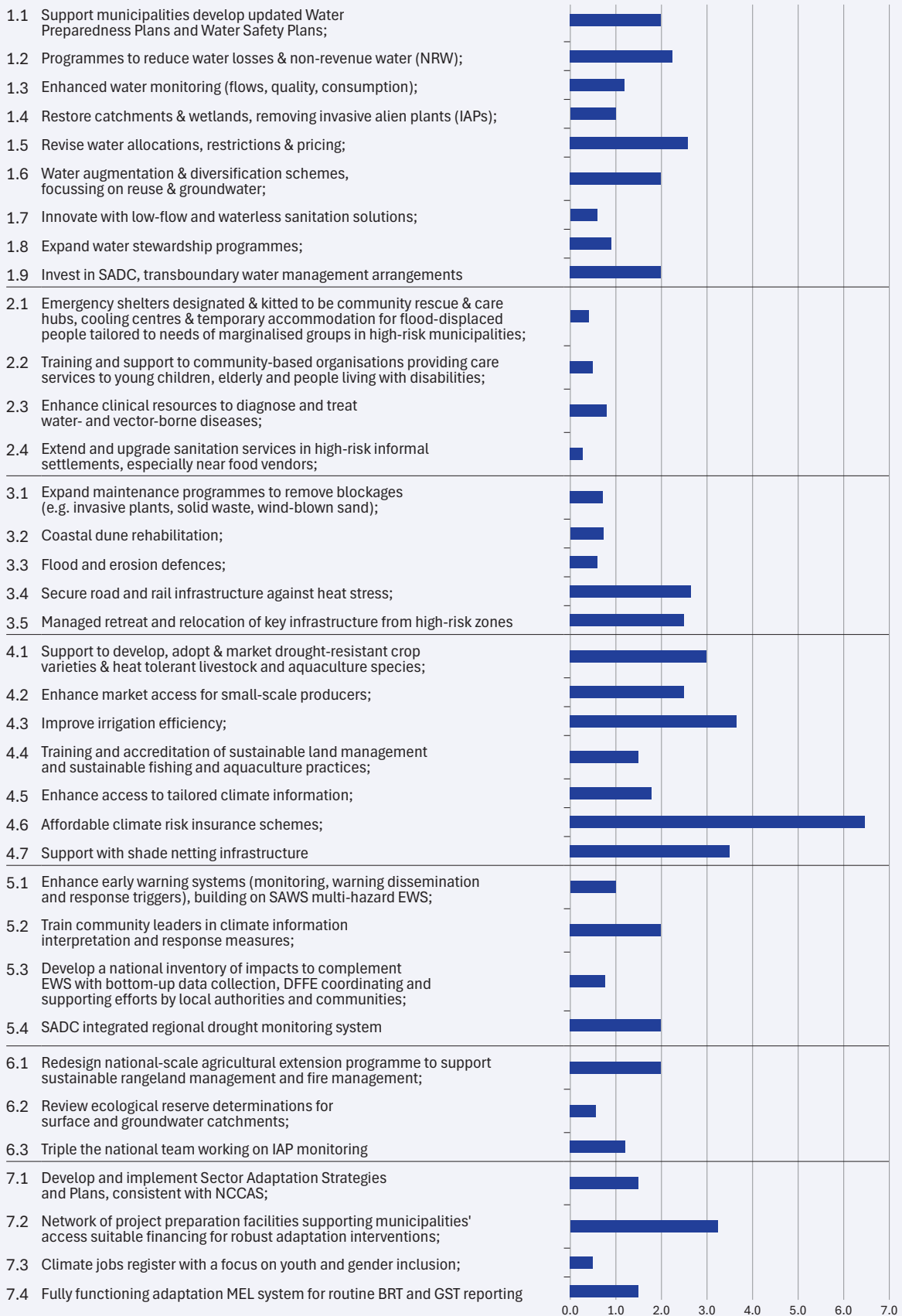


FIGURE 16: Public-private good nature of adaptation options.

SECTION 14

CONCLUSION

This study set out to do six things:

- 1 Identify key climate risks that need to be adapted to currently, through the 2030s and towards the 2050s, based on the latest climate science.
- 2 Take stock of SA's current adaptation strategies, action plans and implemented actions to review progress and the trajectory of existing adaptation efforts and intentions.
- 3 Identify gaps and opportunities for additional adaptation actions, articulated as a proposed set of adaptation goals and interventions, aligned with NCCAS and raising ambition from the updated NDC1.
- 4 Estimate the investment required to implement the 36 climate change adaptation options identified from the period 2026 to 2035.
- 5 Provide means to rank the options in terms of merit as a means of understanding the options better, and in case investment constraints require difficult trade-offs regarding which options top implement.
- 6 Indicate to those responsible for raising climate change adaptation investment, where the funding for respective options might be found based on the public/private good nature.

The climate change risk review highlighted the cascading and escalating nature of risks under increasing warming, as well as the differential impacts distributed both spatially and socially. The availability and provision of adequate water and sanitation services have already been heavily impacts across many parts of South Africa, where climate hazards – notably droughts and floods – compound technical and management problems, with the impacts cascading to health, tourism, sanitation, economic output and levels of employment. South Africa's food systems and communities reliant on agricultural and fisheries livelihoods are highly vulnerable to changing patterns of heat, wind and rainfall. Both human and animal health are already being compromised through exposure to hotter temperatures and extreme weather, leading to increased range and transmission of infectious diseases, increased heat-related mortality, increased mental health conditions, homicide, and drought-associated malnutrition, placing additional strain on South Africa's already struggling health and economic systems.

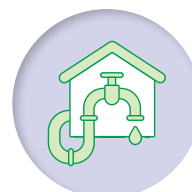
Climate hazards compound technical and management problems, with the impacts cascading to:



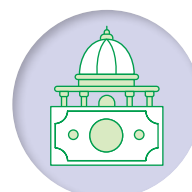
Health



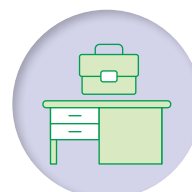
Tourism



Sanitation



Economic output



Levels of employment

Built environments or human settlements, infrastructure networks (including transport and energy) and biodiverse ecosystems on land and in water are under severe strain, with emerging climate conditions comprising and degrading their functioning, with some close to critical thresholds. Many of these technical and ecological systems cross municipal, provincial and national boundaries. The evidence is clear that coordinated adaptation actions are urgently needed, from the local to the regional scale, to curb the uptick in severe losses and costly damages that South Africans are experiencing in their personal and working lives.

The stocktake of existing adaptation efforts shows considerable progress has been made on assessing, planning and resourcing adaptation efforts, but this is not nearly enough. A total of 19 sub-national adaptation strategies or plans and 129 implementation-oriented adaptation projects were identified that can be learnt from and built off, by scaling up, out or deeper to amplify the impacts, especially for those most socially and economically marginalised, notably those living with disabilities and severe physical and psychological trauma. Mpumalanga and KwaZulu-Natal emerge as major hotspots for adaptation action, alongside the Western and Northern Cape. There is a risk of regional concentration of adaptation capacity and efforts, with less attention being given to more peripheral or underserved areas, especially peri-urban areas. Adaptation efforts remain largely disjointed and insufficiently sustained, highlighting the need for coordinated action, resourcing and monitoring. Opportunities exist to build on existing adaptation efforts that increasingly recognize and respond to multiple, intersecting hazards, especially drought, flooding, wildfires, and invasive species threats. Emerging, complex risks such as sea-level rise, extreme heat, and biodiversity loss are beginning to receive focused attention, although issues like food system shocks and climate-induced migration remain under addressed.

The study identifies and articulates 7 adaptation goals and 36 adaptation options to address key gaps and leverage opportunities for South Africa's adaptation agenda and notes an eighth goal that was added during the political NDC process. The 36 adaptation options do not cover the full extent of climate change risks facing South Africa. Instead, they suggest a set of priorities to focus on in the coming 10 years. Implementing the prioritised actions in a coordinated fashion based on action-learning can strengthen South Africa's systemic capacities to detect and act strategically on emerging climate change risks that are contingent on a complex set of domestic and international factors. Many of the adaptation interventions likely to be prioritised and mobilized to achieve the additional goal 8 are covered under adaptation goals 2, 3 and 7. However, a next iteration of NDC technical work needs to unpack further what needs to be done to achieve goal 8 and include any relevant additional actions in the multi-criteria and cost benefit assessments.

The study estimated an investment need for all 36 options to be R25 billion per year for ten years. Three quarters of this investment was required for the 9 options in Adaptation Goal 1: *Adapt South Africa's water and sanitation systems to drying conditions and drought and flood intensification, as water underpins human, plant and animal health and all economic and livelihood activities.*

A multi-criteria assessment, a cost-benefit analysis (in which benefit was defined by human impact) and an estimate of lives saved was used to rank the options. Given that all 36 options were selected for their merit, the differences between the options when ranked by the respective tools was marginal. In terms of cost-benefit (economic efficiency), the following options emerged as the most cost-effective:

- 2.4 *Extend and upgrade sanitation services in high-risk informal settlements, especially near food vendors, which saved money by displacing expenditure on contracted portaloos;*
- 5.4 *SADC integrated regional drought monitoring system;*
- 5.1 *Enhance early warning systems (monitoring, warning dissemination and response triggers), building on SAWS multi-hazard EWS.*

The ranking exercise involved decision makers sharing perspectives and opinions on the respective adaptation options, all of which helped to build understanding of the options and what would be required to implement them. The appended model can be used repeatedly and in a variety of ways for this purpose. It is recommended that this exercise is indeed repeated with more decision makers across the technical and political domains, as the process of detailing the practicalities of each option, going through the scoring, deliberating differences and arriving at an agreed set of results is crucial to building buy-in to the implementation of South Africa's adaptation agenda across multiple sectors.

The final task found the respective options differed greatly in terms of their public/private good attributes. This is important in terms of who might be expected to invest in them and blending the investment required for South Africa's climate change adaptation over the next 10 years. While climate change adaptation has historically been cast as a 'public good', the analysis points to some adaptation options that could attract private sector investment. The incentives for private sector investment are expected to increase as climate change impacts get worse and these investments should be marshalled by public budget allocations (Alaerts, 2019).

Given that South Africa budgeted over R400 billion for related activities in 2025/26, i.e. R210 billion for local government's equitable share, human settlements and water and electricity infrastructure, an additional R175.7 billion for economic regulation and national infrastructure, and R23.7 billion for agriculture and rural development, there is a clear case for spending existing budget allocations in ways that are more aligned with climate resilient development. In an age when the evidence for anthropogenic climate change is "unequivocal" (IPCC, 2021) and the negative impacts of climate change are experienced daily, spending South Africa's budget in any other way should be seen as grossly negligent.

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APPENDIX 1

LIST OF ADAPTATION PROJECTS REVIEWED

- Be Resilient South Africa Project
- Support for Water Conservation and Demand Management in Municipalities
- Mpu Barbeton
- BIO-SMART: Biodiversity Systems Management and Analytics for the Restoration of Transboundary Rivers
- National Siltation Management Strategy for Dams in South Africa: Capacity Development
- Integrating Water Quality-Health Impacts into an Integrated Water Resources Management DSS (INWARDS) for Early Warning in the Inkomati Basin
- Mpu Blyde Restoration Custodianship LUI
- An Integrated Climate-driven Multi-Hazard Early Warning System
- Biodiversity Stewardship Adaptation Projects
- Building a Community-based Conservation Model in the Tribal Lands of the Greater Limpopo Transfrontier Conservation Area, Southern Africa
- Building Capacities of small-scale farmers in Bokkeveld
- Building Resilience in the greater uMngeni Catchment, South Africa
- Building climate resilience of coastal communities, ecosystems and small scale fishers through implementing community and EBA activities
- Communal Agricultural Transformation (CAT) Empowering People – Restoring Land
- Cape Town Coastal Protection Zone 1
- Climate Proofing of Urban Communities
- DEA Adaptive Capacity
- Durban Community Ecosystem Based Adaptation (CEBA)
- Durban Green Corridor
- Durban Metropolitan Open Space (D#MOSS): Planning and Implementation
- Ecosystem-based Adaptation in marine, terrestrial and coastal regions as a means of improving livelihoods and conserving biodiversity in the face of climate change
- Global Climate Change and Adaptation – Sea Level Rise Risk Assessment
- Goukou Resilient River Project
- Empowering Women To Lead Rangeland Conservation In Kenya And South Africa
- Lesotho Highlands Water Project Phase II
- Mpu Famine and Pom Pom Weed
- Mpu Hazyview Sabaan
- Mpu Houtbosloop LUI
- Mpu Injaka Dam
- Mpu Kwena Dam
- Mpu Kwena Dam
- Mpu Louwscreek
- Mpu Lower Komati
- Mpu Manyeleti CSA LUI
- Mkhondo Springbok Busters Primary Cooperative
- Mpu MTPA Invasive Species Programme
- Mpu Nooitgedacht
- Mpu Olifants

- Mpu Olifants Aquatics
- Mpu Olifants River LUI
- Mpu Oshoek
- Mpu Pebbles North
- Mpu Robbers Pass
- Mpu Sabi Sands PT LUI
- Mpu Seanego Resources LUI
- Mpu Whiteriver_Current
- Mpu Witbank
- Mpu Witklip Dam
- LM_Verena
- NRM SANP EFP Harvesting Graskop_2
- SANP WfW KNP Parthenium
- NRM SANP EFP Wetmill Graskop_2
- SANP WfE KNP Marula Rehab_3
- SANP WfE KNP Monitoring_3
- SANP WfW Marula South_3
- GP WOF Mdala
- Balfour (MP_091)
- MPU WOF Breyton
- MPU WOF Dispatchers
- MPU WOF Graskop
- MPU WOF Loskop Dam
- MPU WOF Lydenburg
- MPU WOF Mayflower
- MPU WOF Mlambongwane
- MPU WOF Nelspruit
- MPU WOF Nelspruit – Drivers
- MPU WOF Nkomazi
- Building Resilience in the Greater uMngeni Catchment
- Taking Adaptation to the Ground: A Small Grants Facility for Enabling Local Level Responses to Climate Change
- Scaling up ecosystem-based approaches to managing climate-intensified disaster risks in vulnerable regions of South Africa
- Household food production and rainwater harvesting
- The Presidential Youth Employment Intervention
- Career Path Development for Employment (CPD4E)
- Kendal Dry-Cooled Power Station
- Matimba Dry-Cooled Power Station
- Working on Fire
- Working for Wetlands
- Biodiversity and Red Meat Initiative
- Working on Fire
- Working for Water
- Working for Land
- Water and Climate Change
- Coastal Urban Edge
- Working for Water in Lesedi
- Rain Water Harvesting

- COASTAL ADAPTATION
- Mitigation and adaptation to climate variability and change in the Thabo Mofutsanyane district
- Western Cape Climate Adaptation Database
- Mandate mapping for the AFOLU project under the Australia-South Africa collaboration
- Namaqualand Green Economy Demonstration
- Umzimvubu Catchment Partnership Programme
- Coastal Set-back line determination
- South African Risk and Vulnerability Atlas
- Greening Events Project
- Greening of Training Stadia for the 2010 Fifa World Cup
- Paradise Valley Reforestation Project
- COP17/CMP7 Event Greening Programme
- Working for Ecosystems
- Green Guideline Series
- Municipal Adaptation Plans Cost-Benefit Analysis
- COP17/CMP7 Durban Responsible Accommodation Campaign
- Integrated Assessment Tool for Climate Change Adaptation
- Working For Wetland
- Inanda Mountain Reforestation Project
- Sihlanzimvelo Project
- Design Floodline Planning
- Community Adaptation Plans
- Luganda School Water Harvesting and Micro Agricultural Water Management Technology
- Durban Climate Change Partnership
- Mechal: An integrated research approach to develop agricultural adaptive management strategies
- Modelling the impact of future climate change (2046–2065) on subregional wheat production in the Western Cape
- Climate Change and Livestock Management in the Succulent Karoo
- Community-based climate change adaptation – small-scale farmers and artisanal fishers
- Endangered Wildlife Trust – Drylands Conservation Programme
- City of Cape Town Biodiversity Network
- City of Cape Town City Staff Training
- Climate Smart Cape Town
- SmartAgri
- Development of an early warning system for infectious diseases
- Youth Environmental School Programme
- Climate Change Think Tank
- Namaqualand Climate Change Adaptation Corridors: South Africa Organic Garden of Hope
- Mainstreaming Biodiversity into Land Use Regulation and Management at the Municipal Scale
- Building Resilience in the Greater uMngeni
- Working for Water in Merafong Municipality
- Maloti-Drakensberg Transfrontier Conservation and Development Project
- Working for Water in Zuurbekom
- Duiwenhoks River Control
- Climate Change Resilience through South Africa's Water Reuse Programme (WRP)

APPENDIX 2

LIST OF ADAPTATION PLANS REVIEWED

1. City of Cape Town Climate Change Action Plan
2. Western Cape Climate Change Response Strategy: Implementation Plan
3. Namakwa District Municipality: Municipality Vulnerability Assessment and Climate Change Response Plan
4. Climate Change Adaptation Action Plan for the Eastern Cape Province
5. Durban Climate Action Plan
6. Polokwane Local Municipality Adaptation Action Plan
7. City of Johannesburg Climate Action Plan
8. Gauteng Climate Change Response Strategy and Action Plan
9. Free State Provincial Climate Change Adaptation Strategy and Implementation Plan
10. Saldanha Bay Municipality Climate Change Response Plan
11. Cape Winelands District Municipality Climate Change Adaptation Strategy
12. Garden Route district municipality climate change adaptation plan
13. Overberg District Municipality climate change adaptation plan
14. West Coast District climate change adaptation plan
15. Central Karoo District Municipality Climate change adaptation plan
16. Bergrivier local municipality climate change response strategy
17. Ehlanzeni District Municipality Climate Change Response Plan
18. Gert Sibande District Municipality Climate Change Response Plan
19. Nkangala District Municipality Climate Change Response Plan

APPENDIX 3

LIST OF FUNDED ADAPTATION PROGRAMMES REVIEWED

1. Increased Resilience to Climate Change in Northern Ghana through the Management of Water Resources and Diversification of Livelihoods
2. Program on Affirmative Finance Action for Women in Africa (AFAWA): Financing Climate Resilient Agriculture Practices in Ghana
3. Empowering Women Groups to Build Resilience to Climate Impacts in the Province of Cunene in South West Angola (CREW Angola)
4. Adaptation Initiative for Climate Vulnerable Offshore Small Islands and Riverine Charland in Bangladesh
5. Resilient Homestead and Livelihood support to the vulnerable coastal people of Bangladesh (RHL)
6. Extended Community Climate Change Project-Flood (ECCCP-Flood)
7. Extended Community Climate Change Project-Drought (ECCCP-Drought)
8. Climate Resilient Infrastructure Mainstreaming (CRIM)
9. Enhancing adaptive capacities of coastal communities, especially women, to cope with climate change induced salinity
10. Marajó Resiliente: Enhancing the resilience of smallholders to climate change impacts through adapting and scaling up diversified agroforestry systems in the Marajo Archipelago of Brazil
11. Planting Climate Resilience in Rural Communities of the Northeast (PCRP)

12. Reducing Risk and Vulnerability to Climate Change in the Region of La Depression Momposina in Colombia
13. Building Resilient Food Security Systems to Benefit the Southern Egypt Region
14. Building Resilient Food Security Systems to Benefit the Southern Egypt Region- Phase 2
15. Enhancing climate change adaptation in the North coast and Nile Delta Regions in Egypt
16. Sustainable Communities for Climate Action in the Yucatán Peninsula (ACCIÓN)
17. River Restoration for Climate Change Adaptation
18. Basin Approach for Livelihood Sustainability through Adaptation Strategies (BALSAS)
19. Irrigation development and adaptation of irrigated agriculture to climate change in semi-arid Morocco
20. Development of arganiculture orchards in degraded environment (DARED)
21. The Saïss Water Conservation Project
22. Implementing Protection Technologies to Foster the Resilience of Aquaculture in the Regions of Huanuco, Junin, and Puno to Strengthen Food Security in the Context of Extreme Events Associated with Climate Change
23. Building a Program for Adaptation and Resilience to Climate Change of Andean Local Communities and Ecosystems in Peru
24. AYNINACUY: Strengthening the livelihoods of vulnerable highland communities in the provinces of Arequipa, Caylloma, Condesuyos, Castilla and La Union in the Region of Arequipa, Peru
25. Adaptation to the Impacts of Climate Change on Peru's Coastal Marine Ecosystem and Fisheries
26. Resilient Puna: Ecosystem based Adaptation for sustainable High Andean communities and ecosystems in Peru
27. Ground Water Recharge and Solar Micro Irrigation to Ensure Food Security and Enhance Resilience in Vulnerable Tribal Areas of Odisha
28. Enhancing climate resilience of India's coastal communities
29. Building Adaptive Capacities of Communities, Livelihoods and Ecological Security in the Kanha-Pench Corridor of Madhya Pradesh
30. Building Adaptive Capacities of Small Inland Fishermen Community for Climate Resilience and Livelihood Security, Madhya Pradesh, India
31. Climate smart actions and strategies in north western Himalayan region for sustainable livelihoods of agriculture-dependent hill communities
32. Climate Proofing of Watershed Development Projects in the States of Tamil Nadu and Rajasthan
33. Enhancing Adaptive Capacity and Increasing Resilience of Small and Marginal Farmers in Purulia and Bankura Districts of West Bengal
34. Conservation and Management of Coastal Resources as a Potential Adaptation Strategy for Sea Level Rise
35. Building Resilience of the Agriculture Sector to Climate Change in Iraq
36. Strengthening climate Resilience of Vulnerable Agriculture Livelihoods in Iraq (SRVALI)
37. Adapting Philippine Agriculture to Climate Change (APA)
38. Multi-Hazard Impact-Based Forecasting and Early Warning System for the Philippines
39. Developing climate resilience of farming communities in the drought prone parts of Uzbekistan
40. Enhancing Multi-Hazard Early Warning System to increase resilience of Uzbekistan communities to climate change induced hazards
41. Climate Adaptation and Mitigation Program for the Aral Sea Basin (CAMP4ASB)
42. Climate Adaptation and Resilience in Thua Thien Hue Province Vietnam (CARE Hue)
43. Enhancing the resilience inclusive and sustainable eco-human settlement development through small scale infrastructure interventions in the coastal regions of the Mekong Delta in VietNam
44. Community Resilience Partnership Program (CRPP)
45. Improving Climate Resilience by Increasing Water Security in the Amazon Basin
46. Mekong EbA South: Enhancing Climate Resilience in the Greater Mekong Sub-region through Ecosystem-based Adaptation in the Context of South-South Cooperation (Thailand, Viet Nam)

APPENDIX 4

DETAILS OF KEY RISKS BY SYSTEM AND REGION IDENTIFIED BY IPCC WGII CHAPTERS

Elaborated from SM16.7.4 Details of Key Risks by System and Region Identified by IPCC WGII Chapters on Water (Ch. 4), Food, Fibre, and Other Ecosystem Products (Ch. 5), 'Cities, settlements and key infrastructure' (Ch. 6), 'Health and Well-Being' (Ch. 7), Poverty, livelihoods and sustainable development (Ch. 8), 'Africa' (Ch. 9), 'Small Islands' (Ch. 15), and 'Key Risks' (Ch. 16) of IPCC Working Group II and the underlying literature for both, relevant to South Africa^{1,59,81,131,148,149}.

KEY RISK	HAZARD CONDITIONS	VULNERABILITIES & EXPOSURES	RESPONSES OPTIONS TO REDUCE RISK
Risk to water and energy security due to drought-induced shortage of irrigation and hydropower ^{1, 131, 150}	Severe risks driven by long-term warming and drying and reduced river runoff, which occurs in some climate models.	Increased urbanisation, population and economic growth, increasing electricity, water and food demand.	Increased electricity trade between river basins, which have little correlation in yearly rainfall and runoff. More diverse electricity generation mixes. Diversifying water sources. Catchment restoration and integrated water (demand) management schemes. Urban gardening and agriculture.
Risk of food insecurity, malnutrition (micronutrient deficiency) and loss of livelihood due to reduced food production from crops, livestock and fisheries ^{1, 131, 150, 151}	Increasing aridity, rainfall variability, combined with and increases in evapotranspiration affect reductions in primary productivity and yield across agriculturally productive farmland, rangelands and fisheries.	Vulnerability is highest for food producers dependent on rainfall and temperature conditions, including subsistence farmers, the rural poor, pastoralists and populations reliant on fish for protein and micronutrients	The combination of (i) Climate Information Services (CIS), (ii) institutional capacity building and (iii) strategic financial investment can be effective adaptation responses to projected climate risks.

KEY RISK	HAZARD CONDITIONS	VULNERABILITIES & EXPOSURES	RESPONSES OPTIONS TO REDUCE RISK
Risk of decreased economic output and increased poverty rates due to increased heat and frequency and severity of drought ^{1, 59, 131, 150}	Substantial increase in frequency and duration of extreme heat events at ~2.7°C GWL and ~4.4°C by 2100, including days over deadly heat threshold, exacerbated by urban heat island effects.	Large increases in exposure to heat, particularly in urban areas, driven by population growth and increased urbanisation. Total population exposure to extreme heat in African cities will likely increase by a factor of as much as 52 times that of present exposure (i.e., 217 billion person-days per year) by the end of the 21 st century. Large and growing urban population residing in informal settlements. Vulnerability is highest for elderly, pregnant women, individuals with underlying conditions, immune-compromised individuals (e.g., from human immunodeficiency virus [HIV]) and young children. Inadequate insulation in housing in informal settlements in urban heat islands. Inadequate improvements in public health systems.	Options for reducing heat risk (building codes, use of insulating materials, fans, cool water, regular breaks, shade)
Risk of increased mortality and morbidity due to increased vector-borne and diarrhoeal diseases ^{1, 59, 131, 150}	Expansion of geographic areas with suitable temperatures and precipitation for vector-borne diseases at 1.5–2°C global warming. Increasing temperatures ~1.5°C GWL and surface-water runoff contaminating drinking water supplies, and changing sea salinity and temperatures influencing cholera prevalence.	Elderly, pregnant women, individuals with underlying conditions, immune-compromised individuals (e.g., from HIV) and young children are most vulnerable to complications from exposure to the risk. Inadequate water and sanitation infrastructure, especially in rapidly expanding urban areas and informal settlements. Disruption of vaccination programmes and primary healthcare due to climate impacts on the healthcare system or conflict will exacerbate outbreaks. Regions without vector control programmes in place or without detection and treatment regimens.	Vector control, vaccination and integrated disease control programs, and outbreak surveillance. Improved water sanitation and hygiene as well as waste Disposal management, vaccination and outbreak surveillance.
Local or global extinction of species and reduction or irreversible loss of ecosystems and their services in freshwater and land ecosystems ^{1, 131, 150}	Increase in annual average temperature and changes in precipitation (both increases and decreases). Quantitative extinction estimates provided for a global warming level of 4.4°C above pre-industrial (RCP8.5 in 2080–2100).	Vulnerability highest among poorly dispersing organisms (plants), ectotherms (e.g., insects), species with narrow and disappearing niches (e.g., mountain endemics) and exacerbated by non-climate hazards (e.g., habitat loss for expanded agriculture, bioenergy and mitigation afforestation projects); vulnerability is high for Protected Areas (PAs) surrounded by transformed land preventing species dispersal and PAs with limited elevational gradients that reduce their potential to act as climate refugia.	Improved management and increased coverage and connectivity of protected areas, targeted conservation (e.g., assisted migration); management of land outside PAs to enhance dispersal (e.g., restoration); ecosystem restoration; diversified livelihoods for people dependent on PAs.

KEY RISK	HAZARD CONDITIONS	VULNERABILITIES & EXPOSURES	RESPONSES OPTIONS TO REDUCE RISK
Growing and widespread economic and non-economic losses and damages to heritage and culture and loss or significant change in cultural resources that contribute to adaptive capacity and resilience, including IKLK, identity, social cohesion, social and kinship reciprocity networks, practices ^{1, 131, 149}	Rising sea level (0.2–0.3 m at 2°C GWL, 0.4–0.7 m by 3.5 GWL), storm surges, rising ground water tables. Increases in extreme heat.	Population and settlement concentration in coastal areas increases exposure of cultural heritage to climate-driven coastal hazards and risk of uninhabitability and associated loss of intangible cultural systems. Buildings, roads, railways, electricity and water infrastructure. Incapability of maintaining cultural heritage due to lack of resources for protection and continuation. Loss of cultural asset reduces resilience building opportunities by undermining IKLK-based climate adaptation options.	Mangrove restoration, shaded cooling in parks. Integrating cultural heritage into climate adaptation plans and strategies; promote nature-based solutions that are congruent with cultural heritage; utilise appropriate technologies to protect culturally sensitive natural capital.
Cascading and compounding risks to local economies and governance due to severe, concurrent or successive climate-intensified disasters (floods, droughts, fires, wind, heat) affecting human settlements and infrastructure ^{1, 131, 150}	Cascading and compounding risks to economies and governance due to severe, concurrent or successive climate-intensified disasters (floods, droughts, fires, wind, heat) affecting human settlements and infrastructure.	Large increases in exposure, particularly in urban areas, driven by population growth, changing demographics and projected urbanisation patterns. Unaffordable maintenance of protective infrastructure, downstream levee effects and increased concentrations of coastal urban populations. Greater water resource demand from urban and non-urban populations and key economic sectors.	Early-warning systems. Water restrictions. Financial tools for risk management. Monitoring and forecasting systems. Economic incentives for behaviour change. Disaster risk preparedness, response and recovery plan. Enforced, robust environmental regulations and assessments for developments. Leadership locally accountable.

APPENDIX 5

MULTI-CRITERIA ASSESSMENT AND COST BENEFIT ANALYSIS OF 36 ADAPTATION OPTIONS

Excel file available on request from anna.taylor@uct.ac.za



This work was undertaken by teams at the University of Cape Town's Energy Systems Research Group (ESRG) and African Climate and Development Initiative (ACDI).

The Energy Systems Research Group (ESRG) studies sustainable development questions related to energy systems and their role in achieving a just energy transition. The group develops and maintains South Africa's only full energy sector model, along with a range of other analytical tools and approaches. Its research provides evidence to evaluate and inform pathways towards near- or net-zero greenhouse gas emissions at the economy-wide level and within specific sectors.

The African Climate and Development Initiative (ACDI) is a university-wide institute which supports collaborative research and training in climate change and development. ACDI is at the forefront of innovative research, shaping Africa's journey towards low-carbon, equitable, and climate-resilient societies. ACDI is home to the African Synthesis Centre for Climate Change, Environment and Development (ASCEND) that provides specialised infrastructure for enabling collaborative teamwork across research, policy, and practice that integrates diverse data and knowledge, and accelerates solutions-oriented research for enhancing action on climate change and development.





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