Technical Brief – Adaptation

Technical Analysis to Support the ADAPTATION COMPONENT of South Africa's Second NDC

ACDI, October 2025

Summary

Research teams in the African Climate and Development Initiative (ACDI) and the Energy Systems Research Group (ESRG) at the University of Cape Town carried out analyses pertaining to climate change adaptation and mitigation as technical support to government in developing South Africa's second Nationally Determined Contribution (NDC2) under the Paris Agreement. This technical brief summarises the adaptation component of the work, reviewing key climate change risks and adaptation efforts to date, proposing seven priority adaptation goals, and estimating the costs and benefits of identified adaptation options. There is a companion brief summarising the mitigation component.

South Africa's NDC Process

The technical analysis interrogates the latest climate science to inform the setting of South Africa's climate change adaptation goals and priorities to 2035. These are articulated in a second update to its Nationally Determined Contribution (NDC2). NDC2 advances the adaptation ambitions set in the 2021 update (NDC1).

The first NDC update laid out five adaptation-related goals for 2021–2030. South Africa's policy ambition for the past five years has primarily been to promote the development of a legal framework for climate action countrywide. This culminated in the promulgation of the Climate Change Act of 2024. South Africa's NDC2 aims to build on this to drive the implementation of the now-established legal framework.

Updating the NDC presents an opportunity for South Africa to develop adaptation goals within the framework of the government's commitment to a Just Transition. This commitment means that the country is approaching its increasing level of ambition in the NDC process with a focus on the social and environmental justice of climate adaptation.

South Africa's adaptation component aligns with the Global Goal on Adaptation's 11 targets (as laid out in the UAE Framework for Global Climate Resilience). It commits to making a fair and ambitious contribution to a globally coordinated, long-term set of responses that enhance the collective wellbeing of all people, protect livelihoods and economies, and preserve and regenerate ecosystems within changing climate conditions through planned, proactive adaptation.

Adaptation Goals

The analysis identifies seven adaptation goals for consideration in NDC2. There is an eighth goal being considered that focuses on efforts to build climate resilient human settlements. It was added during the political process of drafting the update to the NDC.

Seven proposed 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 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.

The technical analysis identifies 36 adaptation options that, if implemented well, would make a significant contribution to realising the goals. The costs of implementing these options was estimated to be R250 billion between 2026 and 2035 (R25 billion per annum over 10 years). This equates to approximately 1% of South Africa's current annual public sector expenditure, the budget for which is R2.4 trillion in 2025/2026. The analysis ranks the 36 options using a multi-criteria assessment and cost-benefit analysis. The options are further distinguished based on their 'public' or 'private good' attributes and likely sources of investment.

NDC process

The NDC process is framed by the notions of increasing ambition and equity. The bigger the gap between global mitigation targets and measured emissions reductions, the higher the ambition needs to be for effective adaptation to a wide range of climate futures.

Citation

African Climate and Development Initiative (2025), Technical Analysis to Support the Adaptation Component of South Africa's Second Nationally Determined Contribution, technical brief, University of Cape Town

Methodology

To inform the increase in ambition of South Africa's NDC2 adaptation goals and priorities for implementation, this technical analysis uses several methods.

Identify key climate risks to be adapted to now, going forwards to the 2030s and towards the 2050s.

- Review existing literature, carry out expert elicitation process, cluster risks by theme/sector, identify key emerging risks.
- Experts help rank and characterise identified risks.
- Use the Climate Analytics Warming Attribution Calculator to ensure alignment with global climate goals specified in the Paris Agreement and ensure consistency with IPCC AR6.

Do a stocktake of current adaptation strategies, action plans and implemented actions to review progress and the trajectory of existing adaptation efforts and intentions.

- Carry out structured literature review of websites/documents reporting on climate adaptation projects and programmes implemented – 129 identified.
- Extract information on activities, sectoral focus, climate hazards targeted, vulnerable groups targeted, lead actors driving design and implementation, funder, budget allocations, project status, duration, spatial coverage.
- Extend review to public sector adaptation plans – 19 identified.
- Complete horizon scanning exercise to look at what is being implemented with international adaptation funding from the Green Climate Fund and the Adaptation Fund in countries of comparable size.

Identify gaps and opportunities.

- 36 adaptation options, linked to seven proposed adaptation goals, identified and clustered.
- Prioritise options in terms of impact and economic efficiency, using multi-criteria screening process and cost-benefit analysis.

Evaluate the public and private good nature of the options.

- Score against four criteria: saves lives; protects nature; reduces costs; generates revenue.

Identify Key Climate Risks

South Africa is experiencing significant climate shifts, with temperature rises greater than the global average, leading to more frequent and severe extreme weather events. Most of South Africa's sectors, provinces and municipalities have already experienced costly and damaging impacts from the current level of 1.3°C global warming above pre-industrial climate levels. A consolidated inventory of these impacts and associated losses and damages still needs to be prepared, although there have been attribution studies done on several extreme events in the country. The latest global projections for the next five years suggest a global warming level of 1.5°C, with the potential for one of those years to exceed 2°C.

As a consequence, South Africa faces **climate risks** across multiple sectors, as well as inter-sectorally. It also faces a cascading and escalating nature of risks as temperatures increase. Of these risks, sustainable, integrated water management is a top priority for climate adaptation because water underpins and mediates the risks to food security, human health and also ecological health. Many of South Africa's major water resources are shared with neighbouring countries so it is important to invest in regional water initiatives (e.g. SADC Water Fund).

Multidimensional vulnerability assessments and mapping across South Africa, overlaid with recorded disaster incidents, show how many parts of KwaZulu Natal, North West, Limpopo and Eastern Cape provinces are highly susceptible to climate risks and impacts, and need priority support for implementing effective and feasible adaptation options. The prevalent vulnerability indicators are a lack of access to safe sanitation, clean water and nutritious food, which reduce people's capacity to cope with flooding, heat stress, drought and other climate shocks.

Stocktake of Current Adaptation Strategies

Over the past 20 years, South Africa has made considerable progress in assessing, planning and resourcing proactive adaptation efforts. Since its first National Climate Change Response Strategy in 2004, the country has been advancing from high-level strategy development to increasingly operational adaptation planning and actions, albeit unevenly distributed between sectors, provinces and municipalities. This progression has been institutionalised through the Climate Change Act of 2024, which establishes a comprehensive legislative framework for climate action. However, there is a risk that adaptation capacity and efforts will continue being regionally concentrated, with less attention being given to more peripheral or underserved areas, especially peri-urban areas.

Adaptation efforts remain largely disjointed and insufficiently sustained. More coordinated action, resourcing and monitoring is needed. Adaptation implementation efforts in South Africa lean towards ecosystem-based approaches, water conservation innovations, early warning systems, community empowerment and sustainable livelihoods initiatives. Urban adaptation, institutional strengthening and fire management are also gaining attention, indicating a broadening understanding of resilience as a multi-dimensional challenge.

A nationally coordinated effort to scale up adaptation implementation needs to address **four primary drivers of the climate risks** facing South Africa, approaching them as opportunities for climate-resilient development:

Insufficient and unequal access to clean water, electricity and nutritious food.

Opportunities Diversify supplies, enhance storage and distribution networks, and invest in demand management strategies. Increase investment in cross-border networked infrastructure and regional coordination mechanisms to jointly manage shared climate risks. Access international climate finance through adaptation initiatives involving multiple countries.

Growing informal settlements in and around urban areas with inadequate public services and high levels of unemployment.

Opportunities Create local jobs through labour-intensive adaptation measures (e.g. maintenance and ecological restoration of rivers, streams, wetlands and ponds to channel and store water during intense rainfall events).

Heat stress and changing patterns of infectious and communicable diseases.

Opportunities Redesign and scale out health surveillance, early detection, warning and response systems to curb the escalation of climate-related health impacts. Proactively adjust working conditions (e.g. 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.

Opportunities Scale out land, water and marine stewardship programmes that incentivise and resource the restoration/maintenance of ecological infrastructures that support biodiversity.

Adaptation Priorities

Existing and emerging climate risks to 2035 are contingent on a complex set of domestic and international factors. Adaptation planning must therefore prioritise implementing adaptation measures that are designed to reduce climate impacts at higher levels of global warming. It must also prepare for losses and damages associated with residual risk that is not sufficiently adapted to and build capacity for future options.

Each NDC needs to strengthen the ambition of national actions to move beyond business-as-usual and unlock the system changes needed for net zero greenhouse gas emissions and minimised climate change impacts, losses and damages. Building on the NDC1 update, this study proposes **seven adaptation goals** for consideration in the second NDC period, 2031–2035.

Adaptation options are identified to progress towards these adaptation goals. The list of 36 options is not exhaustive and underrepresents new options, but it does address key gaps and leverage opportunities for South Africa's adaptation agenda in line with the progressive implementation of the NCCAS. The options do not cover the full extent of climate change risks facing the country. Instead they suggest a set of priorities to focus on in the coming 10 years. Coordinating the implementation of prioritised actions can build South Africa's systemic capacities to identify and act strategically on existing and newly emerging risks.

Cost Analysis

The analysis 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 investment in adaptation will require those responsible for public expenditure and private finance to understand what adaptation options will cost and their respective merits in terms of costs and benefits. The adaptation options do not offer the same value for money and respective options deliver different types of adaptation benefit (e.g. some prioritise climate resilient development, some reduce climate-related ill-health and others reduce the impact of more intense and frequent natural disasters).

The technical analysis relied on three approaches:

- Cost estimation for each of the 36 adaptation options submitted as part of South Africa's NDC2.
- Ranking of the options using a combination of multi-criteria analysis and cost-benefit analysis.
- Describing the options in terms of their public/private good attributes as a means of identifying likely sources of investment.

The total value of the 36 investable projects is estimated to be R250.22 billion over the next ten years. Costs are recorded for the seven adaptation goals and associated adaptation options. Three quarters of the investment was required for the nine interventions in Adaptation Goal 1, which aims to make South Africa's water and sanitation systems more resilient to floods and droughts. One adaptation option involving the replacement of contracted 'portaloos' with upgraded sanitation services in informal settlements is estimated to save government money over the 10 year period. If fully implemented, the 36 options could save an estimated 158,000 lives over the next 10 years.

Unsurprisingly, the strengthening of institutional responses to climate change (e.g. regional drought monitoring, early warning systems) emerge as highly cost-effective if well-implemented. Both the multi-criteria analysis and cost benefit analysis suggest advantages to programmes of action that unlock synergic impacts between the respective options. For example, the benefits of engineered water infrastructure can be enhanced by complementary ecological infrastructure. This programmatic approach is contingent on high levels of intergovernmental cooperation.

Estimated costs for the proposed seven adaptation goals and associated adaptation options

HBI = Human Benefit Index and BCR = Benefit Cost Ratio, see full report for details.

Adaptation option	HBI	BCR (costs divided by 1000)	Discounted 10yr cost (millions)	Rank
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.				
1.1 Support municipalities to develop updated Water Preparedness Plans and Water Safety Plans	8.75	59.469	147.2	9
1.2 Establish programmes to reduce water losses and non-revenue water	12.74	0.962	13 248.16	27
1.3 Enhance water monitoring (flows, quality, consumption)	18.2	2.524	7 212.89	23
1.4 Restore catchments and wetlands, removing invasive alien plants	6.35	0.863	7 360.09	20
1.5 Revise water allocations, restrictions and pricing	4.74	0.263	18 032.21	32
1.6 Introduce water augmentation and diversification schemes, focussing on reuse and 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 Southern African Development Community (SADC), transboundary water management arrangements	2.87	0.294	9 752.12	30
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.				
2.1 Designate emergency shelters, kitted to be community rescue and care hubs, cooling centres and temporary accommodation for flood-displaced people tailored to the needs of marginalised groups in high-risk municipalities	0.8	18.132	44.16	15
2.2 Offer training and support to community-based organisations providing care services to young children, elderly and people living with disabilities	0.8	10.879	73.6	17
2.3 Enhance clinical resources to diagnose and treat water- and vector-borne diseases	5.27	4.090	1288.02	19
2.4 Extend and upgrade sanitation services in high-risk informal settlements, especially near food vendors	1.61	–48.668	–33.12	1

Adaptation option	HBI	BCR (costs divided by 1000)	Discounted 10yr cost (millions)	Rank
Adaptation goal 3: Upgrade critical transport infrastructure (roads, rail, ports) to maintain functioning under increased rainfall intensity, heat stress, wind speeds and storm surges.				
3.1 Expand maintenance programmes to remove blockages (e.g. invasive plants, solid waste, wind-blown sand)	11.7	2.271	5 152.06	22
3.2 Rehabilitate coastal dunes	0.81	0.878	920.01	31
3.3 Build 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 Manage retreat and relocation of key infrastructure from high-risk zones	0.4	0.181	2208.03	33
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.				
4.1 Provide support to develop, adopt and market drought-resistant crop varieties and 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 Offer 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	5.2	706.577	7.36	5
4.6 Introduce affordable climate risk insurance schemes	2.24	3.040	736.01	25
4.7 Build shade netting infrastructure	0.01	0.147	39.74	36
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.				
5.1 Enhance early warning systems (monitoring, warning dissemination and response triggers), building on South African Weather Service's multi-hazard early warning system (EWS)	13.26	1802.086	7.36	3
5.2 Train community leaders in climate information interpretation and response measures	7.02	381.603	18.4	7
5.3 Develop a national inventory of impacts to complement EWS with bottom-up data collection, Department of Forestry, Fisheries and the Environment (DFFE) coordinating and supporting efforts by local authorities and communities	6.67	1.510	4 416.05	24
5.4 Establish SADC integrated regional drought monitoring system	2.27	3080.653	0.74	2
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 tourism economy.				
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	36.8	6
6.3 Triple the national team working on IAP monitoring	11.51	65.179	176.64	10
Adaptation goal 7: Capacitate all spheres of government to implement adaptation through enacting and enforcing all provisions of the Climate Change Act.				
7.1 Develop and implement Sector Adaptation Strategies and Plans, consistent with NCCAS	2.55	866.434	2.94	4
7.2 Establish network of project preparation facilities supporting municipalities' access suitable financing for robust adaptation interventions	7.79	84.620	92	8
7.3 Create climate jobs register with a focus on youth and gender inclusion	8.45	2.872	2 944.03	21
7.4 Set up fully functioning adaptation monitoring, evaluation and learning system for routine biennial transparency reports and global stocktake reporting	2.55	34.657	73.6	11

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