



# South Africa National Adaptation Strategy

**DRAFT**

**FOR COMMENTS**



**environmental affairs**

Department:  
Environmental Affairs  
REPUBLIC OF SOUTH AFRICA

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## List of abbreviations and acronyms

C	Celsius
CoGTA	Department of Cooperative Governance and Traditional Affairs
CSA	Climate-smart agriculture
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
EbA	Ecosystem-based adaptation
ENSO	El Niño-Southern Oscillation
EPWP	Expanded Public Works Programme
GDP	Gross domestic product
GEF	Global Environment Facility
GFCS	Global Framework for Climate Services
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICLEI	Local Governments for Sustainability
IDP	Integrated development plan
IPCC	Intergovernmental Panel on Climate Change
LTAS	Long Term Adaptation Scenarios
M&E	Monitoring and evaluation
NAS	National adaptation strategy
NBSAP	National Biodiversity Strategy and Action Plan
NCCRP	National Climate Change Response Policy
NDMC	National Disaster Management Centre
NFCS	National Framework for Climate Services
NGO	Non-governmental organisation
RCP	Representative concentration pathway
R&D	Research and development
SADC	Southern African Development Community
SANBI	South African National Biodiversity Institute
SASSI	Southern African Sustainable Seafood Initiative
SAWS	South African Weather Service
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WMA	Water management area

## Glossary

Adaptation	Adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise. <sup>1</sup>
Aichi Targets	In the tenth meeting of the Conference of the Parties, held in Japan in 2010, a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011–2020 period, was adopted. This plan provides an overarching framework on biodiversity, not only for the biodiversity-related conventions, but for the entire United Nations system and all other partners engaged in biodiversity management and policy development. <sup>2</sup>
El Niño	El Niño is a climate pattern that describes the unusual warming of surface waters in the eastern tropical Pacific Ocean. El Niño is the “warm phase” of a larger phenomenon called the El Niño-Southern Oscillation. <sup>3</sup>
Gaborone Declaration for Sustainability in Africa	The Gaborone Declaration for Sustainability in Africa is a commitment to a new model of development that, for the first time, takes into account the role of natural capital in development by bringing the value of natural resources from the periphery to the centre of all economic decision-making. <sup>4</sup>
Kyoto Protocol	The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which <b>commits</b> its parties by setting internationally binding emission reduction targets. <sup>5</sup>
Low-carbon economy	The concept emphasises the central role of resource efficiency and energy efficiency for the economy. The low-carbon economy is generally understood as “an economy that produces low GHG emissions” (Regions for Sustainable Change 2013). <sup>6</sup>
Nationally Determined Contributions	It identifies the actions a national government intends to take under the Paris Agreement agreed in December 2015 at the 21st session of the Conference of the Parties for the United Nations Convention on Climate Change. Intended Nationally Determined Contributions are, therefore, the basis of post-2020 global emissions reduction commitments included in the climate agreement. <sup>7</sup>
Paris Agreement	A historic agreement agreed to by 195 nations in December 2015 at the 21st session of the Conference of the Parties for the United Nations Convention on Climate Change which aims to combat climate change and unleash actions and investment towards a low-carbon, resilient and sustainable future. <sup>8</sup>
Small Island Developing States	Small Island Developing States are islands of the Caribbean Sea and the Atlantic, Indian and Pacific Oceans. <sup>9</sup>
South Africa’s National Development Plan 2030	The National Development Plan offers a long-term perspective. It defines a desired destination and identifies the role different sectors of society need to play in reaching the goal of eliminating poverty and reducing inequality by 2030. <sup>10</sup>
Sustainable Development Goals	On 25 September 2015, countries adopted a set of goals to <b>end poverty, protect the planet, and ensure prosperity for all</b> as part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years. <sup>11</sup>
Resilience	Resilience is the ability of a system or community to survive disruption and to anticipate, adapt, and flourish in the face of change. <sup>12</sup>

<b>The Conference of the Parties of the United Nations</b>	The Conference of the Parties (COP) is the supreme decision-making body of the United Nations Convention on Climate Change. All states that are parties to the convention are represented at the COP, at which they review the implementation of the convention and any other legal instruments that the COP adopts and take decisions necessary to promote the effective implementation of the convention, including institutional and administrative arrangements. <sup>13</sup>
<b>The Convention on Biological Diversity</b>	The Convention on Biological Diversity entered into force on 29 December 1993. It has three main objectives: the conservation of biological diversity, the sustainable use of the components of biological diversity and the fair and equitable sharing of the benefits arising out of using genetic resources. <sup>14</sup>
<b>The IPCC Fifth Assessment Report</b>	The Fifth Assessment Report is the most comprehensive assessment of scientific knowledge on climate change since 2007 when the Fourth Assessment Report was released. It was released in four parts between September 2013 and November 2014. <sup>15</sup>
<b>The Let's Respond Toolkit</b>	A Guide to integrating climate change risks and opportunities into municipal planning. <sup>16</sup>
<b>Mitigation</b>	<b>Mitigation:</b> An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases. <sup>17</sup>
<b>The Nairobi Work Programme</b>	The Nairobi Work Programme was established at COP11 (December 2005), through decision 2/CP.11, as a mechanism under the convention to facilitate and catalyse the development and dissemination of information and knowledge that would inform and support adaptation policies and practices. <sup>18</sup>
<b>The National Communications to the UNFCCC</b>	Parties to the convention must submit national reports on implementation of the Convention to the Conference of the Parties. NCs from Annex I Parties provide information on emissions and removals of greenhouse gases; national circumstances; policies and measures; vulnerability assessment; financial resources and transfer of technology; education, training, and public awareness; and any other details of the activities a party has undertaken to implement the convention. <sup>19</sup>
<b>Vulnerability assessments</b>	Assessing vulnerability to climate change is important for defining the risks posed by climate change and provides information for identifying measures to adapt to climate change impacts. Methods of vulnerability assessment have been developed in a wide range of development-related fields, ranging from natural hazards research, food security research and poverty analysis, to sustainable livelihoods research and related fields. <sup>20</sup>

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# EXECUTIVE SUMMARY

[Draft]

South Africa is achieving progress on climate change adaptation at all three levels of government – national, provincial, and local. The momentum increased, in particular, after South Africa issued its National Climate Change Response Policy (NCCRP) White Paper. All provinces and several local government entities have prepared climate change adaptation strategies. Moreover, many national departments representing key sectors of South Africa's economy, including agriculture and forestry, water, human settlements, and health, have developed sectoral climate change adaptation strategies.

As different departments and levels of government continue to build and strengthen their own comprehensive adaptation strategies, it is critical that they all reflect a shared vision. A common reference-point is needed to help create alignment between the different strategies. This document – South Africa's draft National Adaptation Strategy – is intended to be the cornerstone for climate change adaptation in the country and to reflect a unified, coherent, cross-sectoral, economy-wide approach to climate change adaptation. It signals priority areas for adaptation response, both to provide guidance to adaptation efforts around the country and to be a point of resource to inform resource allocation to climate change adaptation.

Specifically, the NAS will:

- Act as the primary guidance document for climate change adaptation efforts in South Africa, providing direction for all levels of government;
- Inform national, provincial and local development planning;
- Help gauge the degree to which development initiatives at different levels of government integrate and reflect critical climate change adaptation priorities, and thus inform levels of resource allocation from revenue streams related to climate change resilience;
- Support South Africa in meeting its international obligations by demonstrating progress on climate change adaptation, and also serve as South Africa's national adaptation plan; and
- Guide stronger coherence and coordination on climate change adaptation between different institutions and levels of government.

## A climate-resilient South Africa

A climate-resilient South Africa will follow a development pathway that is guided by an ongoing process of anticipating, planning for and adjusting responses to changes in climate and the environment, as informed by priority development needs. Adaptation responses will be developed through consultative processes and supported by the best scientific information available. Institutional arrangements for climate change adaptation will facilitate coordinated implementation that optimises development outcomes, necessary transformation, and the interlinked needs of adaptation and mitigation imperatives.

South Africa's "aspirational goal" on adaptation is to **build resilience and adaptive capacity to respond to climate change risk and vulnerability; whilst providing guidance on the integration of climate change responses into current and future development objectives; through optimising policy, planning, and implementation coherence of climate change adaptation actions.**

South Africa's approach is informed by the IPCC's findings that the climate system's warming is unequivocal, that anthropogenic emissions are significantly responsible for this warming, and that the adverse impacts are likely without mitigation and adaptation actions by all nations, according to their respective capacities.<sup>21</sup> This finding is fully supported by scientific analysis of the evidence base available in South Africa, both on changes to the local and regional climate, and to the early observed impacts. South Africa's likely path of action will be guided by its Nationally Determined Contributions, as well as the Sustainable Development Goals that it has adopted.



Scientific evidence indicates further that African nations will suffer some of the worst impacts of climate change in the absence of effective adaptation responses, even though the continent's contribution to the problem is disproportionately low. This reality will be central to the southern African region, and indeed the continent's development agenda.

The African Union's Agenda 2063 acknowledges this challenge at the regional level. South Africa's approach to adaptation must be cognisant of its regional context.

## National adaptation priority strategies

To promote the vision of a climate-resilient South Africa articulated above (and in Chapter 1), the NAS identifies the following as the main pillars of South Africa's climate change adaptation efforts moving forward. Collectively, these priorities represent the country's strategic intent on climate change adaptation:

1. Formalise climate change policy and legislation in the form of a National Climate Change Act that builds on the NCCRP White Paper and establishes the appropriate institutional arrangements for implementation, planning, engagement in research, and M&E. Such policy and legislation must enable the design and capacitation of appropriate institutions, facilitate cross-sectoral alignment in implementation, and integrate adaptation and mitigation efforts.<sup>1</sup> (See a more detailed discussion and rationale for this in Chapter 9).
2. Integrate climate change adaptation within existing development planning and implementation processes, by including key approaches that enhance adaptive capacity, enhance livelihoods, and reduce the risk of and adverse effects from climate-related disasters. These include ecosystem-based adaptation (EbA), sound catchment management, community-based adaptation, conservation agriculture and climate-smart agriculture (CSA) (including forestry and fisheries), climate-proof infrastructure development and settlement planning, among others.
3. Launch a joint planning and implementation process, involving all sectors, that integrates and operationalises necessary systemic changes across government, taking into account both adaptation and mitigation outcomes, and that supports economy-wide resilient development.
4. Assess the cost of integrated systemic changes and build a case to secure international resources to support implementation.
5. Conduct a scoping process to consider climate change vulnerabilities in sectors (such as energy, mining and transportation) that have been underserved in previous climate vulnerability assessments.
6. Ensure that future planning, growth and development within sectors that have traditionally taken a mitigation focus (such as energy, mining and transportation) explicitly take into account future climate change impacts for the sector as well necessary adaptation measures, while simultaneously considering how these sectors can contribute to climate resilience in communities implicated by their development.
7. Strengthen EPWPs to support climate resilience in ecosystems and people (such as the Land User Incentives Programme), to ensure sustainable land management into the long term.
8. Mandate that all public infrastructure be planned, designed, operated and managed after explicitly taking current and predicted future climate change impacts into account, to ensure optimal performance and value-maintenance of infrastructure despite a changing climate.
9. Grow the knowledge base of climate change impacts and solutions, fill gaps in current knowledge and reduce long-term uncertainties by investing in R&D, especially in integrated assessment of impacts, impacts modelling and adaptation assessment.

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<sup>1</sup> The NAS recommends the creation, capacitation and operationalisation of an institutional structure that allows for integration and coordination between climate change adaptation efforts across sectors and at all levels of government, as well as alignment between climate change mitigation and adaptation in South Africa. To this end, the national adaptation plan recommends that this new institutional arrangement be situated within CoGTA. It is envisioned that DEA would continue to provide guidance and direction on climate change adaptation and mitigation, but that the work would be carried out through the CoGTA architecture and network. For climate change adaptation, it is recommended that the NDMC be the channel of implementation, in close cooperation with DEA, and for climate change mitigation it is recommended that the departments of Transport, Energy, Mineral Resources and Agriculture, and key GHG-emitting sectors be the channels of implementation, in close cooperation with DEA. Both streams, however, would be housed within the CoGTA institutional framework. For this new arrangement to succeed, technical and financial capacity needs to be improved in the NDMC, DEA and CoGTA.

Prioritise approaches that quantify socio-economic aspects of impacts to support key decisions. Create integrated knowledge management and information-sharing systems to improve access to climate change-related information and improve informed decision-making.

10. Build capacity to implement effective adaptation programmes across government and all sectors through focused and targeted training programmes and continuing education.
11. Implement an effective climate change adaptation response M&E system and ensure that it is fully integrated with all relevant aspects of the climate change framework.
12. Develop and implement an effective communication and outreach programme that informs all sectors and all levels of society about the risks and opportunities that exist due to climate change.

## **Sectoral adaptation priority strategies**

The NAS is a national document. It is not, however, a document directed only at National government departments. It speaks to South Africa as a whole, including the country's many sectoral institutions, provincial and local governments, as well as non-governmental entities including the private sector and civil society.

Deriving guidance and direction from the NAS, sector departments, provinces, and municipalities are all empowered to develop or modify their own adaptation strategies. The NAS is intended to be a starting point for such strategies, as opposed to a constraint. The NAS does not supplant or obviate existing sectoral climate adaptation strategies, which form the core of South Africa's climate change response, but rather emphasises the need for them to be actioned, so as to improve sectoral and cross-sectoral resilience. Taking this into account, the priority strategies that follow should be viewed as the backbone or core of each sector's adaptation strategy moving forward, rather than as an exhaustive, limited list that stands apart from the sector's strategy development.

### *Disaster risk reduction and management*

1. Finance and staff the national and provincial disaster management centres, including conducting a cost analysis and applying for finance to achieve this objective and identify appropriately qualified staff within metropolitan, district and local municipalities to serve as disaster management focal or nodal points.<sup>22</sup> Coordination between national, provincial, district and local disaster management centres should be ensured.
2. Develop further early warning systems to prevent major impacts from climate-related disasters and to strengthen adaptive capacity across sectors extending to areas that do not currently have cover. Strengthening early warning systems improves alignment between climate change impacts and disaster risk reduction and management.
3. Prioritise and integrate disaster risk reduction, prevention and preparedness and climate adaptation into local integrated planning and design. This should include appropriate infrastructure design and identification of development areas, for example outside of flood prone areas and important wetlands. Ensure local knowledge (indigenous) and practices on adaptation, ecosystem-based adaptation approaches and early warning systems are integrated into this planning.
4. Enhance integrated drought planning and management to include long term systemic and structural changes as well as physical, ecological and/or engineering solutions.
5. Identify and establish short-term drought adaptation options that include developing and making available new drought-tolerant varieties for farmers (seed and livestock) as well as water-wise technologies.
6. Complete and operationalise the coastal management guidelines being developed by DEA's Oceans and Coasts Branch as a spatial planning tool to guide municipalities in their land-use developments and in building climate adaptation resilience.
7. Invest in disaster risk reduction and climate change adaptation, including Ecosystem and Community Based Adaptation approaches, at a catchment scale such as restoration/rehabilitation of natural systems, removal of invasive alien plants, and rehabilitation of wetlands.
8. Create new strategic partnerships between the insurance sector, civil society and government to support innovative insurance mechanisms that build adaptive capacity and allow people to proactively reduce their risk and increase their response capacity. Partnerships should be developed with the insurance industry to assess loss and damage threats, and assess opportunities for international support for loss and damage to these sectors from climate change.

9. Maintain and improve infrastructure for resilience (such as stormwater drains, agriculture water infrastructure) for accelerated weathering and deterioration.<sup>23</sup> Other non-climatic issues, such as vandalism, illegal connections and disposal of foreign substances, that affect the longevity of infrastructure, prevent water loss and provide overall climate resilience, also need to also be addressed.
10. Support improved fire management and planning at the local and provincial level to control fires within urban and rural areas.

### Human settlements

1. Utilise the enabling framework of The Spatial Planning and Land Use Management Act SPLUMA and The Integrated Urban Development Framework (IUDF)<sup>24</sup> to provide guidelines for adaptive and integrated human settlements. There is a national coordinating forum dealing with SPLUMA implementation and this should support climate change integration and implementation of guidelines.
2. New cross-sectoral approaches should be designed to ensure that the new design, location and implementation of all human settlements is adaptive. There are many opportunities for location and design of settlements where ecosystems and development work together to create more resilient, communities that have access to adequate services and that also promote the health and wellbeing of communities. This will require looking at aspects such as design, orientation, selection of materials, spacing and greening and guidelines should be developed to guide implementation of these approaches, building on the "Green book" settlements design guidelines for adaptation currently under development by CSIR. An example could be to climate proof all the new Strategic Infrastructure Projects (SIPS).
3. Develop guidelines for and implement retrofitting of existing housing settlements to build adaptive capacity, including for example through, rain water tanks, composting toilets etc.
4. Design and develop new systems for municipal finance, which allows for access to finance that supports appropriate investment in human settlements that are resilient to climate change.
5. Integrate Ecosystem-based Adaptation within human settlement development, in rural, urban and coastal settlements to enhance resilience and support livelihoods and health. Develop and implement public programmes and activities for these such as: installing green roofs, increasing urban vegetation, etc.
6. Identify and implement decentralised energy, water and wastewater systems in rural and urban settlements that are more resilient to projected climate change impacts.
7. Develop or enhance approaches and programmes (including Expanded Public Works programmes) to ensure rural livelihoods are enhanced secured and which may also assist to manage migration to urban areas. The Integrated Urban Development Framework (IUDF) also prioritises the importance of strengthening the urban/rural linkage which should be addressed.
8. Coastal settlements should regulate shorelines at risk and implement their shorelines and coastal management programmes as per the Integrated Coastal Management Act. Enforcement is needed to regulate seashore development, NEMA regulations and Coastal Management Lines.
9. Build local adaptive capacity within communities to understand the implications of climate change and the role they can play in building resilience.

### Water

1. Adaptive Governance and Institutions: Ensure that institutions responsible for water resources management in South Africa incorporate adaptive management responses in the development of their strategies (e.g. catchment management strategies developed by Catchment Management Agencies), so that they are able to respond to changing conditions. The engagement of stakeholders in the development of these strategic approaches will provide important support in enabling such adaptive management approaches.
2. Intra and Inter Departmental Coordination: Strengthen coordination of climate change related activities within various line-functions of DWS, as well as to improve coordination between different National Departments, as well as across provincial Departments and municipalities. In particular, a more cohesive approach is needed between DWS and other Departments to preserve and improve water quality, reducing damaging impacts from various sectors.

3. **Transboundary Cooperation:** Strive towards transboundary agreements that enable adaptive response. These international arenas are complex and require sustained and committed engagement by all member states. DWS should work closely with SADC, the various member states, as well as the National Planning Commission to develop shared water solutions in SADC, that support sustainable development in the context of climate change.
4. **Assurance of Water Supply:** Adopt a low or no regrets approach with regards to decisions about water infrastructure, in the context of climate change, to balance socio-economic considerations with ecological considerations.
5. **Infrastructure Safety:** Address the issue of climate change impacts in the Asset Management Plans so all water sector institutions managing water infrastructure.
6. **Reconciliation Studies:** Integrate climate change into reconciliation studies. This will help ensure that approaches to manage water demand and supply are determined within the context of climate change, and at a system-wide level.
7. **Water Allocation:** Integrate intra and inter-annual variability in water resources, due to climate change, into water allocation tools.
8. **Integrated Water Resources Management (IWRM):** Strengthen and expand IWRM to better integrate climate change considerations, particularly at different spatial scales. Integrate ecosystem-based approaches into IWRM.
9. **Ecological Reserves:** Integrate climate change into reserve determination methodologies, informed by steadily improving science.
10. **Groundwater Assessments:** Conduct robust assessments to identify how better use of groundwater (including artificial recharge) can strengthen climate change resilience in South Africa.
11. **Catchment Management Strategies:** Provide guidance to CMAs on integrating climate change considerations in the Catchment Management Strategies that will articulate how the water resources within each WMA will be adaptively managed.

### Agriculture, forestry and fisheries

#### Agriculture

1. Ensure that land and agricultural policy and legislation increases resilience of land users, natural resources, and biodiversity to climate change, and supports food security is implemented and enforced. This includes policy and legislation relating to spatial planning, veld and livestock management, and conservation and development of agricultural resources, which should also align with current strategies developed by DAFF on climate change.
2. Integrate climate change into land reform processes, including building on platforms such as Operation Phakisa, which aims to support sustainable land reform which contributes to agrarian transformation and improved land administration and spatial planning for integrated development in rural areas.
3. Implement more efficient Climate Smart Agriculture and Conservation Agriculture practices. The three pillars of Climate Smart Agriculture (CSA) are increasing productivity and incomes; enhancing resilience of livelihoods and ecosystems; and reducing / removing GHG emissions and increasing Carbon sequestration. The CSA approach combines policy, technology and financing to achieve sustainable agricultural development under climate change, it directly incorporates climate change adaptation and mitigation into agricultural development planning and investment strategies and its practices require scaling up which is facilitated through institutional and governance mechanisms.<sup>25</sup> It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges, and includes the agriculture, forestry and fisheries sectors. Training on CSA at all levels, including the development of knowledge platforms and ways to integrate indigenous knowledge into CSA, needs to be provided to support this implementation. Conservation agriculture refers to resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while conserving the environment. Conservation agriculture should be included with CSA as part of training and knowledge management for implementation. Carbon sequestration benefits should also be explored and maximised as part of these approaches. Low-carbon agriculture case studies, including renewable energy, should be developed for further upscaling.

4. Develop systems to support food production and security. This response should include building on existing programmes such as the Agriparks project (focused on food security, resourcing small towns with infrastructure and funding farmers close to the hub) and other CSA and permaculture programmes nationally in order to support food security. Climate-proofing food and agriculture processing should form part of these approaches.
5. Use and manage water sustainably. Enhancing water availability through adaptation options that consider sustainable water use and management (also included under EbA, conservation agriculture and CSA practices) is an important strategy for increasing agricultural productivity and securing food security in South Africa. Collaborative integrated catchment management also improves water resources and supports job creation. Ways to integrate these approaches need to be further explored.
6. Develop effective early warning systems for farmers to help prevent disasters. The capacity to adapt to climate change is unevenly distributed across and within the agricultural sector. Several barriers to effective climate and disaster risk management and adaptation exist. These include a lack of accessible and reliable information and early warning which should be addressed.
7. Integrate Ecosystem and community-based adaptation practices, where feasible. In addition to EbA, Community-based adaptation is an important component of the larger scope of adaptation to climate change impacts and pressures by local communities, and these approaches should be embedded in agricultural programmes and activities where possible. Examples include improved grazing management for rangelands and livestock production and restoration to enhance soil stability. Regulation measures need to be strengthened to improve this protection of natural resources.
8. Build resilience in rangeland farming. Enhancing incentive mechanisms to support landowners to manage their rangelands sustainably and support healthy livestock will provide for more sustainable production and allow farmers to access more formal markets. It will also help support informal stewardship approaches to conserving our natural resources in future. The UN resolution on the importance of rangelands and grasslands advocates this by supporting economic growth, resilient livelihoods, freshwater availability, soil and biodiversity conservation, and carbon sequestration, which signifies the importance of rangelands for adaptation. Programmes for building resilience in rangeland farming should build on existing mechanisms such as DEA Natural Resource Management Land User Incentives programmes and platforms such as Operation Phakisa.
9. Build and expand capacity in extension support, especially to small-scale, smallholder and commercial farmers, with climate-smart, ecosystem-based approaches. In order to expedite adaptation to the added uncertainties of climate change farmers need efficient and informative agricultural extension services to provide advice on how to adapt for climate variability and change. These services need to be strengthened in number and capacity and should include guidelines specific for adaptation, (for example on how to deal with heat stress for livestock).
10. Expand tree planting and food garden programmes, building current efforts, to help reduce food insecurity and hunger and establish food markets at various transport hubs, which will enable farmers/producers to supply local communities.

## Forestry

1. Develop a specific forestry sector climate change adaptation strategy, building on the climate change mitigation and adaptation plan for the agriculture, forestry and fisheries sectors that would look at natural forest, woodlands and commercial plantations.
2. Develop community based- small, medium and micro-sized enterprise development to restore and protect natural forests whilst supporting livelihoods.
3. Use the results of available local risk and vulnerability studies to identify climate resilient land-uses, which would need to consider natural forest protection and management.
4. Reduce impacts on natural forests such as high dependence on these natural resources within rural areas to restore their ecological integrity and improve the communities' resilience to climate change.
5. Integrate CSA and EbA approaches into forestry practices for natural forests, and woodlands. These approaches should focus on protecting and restoring natural forest, which is the smallest biome and constantly affected by land-use changes. They should also look at the impact of climate change on woodlands species and their impact on other biomes such as savannah and grasslands, and determine the best ecological approach going forward. Natural forest rehabilitation projects produce job opportunities, such as alien clearing and restoration work under EPWP, and these projects could extend to the management of woodlands depending on further research.

6. Identify appropriate areas for commercial forestry activities to prevent inefficient water use, biodiversity loss, catchment degradation, and to minimise climate risks such as fire and optimise mitigation opportunities.
7. Use early warning systems to give timely warnings of adverse weather and possibly related pests and disease occurrence within commercial and natural forest systems.

## Fisheries

1. Finalise, adopt and implement the Climate Change (Agriculture, Forestry and Fisheries) Adaptation Strategy, to ensure sustainable and equitable use of marine resources. This should include the development and adaptation of the 21 fisheries sectors which are particularly vulnerable to climate change, starting with the most vulnerable as identified by DAFF as small scale and net fisheries and small pelagic fisheries including sardine, anchovy and around herring. It is also critical to develop a monitoring unit for these sectors to track adaptation activities.
2. Build on Operation Phakisa to ensure that climate resilient Marine Protected Areas are effectively managed. It is anticipated (in DAFF 2013), that Operation Phakisa will be a further platform for increasing the ability of the fishery sector to adapt to climate change particularly regarding MPAs and maintaining genetic potential and ability to adapt to changing conditions.
3. Establish credible third-party eco-certification as an incentive for responsible fisheries that can deliver additional socioeconomic benefits through improved market access and security.
4. Promote EbA as part of fisheries management and to support resource recovery. The current move towards the Ecosystem Approach to Fisheries Management (EAF) is in itself a generic adaptation measure, since it is designed to build greater resilience in the fisheries sector by securing existing fisheries and biodiversity, and assisting the recovery of impacted resources and whole ecosystems (e.g. by protecting spawning and nursery areas and other essential habitats).
5. Enforce action against illegal harvesting of coastal and offshore fishery resources to increase the resilience of natural fish populations to climate change. Current levels of poaching should also be reduced to ensure recovery of key resources and to secure livelihoods of legitimate fishermen and their dependent communities.<sup>26</sup>
6. Support small-scale fishermen to be more resilient, including safety at sea mechanisms, early warning systems and building on systems such as the Abalobi<sup>27</sup> approach.
7. Line fish management: Target other species, improve catching efficiency and vessel safety, put catches (particularly by-catch) to better use, move to larger vessels and introduce specific management measures to alleviate fishing pressure on the most vulnerable species. These include adapting existing marine protected areas and creating new ones, to cater for changes in fish distribution due to climate change, and increasing the adaptability of line-fishing communities by promoting better cooperation among them, and with government, through the new Small-scale Fisheries Policy.
8. Manage small pelagic fish: Make better use of present resources, develop fisheries for alternative pelagic species and mesopelagic fish, move to alternative catching methods and larger vessels, and allow for increased uncertainty in abundance and availability in operational management procedures.
9. Protect existing fish farms from increased storm activity and rising sea level; control the in-farm environment more effectively; switch to, and/or develop, more climate-resilient farmed species; and improve longer-range prediction of harmful algal blooms and other harmful events and trends, such as ocean acidification.
10. Develop and apply municipal planning and decision-making guidelines around coastal activities, especially within 200 metres of the coastline (i.e. establish more stringent set-back lines) to ensure nursery habitats essential for prawns and estuarine fish are maintained and coastal ecosystems are protected to buffer against impacts of storm surges.

## Biodiversity and ecosystems

1. Enforce implementation of all strategies and plans pertaining to biodiversity and ecosystem management such as the Biodiversity Sector Climate Change Response Strategy, Climate Change Adaptation Plans for South African Biomes, the NBSAP, the Ecosystem-based Adaptation Strategic Framework and Overarching Implementation Plan, the National Protected Areas Expansion Strategy, Biodiversity Management Plans for Ecosystems and Species, and the National Action Programme to combat desertification, land degradation and drought.

2. Implement EbA under the South Africa biome adaptation plans across all biomes, as well as the EbA overarching Implementation Plan for ecosystem restoration and maintenance and improved livelihoods.  
EbA supports the inherent ability of ecosystems, including their human inhabitants and organisms, to adapt to climate change, principally by reducing the other stresses which might impede that capacity, and restoring ecosystem function where it has been damaged, thus providing services on which people can depend.
3. It is imperative that EbA and biodiversity considerations are integrated into development planning and implementation at the local government level. These approaches should include working with existing national and provincial programmes such as the EPWP and continuing to focus on the removal of alien invasive plants, as well as protecting, restoring and sustainably managing ecosystems. Some district municipalities such as Namaqualand (Northern Cape) and Alfred Nzo (Eastern Cape) have undergone vulnerability assessments, which have also included EbA priority areas maps. These maps are guiding decision-making regarding adaptation implementation in these regions.
4. Strengthen institutional arrangements to further develop Expanded Public Works Programmes for building ecosystem and community resilience through the removal of alien invasive plants, restoration of wetlands, controlling wildfires, and other sustainability programmes such as the land user incentives programme. Integrate these approaches into development planning and implementation at the local government level.
5. Include provincial and local climate change adaptation response plans in provincial and local biodiversity plans, and include climate change projections in long-term biodiversity management plans. Develop spatial planning approaches that support climate resilience in given biomes, including the possibility of abandoning some land uses completely and introducing new ones.
6. Support biodiversity stewardship approaches to extend protected areas and areas under formal or informal conservation. Expand protected areas on private land and promote sustainable land management through management agreements to form corridors (for greater ecological connectivity) that will improve the adaptive capacity outside of state-owned protected areas. The expansion of the protected area network is in line with the National Protected Area Expansion Strategy and relevant provincial protected area expansion strategies, which promote climate resilience.
7. Improve nature-based tourism opportunities with multiple benefits for both people and ecosystems, including job opportunities.
8. Enhance incentive mechanisms to support landowners along priority catchments, to improve their land management practices in order to protect ecosystems and enhance productivity.
9. Develop a biodiversity checklist to ensure biodiversity is included in funding mechanisms at local, provincial and national levels. This can be done in partnership with government, the National Treasury and the private sector.
10. Monitor and control alien invasive species that benefit from climate change to reduce risks of biodiversity loss through the EPWP and other mechanisms. This should include improving existing programmes to combat the spread of terrestrial and marine alien invasive species to integrate climate change into decision-making and to link with longer-term benefits for ecosystems and people.

### Human health

1. Convene a national climate change and health committee on a regular basis to plan implementation processes. As part of this, convene a national inter-sectoral committee on water, sanitation and health issues exacerbated by climate change that can look at the development and implementation of cross-sectoral adaptation approaches.
2. Develop local climate change and health committees to discuss local issues around health and climate risks, needs and priorities, and support implementation. Community partnerships should also be created with these committees to raise issues and help implement approaches.
3. Mandate that national, provincial and local disaster management plans address climate change-related health concerns (such as outbreaks of pests and diseases, and heat stroke and dehydration). As part of this process identify communities that are most vulnerable to climate change health impacts such as floods or heat waves and implement measures to reduce their level of risk including ecosystem and community based approaches.
4. Ensure fresh water and clean sanitation services are provided to reduce impacts on health such as water-borne diseases. Water quality tests should be done regularly and made available to the public and monitor and manage the incidence and spread of climate-related water-borne disease vectors.

5. Evaluate effective public health interventions for extreme weather events, such as warning systems to reduce the impact of heat waves.
6. Develop, design and roll out special working conditions for outdoor workers across a range of sectors to protect against heat-related health risks.
7. Equip healthcare facilities to manage climate change-related health impacts by ensuring sufficient medical supplies are available and sufficient capacity is on hand to deal with an increased number of cases of climate-related health conditions (including heat stroke, dehydration, burns, smoke inhalation and respiratory tract agitation, and water-borne diseases like diarrhoea).

### Mining

1. Conduct a sector climate change risk and vulnerability assessment
2. Develop a sector climate change adaptation and resilience strategy, taking into account impacts on assets, systems, operations and resources.
3. Follow and implement global best practices in climate change adaptation and resilience for the mining sector before, during and after mining operations.
4. Take into account mining and biodiversity guidelines when identifying priority areas for extractions to avoid reducing ecosystem resilience to climate change, and adopt environmentally responsible mining development and closure to support ecosystem resilience.

### Energy

1. Conduct a sector climate change risk and vulnerability assessment (Note: Eskom has one for its operations, but it is important from a governance perspective that the Department of Energy does this for the sector as a whole, at a national level).
2. Develop a sector climate change adaptation and resilience strategy, taking into account impacts on assets, systems, operations and resources. (Note: Eskom has one for its operations, but it is important from a governance perspective that the Department of Energy does this for the sector as a whole, at a national level).
3. Promote Energy Efficiency and lead by example: the government should implement a drive to improve energy efficiency in all state owned buildings – showcase where it works and by how much it saves, then invite the community to participate and help accelerate community uptake of energy efficiency with incentives (such as rebates, tax breaks, and a host of well-tested instruments that global best practice points towards).
4. Integrate climate-resilience and robustness in energy infrastructure: the government should revise building codes to take climate change into account for all future buildings and retrofits, and should collaborate with the insurance industry to “build back better,” i.e. to ensure that reconstruction after damage from a natural hazard results in adaptive infrastructure.
5. Create a more adaptive, dynamic, nimble electricity system in South Africa, to reduce high dependency on a centralized system. Develop and operationalize mini grids, micro grids, and smart grids, and enable more distributed generation;
6. Support the emergence of a more climate resilient South Africa by reducing dependence on coal, and by increasing low-carbon energy.

### Transportation and public infrastructure

1. Conduct a transport sector climate change risk and vulnerability assessment (Note: Transnet has one for its operations, but it is important from a governance perspective that the Department of Transport does this for the sector as a whole, at a national level).
2. Develop a transport sector climate change adaptation and resilience strategy, taking into account impacts on assets, systems, operations and resources. (Note: Transnet has one for its operations, but it is important from a governance perspective that the Department of Energy does this for the sector as a whole, at a national level).



3. Develop climate change risk and vulnerability assessments for priority public infrastructure assets (based on importance for national socio-economic development as well as asset value) – for (non-transport) state-owned infrastructure this should be done by the Department of Public Works.
4. Invest up front in high quality public infrastructure to ensure long term climate resilience
5. Integrate climate change resilience into local government planning, given that transportation planning and development falls within the local government mandate, to ensure transport systems are climate-robust and help actively strengthen community climate change adaptation.
6. Partner with the insurance industry to identify priority needs and opportunities for climate resilience in the transport and critical infrastructure areas, linked with loss and damage debates.

## **Climate change adaptation governance – the way forward**

### **Institutional arrangements**

Effective climate change adaptation requires effective – and adaptive – governance structures. In the past, no institution has been given a formal and explicit mandate to govern and implement climate change adaptation in South Africa. While climate change adaptation activities currently do sit with the Department of Environment Affairs, it is appropriate for the NAS to identify whether an alternate candidate institutional architecture for coordinating adaptation responses already exists in South Africa, which could be an even stronger platform for the type of cross-sectoral and coordinated resilience building envisaged by the NAS.

A potentially relevant option does exist in the form of the National Disaster Management Centre (NDMC). Disaster readiness and response is one of the most natural entry points into addressing the larger challenge of climate change adaptation. Furthermore, at a higher administrative level, such an institutional architecture may best be situated within a Ministry with the mandate of enhancing cooperative governance due to the need for a cross-governmental role in adaptation response. The CoGTA presents such an opportunity, especially given the inter-departmental and inter-ministerial considerations involved in adaptation response.

An adaptation response chain that is vertically and horizontally integrated could usefully be based on the design of the NDMC, and benefit from the many lessons learned in its legislative development, implementation and through its ongoing activities. Under South Africa's National Disaster Management Framework, the NDMC is already directed to work with provincial and local disaster management authorities and to ensure alignment of provincial, local *and* sectoral disaster management plans. While the intergovernmental linkages and coordination mechanisms already exist within CoGTA and the NDMC, careful consideration would be required in how to bolster, fully implement and enhance both current disaster risk and response in the specific area of climate change impacts, while developing the legislation and machinery to provide for the additional overarching mandate of coordinating climate change adaptation planning and response.

Under such an arrangement, consideration would also have to be given to mandates, roles and responsibilities of the DEA as the focal department for climate change, and the institution implementing adaptation responses. It is desirable for the DEA to continue to provide policy and strategic direction to climate change adaptation, but coordination of planning and on-the-ground implementation, and monitoring of effectiveness could be carried out through an institutional arrangement such as the CoGTA's architecture and network, and specifically an enhanced institution based on design of the NDMC.

### **Financial arrangements**

Material for this section of the Executive Summary to be adapted from Jonathan Ramaiiya's chapter on Adaptation Finance, after it is drafted.

### **Enabling mechanisms to strengthen climate change adaptation**

Several key enablers are required to support and enhance climate resilience in South Africa. In particular, enabling mechanisms are especially critical at the provincial and local government levels, where strategic intent is not easily translated into implementation and programmatic elements because of challenges with information and technical capacity.

Those giving effect to climate change adaptation (across the country but especially at the sub-national level) need to be equipped with the right tools to ensure that they are able to share in the vision of a climate-resilient South Africa, and to contribute to the fullest extent of their mandate to the realization of this vision. To this end, the NAS identifies several priority strategies within these important areas:

### **Communication and knowledge management**

One of the most important enablers of effective strategy implementation is communication. Whether it be communication within key line departments, between departments or between different spheres of government, stronger dissemination of information to relevant actors is a prerequisite for improved coordination. Similarly, better knowledge sharing with stakeholders and awareness-building within key constituencies can help government officials engage in more constructive dialogue with external audiences, once such audiences are empowered with key information. In fact, a desirable outcome of knowledge sharing, outreach and information dissemination is for external stakeholders such as communities to become more involved in supporting and even implementing adaptation responses, thereby becoming strong partners with the government in creating a more resilient future for South Africa. Developing climate resilience requires us to change our behaviour and become conscious of our individual carbon footprints. Enhancing the awareness of individuals, organisations, and institutions about climate change vulnerability, impacts, and adaptation can help build individual and institutional capacity for adaptation planning and implementation.

The NAS provides a framework for communicating the key messages of the NAS and guidance on how to communicate these messages to key stakeholders, as well as on how to share knowledge with relevant institutions, organisations and individuals.

### **Research and development**

1. Investigate the barriers and institutional constraints to climate adaptation.
2. Conduct research on climate-related risks, impacts and opportunities for different sectors (at all scales), as well as developing M&E frameworks for monitoring and sharing the changes in climate risks and impacts.
3. Explore innovative technical solutions and ways to transfer technology that is focused on building climate resilience.
4. Create an institution (or extend the mandate of an existing institution) that focuses on identifying South Africa's climate research agenda, and also ensures that accessible and relevant information is disseminated to the appropriate sectors.
5. Effectively finance R&D, and create financial incentives to increase skills in climate science and climate adaptation.

### **Training and capacity building**

1. Raise awareness and disseminate knowledge with regards to climate change adaptation.
2. Translate climate science into actionable policies and plans.
3. Develop key skills in the different levels of government and within the various sectors.
4. Build capacity to mainstream climate change adaptation into planning, programmes and new developments or projects throughout all spheres of government.
5. Develop a cross-sectoral approach to climate change capacity building, and improving co-ordination between line departments.
6. Obtain further feedback on training and capacity building needs in sectors where this information may be lacking.

### **Monitoring and evaluation**

Adapting to climate change will be an ongoing process that requires effective monitoring, evaluation and reporting to understand progress made towards attaining specific targets. The information generated from M&E interventions will help to ensure the continued support (political, sectoral and societal) needed for ongoing adaptation. The focus of the M&E system is based upon the purpose for which it is undertaken, namely to:

- Improve South Africa's adaptive management.
- Synthesise lessons to underpin the country's adaptive response.

- Be accountable to stakeholders for the resources expended, the interventions undertaken and the outcomes achieved.

DEA, as the responsible coordinating department, will lead the development of the M&E system and the associated reporting mechanisms. It will thus define and communicate roles and responsibilities at the various levels within the system and assess the resource requirements to support the system. The NAS's implementation plan will form the basis for monitoring the effectiveness of this strategy. These reporting requirements need to be aligned with internationally agreed on reporting requirements.

Given the nature and implications of climate change and the economic and social implications of effective climate change responses, decisions must be based on accurate, current and complete information in order to reduce risk and ensure that interventions are effective.[i] It is therefore imperative to establish mechanisms for measuring financial, human and ecological risks related to climate change impacts. The following are essential actions:

- Maintain and improve climate monitoring systems
- Maintain and improve impact monitoring

### **Translating strategic priorities into action**

The NAS is accompanied by an Implementation Plan (*to be developed*), which will inform how each of the priority strategies enumerated in this document will be translated into actions. The plan will identify the entity responsible for implementation, the specific activities that the priority will be given effect by, the locus of such activities (national departments / provincial government / local government), and a broad indicative budgetary range to inform the resource requirements for implementation.

NOTE: The Implementation Plan will be developed after stakeholder consultations on the priorities, so that it takes into account a final list of strategic priorities. Stakeholder consultation will also provide input on aspects of implementation of the priorities, which will then feed into the subsequent development of the Implementation Plan.

# 1. INTRODUCTION

## 1.1 The context for South Africa's National Adaptation Strategy

South Africa is strengthening its readiness for adapting to climate change through several initiatives at national, provincial and local levels, in several sectors and in civil society. Many initiatives have been informed by the National Climate Change Response Policy, published in 2011. These initiatives aim to equip South Africa for a changing climate while addressing development needs, as highlighted by South Africa's Long Term Adaptation Scenarios process. Adaptation to climate change involves both meeting the challenges of reducing the effects of adverse impacts, and maximising benefits from opportunities that may be unlocked by transformational changes.

South Africa is particularly vulnerable to climate change because of its dependence on climate-sensitive economic sectors, high levels of poverty and the interrelated impacts of HIV/AIDS.<sup>28</sup> Even if global warming were limited to 1.5°Celsius (C) under stronger international efforts,<sup>29</sup> South Africa would require effective climate change adaptation responses. This is because adverse effects on people and the economy are already becoming apparent due to sustained warming and increasing rainfall variability, and these are likely to continue over the next two to three decades. Climate change is projected to affect almost all sectors directly, especially through damaging extreme weather events in the short term, disruptions in water and food security, adverse effects on human settlements and human health in the short to medium term, and ecological and biodiversity impacts in the medium to long term. Climate change directly affects sectors on which the poor are most dependent, namely human settlements, agriculture, water, biodiversity and ecosystems.<sup>30</sup> Climate change in South Africa is a poverty and development issue.

A national-level climate change adaptation strategy is now needed to guide climate change adaptation efforts that will build resilience, avoid the worst of these impacts, and facilitate beneficial transformational change to support sustainable development. A unified strategy will:

- Encourage synergy in climate change adaptation efforts at the three levels of government (national, provincial, local), with these efforts contributing to shared priorities.
- Enable climate change adaptation in any one sector to leverage the work of other sectors, creating co-benefits and reducing trade-offs between sectors.
- Allow resources to be sought and allocated in a more deliberate way.
- Support efforts that are aligned in order to reduce the risk of investments in disparate activities that may not be complementary.

A national adaptation strategy (NAS) will help to link adaptation efforts more coherently to South Africa's national developmental goals. The projected adverse effects of climate change in South Africa are likely to threaten the achievement of urgent national development goals and the reversal of historical inequities.

### Climate mitigation

Mitigation refers to measures that reduce or prevent emissions. These include technological changes and substitutions that reduce resource inputs and emissions per unit of output. Governance measures, such as introducing and implementing policies to reduce GHG emissions and enhance sinks can also be considered as mitigation measures. Therefore, mitigation can mean using new technologies (such as renewable energy), improving energy efficiency, and changing consumer behaviour and management practices.

### Climate adaptation

Adaption refers to adapting to life in a changing climate. This includes initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist; for example, anticipatory and reactive, private and public, and autonomous and planned. Examples are raising river or coastal dikes (to prevent flooding or sea level encroachment), the substitution of sensitive plants with more temperature shock resistant ones (to promote agriculture resilience), etc.

### Climate resilience

Resilience is understood as the "capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organising itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures. (Source: UN/ISDR 2004). Resilience also has anticipatory and equitability aspects, being defined by IPCC (2012) as "a system's ability to anticipate, reduce, accommodate and recover from disruptions in a timely, efficient and fair manner".

A robust NAS is important to ensure not only that development remains unhindered by climate change, but also to make climate change adaptation itself a vehicle for sustainable economic and social development.

South Africa has three autonomous levels of government: national, provincial and local. Each of these levels has different but interrelated roles and responsibilities. Having a single strategy can allow development planning at various levels of government to be informed by and appropriately driven by identified climate change adaptation priorities.

A strong strategy will help to shape an effective implementation environment for adaptation activities. Some of the biggest challenges to the success of climate change adaptation in South Africa relate to the institutional environment for implementation. A strategy that provides an enabling environment and implementation support will increase the chances of positive results and successful interventions. The NAS is thus an important initiative for identifying roles, responsibilities and modalities, with guidance on the clear differentiation of mandates and effective communication.

An effective NAS is central to South Africa's sustainable development path. Failure to adapt adequately to climate change could undermine development successes achieved thus far and create a poverty trap for many South Africans. The country's climate reality demands adaptation responses that are comprehensive and coherent across all levels of government and across all sectors of society. A well-coordinated response to climate change will unlock many opportunities while reducing risks, because new funding flows to support adaptation can be aligned with development needs. This could represent the biggest potential acceleration of development investment since the achievement of democracy in South Africa, and it provides an opportunity to ensure climate resilience while achieving national development goals.

#### **A vision of a climate-resilient South African society**

A climate-resilient South Africa will follow a development pathway that is guided by an ongoing process of anticipating, planning for and adjusting responses to changes in climate and the environment, as informed by priority development needs. Adaptation responses will be developed through consultative processes and supported by the best scientific information available. Institutional arrangements for climate change adaptation will facilitate coordinated implementation that optimises development outcomes, necessary transformation, and the interlinked needs of adaptation and mitigation imperatives.

## **1.2 A global perspective**

International environmental trends reveal early diverse impacts of climate change that raise concerns about regional and global sustainable development under a changing climate. Atmospheric CO<sub>2</sub> levels have now passed the significant 400-parts-per-million barrier. Rapid warming, amplified by El Niño conditions in 2015 and 2016, has removed any illusions that global warming trends have abated. Adverse effects, including lack of rainfall in some regions, excessive rainfall in others, novel diseases, ecosystem damage, crop failures and human impacts due to heatwaves, reveal a world already showing the human and socioeconomic costs of inadequate preparation for climate change impacts.

A strong NAS will allow South Africa to be a more effective participant in the global response to climate change, and position the country to take advantage of multiple potential benefits. It has been internationally agreed that climate change is an emerging global challenge that needs to be addressed with a coordinated global response.<sup>31</sup> It is also increasingly appreciated that a sense of urgency is required to reduce vulnerabilities now, because this is no longer a challenge only for future generations.

One of the many imperatives for South Africa to develop a NAS comes from a changing global adaptation landscape. Other countries are gearing up to become more resilient in the face of climate change, both individually and as part of the multilateral process. South Africa needs a strategy that not only allows it to stay abreast with the adaptation responses regionally and globally, but also helps it to shape the development of a regional and global climate-resilient economy and society.

With the unanimous acceptance of the Paris Agreement at the 21st Conference of the Parties of the United Nations (UN) Framework Convention on Climate Change (UNFCCC) in December 2015, the global focus shifted towards implementing meaningful solutions to this increasingly pressing challenge.

While the principle of common but differentiated responsibility remains in place, the sharp division of responsibility defined in the Kyoto Protocol has been replaced by the more collaborative approach of Nationally Determined Contributions. This more inclusive and visionary step has evolved through lengthy negotiations, supported by scientific evidence of emerging and projected risks, and potential opportunities and benefits for decades to come.

However, the Nationally Determined Contributions approach currently leaves a large gap between emissions reductions required to remain below 2°C and those proposed so far by governments. Adaptation thus remains a significant imperative.

Countries in the Africa Group negotiating bloc, together with Small Island Developing States, appealed to the global community to ensure that global warming does not exceed 1.5°C, and this sentiment is captured in the Paris Agreement. However, after the rapid warming of 2015 and 2016, this threshold is much closer to being breached. The Paris Agreement, through the Intergovernmental Panel on Climate Change (IPCC), will review the potential effectiveness of this lower temperature threshold. The significant emissions cuts themselves may have associated socioeconomic and even environmental costs. A scenario involving some level of “overshoot”, or peaking global temperatures at or above 1.5°C, followed by stabilisation and then cooling in the long term, is not unlikely in the light of current Nationally Determined Contributions. Business-as-usual scenarios would see global warming of well above 4°C, possibly this century. Warming effects in South Africa and the southern African region are likely to be roughly 1.5 times to 2 times the global average, highlighting the critical need for adaptation, regardless of mitigation pathways.

#### Nationally Determined Contributions

The commitment that signatories to the Paris Agreement submitted in March 2015 to the UNFCCC outlining their plans to reduce greenhouse gas (GHG) emissions and improve adaptive capacity within their own national contexts. The plan also outlines the necessary support each country needs or can provide to others.

It is in this context that the Paris Agreement (reference) elevates the importance of climate change adaptation and provides extensive guidance on how countries should approach adaptation as a priority. Article 7 of the Paris Agreement establishes a global goal of “enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal”<sup>32</sup> of 1.5°C. Article 7 emphasises that adaptation has “local, subnational, national, regional and international dimensions, and that it is a key component of and makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems.”<sup>33</sup> A NAS that helps translate the directions in Article 7 into clear guiding principles for South Africa, and establishes an implementation framework that reflects the elements contained in Article 7, will help the country meet its international obligations. Among these obligations are South Africa’s Nationally Determined Contributions (initially submitted as the Intended Nationally Determined Contributions) under the UNFCCC.

The preliminary success of UNFCCC negotiations in producing the Paris Agreement stands to change the path of global development. Part of the outcome is an increase in international adaptation funding for developing countries. Taking cognisance of this, a NAS should help position South Africa to benefit from the knowledge- and technology-sharing processes and funding opportunities that flow from the Paris Agreement. Finally, an effective NAS should reflect the global shift towards viewing adaptation and mitigation as inextricably linked.

### 1.3 A regional perspective

Scientific evidence indicates that African nations will suffer some of the worst impacts of climate change in the absence of effective adaptation responses, even though the continent’s contribution to the problem is disproportionately low. This reality will be central to the southern African region, and indeed the continent’s development agenda. The African Union’s Agenda 2063 acknowledges this challenge at the regional level. It notes that:

*Whilst Africa at present contributes less than 5% of global carbon emissions, it bears the brunt of the impact of climate change. Africa shall address the global challenge of climate change by prioritizing adaptation in all our*

*actions, drawing upon skills of diverse disciplines with adequate support (affordable technology development and transfer, capacity building, financial and technical resources) to ensure implementation of actions for the survival of the most vulnerable populations, including islands states, and for sustainable development and shared prosperity.<sup>34</sup>*

In response to climate change, Agenda 2063 affirms that African nations will act with a sense of urgency in implementing a Programme on Climate Action in Africa, including:

- Identification of five regional technology centres, linking with national designated climate technology entities.
- Implementation of programmes on climate change targeting women and youth.
- Establishment of a climate-resilient agricultural development programme.
- Instigation of sustainable forest management programmes.
- Creation of national adaptation plans, systems and structures (National Designated Authorities and Implementation Entities).
- Ensuring sustainable exploitation and management of Africa's diversity for the benefit of its people.

Several African nations, including South Africa, are party to the Gaborone Declaration for Sustainability in Africa. The declaration points to the threat of climate change hampering sustainable development on the continent, and notes, "Economic growth and human well-being in Africa will be threatened if we do not undertake concerted action to halt and reverse the degradation and loss of healthy ecosystems and biodiversity, and to enhance society's ability to adapt to climate change and environmental risks and scarcities."<sup>35</sup>

The declaration reaffirms commitment to several international instruments, and outlines key actions that signatories must take to help better protect natural capital. The NAS should therefore take South Africa's obligations under the declaration into consideration.

Within southern Africa, the Southern African Development Community's (SADC's) Regional Programme on Climate Change and the various sub-regional climate change programmes developed by the African Ministerial Conference on the Environment are relevant to South Africa's climate change adaptation efforts. One significant instrument from SADC that the NAS takes into account is the SADC climate change adaptation strategy for the water sector.

It is therefore important for South Africa to consider climate change adaptation from a regional perspective. Even as it moves forward with the NAS, South Africa could make significant efforts to collaborate with its neighbours, enabling countries to share resources, technology and information, and working to coordinate a regional response. The NAS recognises that in the longer term, a regional approach that achieves climate resilience will have significant socioeconomic benefits for the country, including resource efficiency, as well as lowering the risk of socioeconomic impacts such as unmanaged regional migration.<sup>36</sup>

## **1.4 A national perspective**

South Africa's commitment to addressing the challenge of climate change is based on science and equity. These key pillars are reflected in the National Climate Change Response Policy (NCCRP) White Paper (2011) and the National Development Plan (2012), as well as in South Africa's Nationally Determined Contributions. As such, South Africa considers development needs within the framework of climate change imperatives, relating to both mitigation and adaptation, and capacity development and financial support. The NDP proposed achievable but ambitious targets for 2030, including the elimination of income poverty, significant reduction in inequality, increase in employment from 13 million in 2010 to 24 million in 2030, and raising per capita income from R50 000 in 2010 to R120 000 by 2030. Several critical actions envisaged to achieve this have implications for climate change responses, including investments in public transport, investments into labour intensive industries such as agriculture, significant public infrastructure investment, environmental sustainability and considerations of spatial norms and standards such as urban densification.

South Africa's approach is informed by the IPCC's findings that the climate system's warming is unequivocal, that anthropogenic emissions are significantly responsible for this warming, and that the adverse impacts are likely without

mitigation and adaptation actions by all nations, according to their respective capacities.<sup>37</sup> This finding is fully supported by scientific analysis of the evidence base available in South Africa, both on changes to the local and regional climate, and to the early observed impacts. South Africa's likely path of action will be guided by its Nationally Determined Contributions, as well as the Sustainable Development Goals that it has adopted. (The country does acknowledge, however, that some level of rigidity exists in terms of immediate climate action due to developmental constraints that reflect legacy investments, particularly in energy.)

Specifically, the Nationally Determined Contributions establish six primary goals for climate change adaptation:

- Develop a national adaptation plan.
- Account for climate considerations in frameworks for national development, provincial and local government and sector policies.
- Build institutional capacity for response planning and implementation.
- Develop an early warning, vulnerability and adaptation monitoring system.
- Develop a vulnerability assessment and adaptation needs framework.
- Communicate previous investments in adaptation.

South Africa will realise the goals listed above through the NAS, which links the Nationally Determined Contributions to South Africa's domestic development plans and activities. Beyond such integration, the NAS also recognises that the climate change challenge requires a paradigm shift in South Africa's sustainable development agenda. A highly constrained global carbon budget in decades to come underscores the need for South Africa to internalise mitigation in its future development plans, while at the same time ensuring that a carbon-constrained future does not limit necessary, and climate-resilient, development.

A bold and transformative vision for inclusive development has already been laid out in South Africa's National Development Plan.<sup>38</sup> The plan guides the country's development trajectory towards eliminating poverty and reducing inequalities by 2030.<sup>39</sup> Among its central tenets are raising employment through faster economic growth; improving the quality of education, skills development and innovation; and building the capability of the state to play a developmental, transformative role. These tenets are all important elements of National Adaptation Strategy.

The NAS is therefore an opportunity to help mainstream climate change adaptation into the National Development Plan and various planning processes tied to it. Vertical integration across national, provincial and local government is critical to realising the vision captured in the plan.<sup>40</sup> Additionally, delivering its vision is predicated on several informed assumptions about the nature of the environment, the services it provides and the living conditions it creates for citizens. Thus, the availability of natural resources underpins many of the sectoral development strategies it sets out. In this context, South Africa's NAS recognises that climate change could alter the availability of these natural resources, with implications for trade-offs in resource allocations across sectors, and for the achievement of the plan as a whole.<sup>41</sup>

To support the National Development Plan, the NAS puts forward strategies based on coherent planning, sustainable development, enhanced institutional capacity, risk and vulnerability reduction, evidence-based assessment and clear communication. The role of the sectors identified in the NDP as growth drivers, and their coordinated response, will be central in implementing adaptation.

Achieving sustainable development objectives must enhance resilience to climate variability and change for all countries. Countries that succeed in these objectives will maximise opportunities for advancement. As international funding commitments materialise, such objectives will be supported by greater availability of financial and other resources directed at developing countries, representing one of the biggest investments in fast-tracking sustainable development in history. The NAS is a pivotal step towards positioning South Africa to attract and absorb such funding, which would help accelerate climate-resilient sustainable development.



## **1.5 Sub-national perspectives**

The NAS is of importance to national departments governing major economic sectors in South Africa, as well as to provincial and local governments. All levels of government have roles to play in each of the major sectors, and in integrating climate change adaptation into planning and implementation within their own areas of operation. The nine provinces of South Africa have their own characteristics and vulnerabilities relating to climate change. At the local level, the country has 44 district municipalities and eight metropolitan municipalities. The district municipalities are further divided into 266 local municipalities.<sup>42</sup> The impacts of climate change will differ across the country and certain regions are more vulnerable than others. It is therefore important that context-specific climate change responses are developed at the provincial and local levels.

While provinces and local governments are empowered to develop locally relevant climate change adaptation strategies (and many already have, or are in the process of developing them), a guidance document like the NAS can provide clarity about adaptation priorities, and help these provincial and local government efforts better align with the national vision. One of the goals of the NAS process is to better equip decision-makers at the provincial and local level with information on priority actions they can integrate into sub-national efforts, and to create or strengthen the enabling environment (including human and technical capacity, resource allocation, knowledge and data dissemination, and communication and information-management systems) that will help them achieve success in their chosen climate adaptation activities.

## 2 CLIMATE CHANGE GOVERNANCE IN SOUTH AFRICA

This section outlines South Africa's existing governance systems and architecture that are relevant to climate change adaptation in the country. Before examining climate change impacts as well as the linkages to who is responsible for addressing or mitigating such impacts (in different sectors and at different levels of government), it is important to first understand the status quo of governance structures. Such a foundation is key to insights later in the NAS document regarding suggested changes in governance that would enhance climate change resilience (i.e. divergence from the status quo described here).

### 2.1 The existing policy landscape and legal framework

#### 2.1.1 South Africa's Constitution

At the highest level, legal authority in South Africa to take action on climate change derives from the Constitution. South Africa's Constitution (1996) emphasises the right to a healthy environment, by noting:

*Everyone has the right— (a) to an environment that is not harmful to their health or well-being; and (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that— (i) prevent pollution and ecological degradation; (ii) promote conservation; and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*<sup>43</sup>

The Constitution also lays out principles of cooperative governance between the three spheres of government. It defines the areas of provincial and local government competence (in terms of subject-matter jurisdiction), and delineates the areas where provinces have the authority to pass and administer laws (Schedules 4 and 5, parts A) and where local governments have such authority (Schedules 4 and 5, parts B). Many areas of competence within these two schedules are directly implicated in efforts to build climate change resilience. For instance, provinces have authority (either concurrent with national government or exclusive) on disaster management, agriculture, environment, health services, nature conservation, pollution control, property development, public transport, public works, regional planning, urban and rural development, and provincial planning. Similarly, local governments have authority (concurrent with provinces) on air pollution, building regulations, municipal planning, municipal public works, water and sanitation services, municipal parks, municipal roads, and public places.

#### 2.1.2 Medium Term Strategic Framework 2014–2019

Each elected national government in South Africa develops a five-year plan (in line with its term of office) to deliver on its development agenda. The current plan, the Medium Term Strategic Framework 2014–2019, includes several outcomes, each of which is given effect through a delivery agreement by the concerned line department. Outcome 10 of the 2014–2019 Medium Term Strategic Framework speaks about climate change (to protect and enhance our environmental assets and natural resources) and sets a target of implementing climate change responses in six critical sectors.

Outcome 10's delivery agreement identifies five sub-outcomes that support the implementation and effectiveness of a climate change response, including:

- Sub-outcome 1: Ecosystems are sustained and natural resources are used efficiently.
- Sub-outcome 2: An effective climate change mitigation and adaptation response.
- Sub-outcome 3: An environmentally sustainable, low-carbon economy resulting from a well-managed, just transition.
- Sub-outcome 4: Enhanced governance systems and capacity.
- Sub-outcome 5: Sustainable human communities.

Several of the other outcomes in the Medium Term Strategic Framework are also inextricably linked to social and economic resilience, and hence to climate change resilience (e.g. outcomes related to public health, food security and sustainable human settlements).

### **2.1.3 National Environmental Management Act**

The National Environmental Management Act aims to provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, and supporting institutions that will promote co-operative governance and procedures for co-ordinating environmental functions.

The principles of the Act apply to all organs of state, and serve as the general framework within which environmental management and implementation plans must be formulated and therefore where climate change now also needs to be considered. The principles show that, environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.

The principles therefore support sustainable development, equitable access to resources, the rights of workers, environmental justice, and empowerment and ensure that the disturbance of ecosystems and loss of biological diversity are avoided, or, minimised and remedied. The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment. This assessment is significant for climate change where the science is constantly being updated and should be considered as part of decision-making for adaptation. One of the key principles in the Act is the "polluter pays principle", where those responsible for harming the environment must pay the costs of remedying pollution and environmental degradation, and support any consequent adaptive response that may be required. The Act has provided a significant platform on which to base climate change adaptation policy and particularly our National Climate Change Response Policy.

### **2.1.4 National Climate Change Response Policy**

Gazetted in October 2011, the NCCRP, South Africa's seminal policy document on climate change, contains foundational principles to guide climate change mitigation and adaptation in the country. Under the NCCRP, South Africa's response to climate change has two key objectives:

- To effectively manage the inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity.
- To make a fair contribution to the global effort to stabilise GHG concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner.

The policy provides a suite of principles that are important in guiding South Africa's climate change response which are guided by NEMA. Those principles which have not been addressed already under NEMA are:

- **Common but differentiated responsibilities and respective capabilities:** Aligning our domestic measures to reduce the country's GHG emissions and adapt to the adverse effects of climate change with our unique national circumstances, stage of development and capacity to act.
- **Special needs and circumstances:** Considering the special needs and circumstances of localities and people that are particularly vulnerable to the adverse effects of climate change, including vulnerable groups such as women, and especially poor and/or rural women; children, especially infants and child-headed families; the aged; the sick; and the physically challenged.
- **Uplifting the poor and vulnerable:** Climate change policies and measures should address the needs of the poor and vulnerable, and ensure human dignity while endeavouring to attain environmental, social and economic sustainability.
- **Intragenerational and intergenerational sustainability:** Managing our ecological, social and economic resources and capital responsibly for current and future generations.

- **The precautionary principle:** Applying a risk-averse and cautious approach, which takes into account the limits of current knowledge about the consequences of decisions and actions.
- **Informed participation:** Enhancing public awareness and understanding of climate change causes and impacts to promote participation and action at all levels.

The NCCRP stipulates that all governmental departments and state-owned enterprises must conduct a review of all policies, strategies, legislation, regulations and plans falling within their jurisdiction or sphere of influence by 2012, with the intention of aligning all relevant policies, strategies, legislation, regulations and plans falling within the policy by 2014.<sup>44</sup> The NCCRP has been able to support the integration of climate change into various policies and frameworks. Of particular note is the role it has played in guiding the MTSF outcomes, specifically on outcome 2. There has been concerted effort by key sectors highlighted in the NCCRP towards this alignment in terms of developing their adaptation strategies. In 2016 there are climate change adaptation strategies available (some in draft) for the sectors of Water, Biodiversity, Health, Agriculture Forestry and Fisheries and Rural Human Settlements.

Some sectors don't have specific adaptation plans but there is policy which integrates this, for example the Amendment of the Disaster Management Act in 2015. The impact of these policies in terms of supporting implementation is varied and also requires further analysis once all strategies are finalised.<sup>45</sup> The strategies are also further discussed in Chapter 5.

The NCCRP White Paper requires the Department of Environmental Affairs (DEA) to implement the policy in partnership with national, provincial and local governments, including research institutions and centres, to achieve its goals of transitioning to a low-carbon and climate-resilient society.<sup>46/47</sup> Section 10.2.6 of the policy calls for each province to develop a climate response strategy, which evaluates provincial climate risks and impacts, and to give effect to the policy at provincial level. In 2016 all provinces have either completed or are in the process of revising their strategies.

The policy also directs local government to integrate climate change considerations and constraints into their municipal development tools such as integrated development plans (IDPs) and municipal service delivery programmes.<sup>48</sup> Municipal by-laws are one of the most concrete channels for municipalities to give effect to activities that build climate change resilience.

#### **2.1.4 Municipal Systems Act**

Municipalities' functions are governed by the Local Government: Municipal Systems Act (2000) and the Local Government: Municipal Finance Management Act (2003). Specifically, the Municipal Systems Act provides:

*...the core principles, mechanisms and processes that are necessary to enable municipalities to move progressively towards the social and economic upliftment of local communities, and ensure universal access to essential services that are affordable to all ... (and) to establish a framework for support, monitoring and standard setting by other spheres of government in order to progressively build local government into an efficient, frontline development agency capable of integrating the activities of all spheres of government for the overall social and economic upliftment of communities in harmony with their local natural environment.<sup>49</sup>*

The constitutional system of cooperative government and intergovernmental relations is entrenched in the act.

Under this act, municipalities have the following functions:

- Making sure that national and provincial legislation is followed in its area.
- Developing plans, policies and strategies and setting delivery targets.
- Preparing and implementing budgets.
- Providing municipal services to its community or outsourcing services to other providers.
- Monitoring the provision of these services.
- Imposing and recovering any applicable charges to members of the community.
- Promoting development and a safe and healthy environment.
- Passing and implementing by-laws.

While climate change is viewed by many as an environmental issue, it is inherently a development priority. Therefore, in a sense, local, district and metropolitan municipalities are already empowered to act on climate change and implement climate change resilience actions.

#### **2.1.4 The National Development Plan 2030**

The National Development Plan, which provides a vision and plan to 2030, identifies climate change as a major factor that will influence the context in which South Africa operates. Its overarching aim is to eliminate poverty and reduce inequality by 2030 by ensuring a transition to an environmentally sustainable, climate-change-resilient, low-carbon economy and just society, among other key priorities.

It emphasises that developmental challenges must be addressed in a manner that ensures environmental sustainability and builds resilience to the effects of climate change, particularly in poorer communities. Furthermore, it states that while it is every stakeholder's responsibility to transition to a low-carbon, climate-resilient society, government has a key role to play in developing the necessary skills and institutional and cultural capacity to support the transition.<sup>50</sup>

Efforts to implement the National Development Plan must take into account that climate change poses many risks and opportunities for South Africa's future, requiring trade-offs in long-term developmental priorities.

#### **2.1.5 National Disaster Management Act and Policy Framework**

South Africa's disaster management legislation is considered one of the most advanced institutional frameworks for disaster management in the world and has served as a model for other countries.<sup>51</sup>

The Disaster Management Act (2002)<sup>52/53</sup> and the National Disaster Management Policy Framework (2005)<sup>54</sup> focus on prevention and decentralisation of disaster risk reduction governance, mandate the integration of disaster risk reduction into development planning and require the inclusion of stakeholders.<sup>55</sup> Each level of government is required to establish structures to ensure that disaster risk reduction, response and recovery are coordinated and implemented.<sup>56</sup> The Disaster Management Act, as amended in 2015, refers to climate change and the responsibility of national, provincial and local government to "provide measures and indicate how it will invest in disaster risk reduction and climate change adaptation, including ecosystem and community-based adaptation approaches; develop early warning mechanisms and procedures for risks identified in its functional area; and regularly review and update its plan".<sup>57</sup> This new legislation is important in terms of supporting adaptation through the requirement for providing measures and investment in ecosystem and community based adaptation for DRR-M.

These efforts are coordinated through the National Disaster Management Centre (NDMC housed within the Department of Cooperative Governance and Traditional Affairs (COGTA). The NDMC's functions include monitoring disasters, mobilising resources, coordinating and responding to disasters, and maintaining a repository of information relating to disasters, as well as a database of relevant stakeholders. The implementation of South Africa's benchmark legislation has, however, proven challenging for reasons that include interpretation of legislation, institution building and capacity limitation at all levels of government. This legislation also however provides an important basis for integration of climate change adaptation as can be seen in the recent legislative changes.<sup>58</sup>

## **2.2 Institutions governing climate change**

South Africa's governance in climate change is influenced by several international, national and subnational entities. Climate change is already being addressed through projects and programmes that are implemented across all spheres of government. At the national level, DEA is responsible for leading policy implementation. While DEA is the nodal department, it has to take into account several other governance structures and institutions.

### **2.2.1 Climate change governance structures**

In considering the key governance structures, both international and national structures have varying but equally important roles to play in addressing climate change.

## International and regional structures

In 2015, the UN Heads of States adopted the 2030 Agenda for Sustainable Development, along with a set of new sustainable development goals. Climate change is highlighted under Sustainable Development Goal 13: "Take urgent action to combat climate change and its impacts". This goal has relevant targets with which South Africa needs to align:

- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
- Integrate climate change measures into national policies, strategies and planning.
- Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

Other relevant international and regional structures include:

- The **UNFCCC**, which came into force in 1994. The Conference of the Parties is the highest decision-making authority for the UNFCCC and is an association of all the countries that are parties to the convention. The Conference of the Parties is responsible for ensuring that international efforts to address climate change are being implemented and the country commitments are aligned to the convention. South Africa has also developed goals for adaptation within its most recent Nationally Determined Contribution (NDC), to which it needs to adhere.
- The **Nairobi Work Programme**, which also helps improve scientific and technical understanding of adaptation through the development and dissemination of climate change information.
- The **Convention on Biological Diversity**, to which South Africa became a party in 1995, its Strategic Plan for Biodiversity (2011–2020) and the Aichi Targets offer further linkages between climate change, biodiversity and ecosystem services. It is also important for South Africa to align with and support implementation thereof.
- **SADC**. As South Africa becomes increasingly integrated across sectors, it has a very real interest in a climate-resilient SADC. This is especially the case in a drying future with respect to food and water security, and in a wetting future with respect to extreme event responses and infrastructure. South Africa is inextricably linked to SADC through, for example, regional climatic impacts, including transboundary water resources, flooding or drought, the migration of people, and trade of goods and services.<sup>59</sup> SADC countries that are not climate resilient may pose a risk to South Africa and the region. There is thus a need to understand how risks can be shared, for example, through trade, technology transfer and information sharing among SADC countries.

## National government

National government is responsible for formulating a NCCRP, amending and promulgating legislation to deal with climate change, establishing and administering regulatory frameworks, and allocating resources and incentives. It is also responsible for participating in international negotiations. Line function national departments (see table below) are responsible for integrating climate change into their policies and programmes, and will manage near-term priority flagship programmes to build climate resilience.

Table 1: National sectoral department responsibilities in relation to climate change

DEPARTMENT	RESPONSIBILITIES
Department of Cooperative Governance	Responsible for facilitating cooperative governance across spheres of government and assisting the institution of traditional leadership as a strategic partner of government. Disaster management falls within the ambit of the department, which is therefore the home of the National Disaster Management Centre (NDMC).
Department of Human Settlements	Human settlements are a concurrent function of national and provincial government. The national Department of Human Settlements develops policy and strategy, while provincial governments manage policy within their jurisdiction and approve housing subsidies and projects and provide support to municipalities. Municipalities in turn create an enabling environment for development, provide and operate infrastructure and services, and undertake land-use planning. The department has to respond to climate change impacts regarding service delivery, sanitation and sewage management, disaster risk management, and urban design considerations (design of houses, use of alternative technologies like solar geysers, etc.).

<b>Department of Rural Development and Land Reform</b>	Responsible for the social and economic development of rural South Africa, including agrarian transformation, which is affected by climate change.
<b>Department of Water and Sanitation</b>	Responsible for ensuring that the country's water resources are protected, managed, used, developed, conserved and controlled by regulating and supporting the delivery of effective water supply and sanitation. These functions are critical in the context of climate change. It may delegate functions to catchment management agencies.
<b>Department of Agriculture, Forestry and Fisheries</b>	Responsible for production and resource management; agricultural support services; trade and economic development; food safety and biosecurity; forestry; and marine aquaculture. Given the importance of the agricultural sector to food security in Southern Africa, there is a Directorate: Climate Change and Disaster Management within the department to facilitate climate change mitigation and adaptation, risk and disaster management; develop a policy framework for climate change and disaster management; develop an early warning system; and implement climate change programmes.
<b>Department of Environmental Affairs</b>	Responsible for biodiversity and ecosystems protection; conservation and management of natural resources; climate change adaptation and mitigation; air and water quality.
<b>Department of Health</b>	Responsible for healthcare in the country, and public sector healthcare in particular. The sector should effectively manage climate change impacts on health through interventions that improve the country's socioeconomic and environmental resilience and emergency response capacity.
<b>Department of Mineral Resources</b>	Responsible for the custodianship of all mineral resources in South Africa; promotes and regulates the minerals and mining sector for transformation, growth and development; ensures that all South Africans derive sustainable benefits from the country's mineral wealth. The sector has to respond to increasing water stress issues.
<b>Department of Energy</b>	Ensures the secure and sustainable provision of energy for socioeconomic development by developing an integrated energy plan, regulating the energy industries, and promoting investment in accordance with the integrated resource plan. All work must take climate change into account.
<b>Department of Transportation</b>	Transport is a function that is legislated and executed at all levels of government. Most of the implementation at a national level is done by public entities that are overseen by the Department of Transport, each with a specific delivery mandate. The national Department of Transport is responsible for the legislation and policies for all subsectors. The transport sector mainly focuses on climate change mitigation.
<b>Department of Public Works</b>	Promotes government's policy objectives by providing and managing the accommodation, housing, land and infrastructure needs of user departments; coordinating the national Expanded Public Works Programme (EPWP); and driving the transformation of the construction and property industries. Efforts to step up the greening of state buildings are underway as part of South Africa's climate change mitigation strategies.

#### Diagrams to be inserted

In addition to the line function departments, there are several parastatals (public sector enterprises) in South Africa that play key roles in their respective sectors. These include the South African National Biodiversity Institute (SANBI), Eskom, the energy utility; Transnet, a freight logistics company; SAFCOL, a forestry company; and Alexcor, a mining enterprise. Furthermore, there are several interdepartmental forums and institutional structures that aim to improve coordination across departments and alignment in national-level efforts on sustainable development. Each of these structures can play a role in coordinating and better integrating climate change activities.

Table 2: Governance structures needed for integrated responses

STRUCTURE	FUNCTION
Parliament Portfolio Committee on Environmental Affairs	Oversees the implementation of the NCCRP and reviews legislation to support the NCCRP.
The Inter-Ministerial Committee on Climate Change	Is an executive (Cabinet)-level committee that coordinates and aligns climate change response actions with national policies and legislation. The committee oversees the implementation of the national climate change response.
Forum of South African Directors-General clusters	South African Directors-General clusters guide national climate change response actions by facilitating engagement on emerging policies and legislation in a way that ensures that mandates of sector departments are given due consideration.
Intergovernmental Committee on Climate Change	The Intergovernmental Committee on Climate Change was established in 2008 to foster information exchange, consultation, agreement and support among the spheres of government on climate change and government's response to climate change. As a high level platform it brings together representatives from National Treasury and the national departments of environmental affairs; agriculture, forestry and fisheries; energy; health; human settlements; international relations and cooperation; trade and industry; transport; rural development and land reform; science and technology; social development; and water affairs; from provincial environment departments; and from the South African Local Government Association.
National Disaster Management Council	Responsible for ensuring that the National Framework for Disaster Risk Management provides clear guidance across all spheres and sectors of government for managing climate change-related risks. The council ensures that an effective communications strategy is in place for early warnings to vulnerable communities.
Ministers and Members of Executive Council and Ministerial Technical Committee	Facilitates policy and strategy coherence among the three spheres of government, and guides climate change work across the three spheres of government.
National Committee on Climate Change	The National Committee on Climate Change advises and consults DEA on matters relating to national responsibilities with respect to implementation of the NCCRP and climate change, and in particular in relation to the UNFCCC and the Kyoto Protocol. It also advises on the implementation of climate change-related activities. The committee is obliged to report on climate change activities every four years through the National Communications to the UNFCCC. It also consults with stakeholders from key sectors that impact on or are impacted by climate change.
National Economic Development and Labour Council	Forum where government comes together with organised business, labour and community groupings at a national level. The council ensures that climate change policy implementation is balanced and meets the needs of all sectors of the economy.

At the national level, intergovernmental cooperation and interaction on environmental matters is guided in part by South Africa's Inter-Governmental Relations Framework Act (2005). The national government's coordination with local government is facilitated through the South African Local Government Association as well as the Department of Cooperative Governance and Traditional Affairs (CoGTA).<sup>60</sup>

#### Provincial government

Similar to national government, the provincial government department responsible for the environment in each province is tasked with leading its climate change response. This includes coordinating the climate change response of line provincial departments and other active provincial entities. To assist with this, most of the lead departments have established provincial climate change forums where provincial stakeholders can learn about climate change and coordinate their climate change responses.



In terms of sector responsibilities, the water, mining, energy and fisheries sectors are the constitutional responsibility of national government. As a result, the provincial climate change response for these sectors is led by the provincial offices of the appropriate national department. Several other sectors are a concurrent responsibility of national and provincial government. As a result, provincial line departments exist for the following sectors: health, biodiversity, agriculture and forestry, disaster management, human settlements, infrastructure and transport.

Every province has a provincial environment department, which may also include other functions (e.g. economic affairs, development planning, tourism and agriculture). Each provincial administration designs its institutional arrangements for the environment in accordance to their needs and strengths. For example, one province may locate conservation with agriculture while another may locate conservation with environmental management and planning.<sup>61</sup> Since climate change response capacity is extremely limited in the provincial sphere of government, a strong distinction is generally not drawn between mitigation and adaptation efforts in the provinces and provincial staff in the climate change sector work on both mitigation and adaptation.

### Local government

In 2016, South Africa's local government structure consisted of eight metropolitan, 44 district and 226 local municipalities, spread unevenly across the provinces. The municipalities are not homogeneous in their spatial, social or economic environments and are allocated into categories in accordance with the Local Government: Municipal Structures Act (1998).

The national disaster management framework is a direct way in which municipalities are empowered to act on climate change and already have existing institutional arrangements. Under this, the Municipal Disaster Management Centre must develop a progressive risk profile for the municipality and integrate this into the IDP process to enable disaster risk reduction. The broader mandate for local government to respond to climate change is rooted in South Africa's Constitution,<sup>62</sup> because many critical actions required for climate change responses fall within the responsibility of local government.

These include the provision of basic services (water, electricity, waste removal, sanitation and sewage infrastructure maintenance), road management, disaster risk management, and the provision of safe and healthy human settlements.

These local government functions are highlighted in South Africa's Let's Respond Toolkit, which is geared towards enabling local governments to use existing authority to catalyse climate change resilience.<sup>63</sup> The Let's Respond Toolkit has become an important tool to guide mainstreaming of climate change into the integrated development planning process at the local level. The Municipal Climate Change Support Programme has been rolled out through established forums and working groups at the municipal level, which are important platforms on which to build capacity and strengthen institutional structures around climate change.

## **2.2.2 Challenges with current institutional structures**

In terms of coordination of climate change within government there is horizontal coordination (i.e. coordination within and across the different departments) and vertical coordination (i.e. coordination among the different levels of government ie national, provincial; and local). At the national government level horizontal coordination presents enormous challenges. Of the 32 national sector departments, at least 19 should be directly or indirectly involved with mainstreaming climate change. However, institutional and legislation fragmentation pose enormous challenges to horizontal coordination, which is compounded by the fact that few of the departments apart from the Department of Environmental Affairs (DEA) view climate change as a priority for their sector.<sup>64</sup>

While the National Climate Change Response Policy advocates full alignment and suggests building on the Outcomes Approach developed by Department of Performance Monitoring and Evaluation (DPME) in order to address the existing institutional and legislation fragmentation, compliance mechanisms have not been developed to ensure implementation although steps are being taken. DEA has made steps towards developing a Monitoring and Evaluation Framework for climate change adaptation, which will help support the need for integration but the actual implementation support is lacking. Furthermore, while two existing centralized mechanisms, namely the Interministerial Committee on Climate Change (IMCCC) and the Forum of South African Directors-General (FOSAD) clusters are endorsed by the NCCRP, weaknesses associated with both of these have been highlighted with regard with their ability to move from policy to implementation.<sup>1</sup>

Some of the challenges to vertical coordination (i.e. coordination among the different spheres of government) relate directly to the issues climate change and environmental management. However, many of the challenges to vertical coordination are intrinsic to the way the different spheres of government are structured and function. Vertical coordination is therefore an inherent challenge for the South African government and will not be resolved merely by addressing challenges specifically related to climate-change or environmental governance.

The NCCRP acknowledges the importance of all levels of government in addressing climate change and recognises the need for collaboration (vertical and horizontal) to ensure that experiences, knowledge and know-how are effectively shared. The policy suggests utilising existing coordinating structures, namely the Intergovernmental Committee on Climate Change (IGCCC), the extended MINMEC/MINTECH structures as utilised for developing the Outcomes Approach and the South African Local Governments Association (SALGA). Weaknesses have also been highlighted around these forums such as the IGCCC being merely an information platform and not supporting implementation; the MINTECH and MINMEC remains too high level and too sector oriented to facilitate mainstreaming; and SALGA although making concerted efforts towards mainstreaming at the local level, has limited capacity, which constrains its actions.<sup>1</sup>

The NCCRP also highlight the critical need for best-practice knowledge-sharing across provinces and municipalities to take advantage of innovative models in climate change adaptation, which is to be coordinated by the DEA and COGTA. Although there has been efforts around knowledge sharing through the Lets respond toolkit programme and Municipal Support programme and other mechanisms, also with support from SALGA and other institutions outside of government, there is still much effort needed in terms of knowledge sharing and capacity development between the levels of government by DEA and COGTA to assist mainstreaming of climate change and to support effective implementation.

### **3. BUILDING A NATIONAL ADAPTATION STRATEGY**

South Africa's policy and regulatory landscape can be built on to improve climate change adaptation efforts; however, the institutional environment is complex, and multiple entities drive the planning and implementation of adaptation responses. Because of this pre-existing policy and institutional architecture, the important role for a NAS to optimise alignment, especially in relation to the national development agenda is emphasized. A single, unifying strategy would provide clear guidance, both on priority actions and on implementation mechanisms. This will allow previously disparate efforts to be tied together and proceed in a complementary manner.

#### **3.1 Importance of the NAS for South Africa**

National strategic processes are critical for successful climate change adaptation planning and implementation.

National adaptation strategies (sometimes referred to as frameworks) position countries to reduce their climate change risks and take advantage of opportunities. Although adaptation responses are implemented locally or regionally, they need overarching guidance to reduce risks of maladaptation and maximise opportunities for integration at multiple levels. These include integration of adaptation with national sustainable development aspirations, socioeconomic imperatives and identified climate risk priorities, and alignment with financial and other resources.

The NAS is an important step forward for South Africa. It will:

- Act as a common reference point for climate change adaptation efforts in South Africa in the short to medium term, providing guidance across all levels of government.
- Inform national, provincial and local planning.
- Help gauge the degree to which development initiatives at different levels of government integrate and reflect critical climate change adaptation priorities, and thus inform levels of resource allocation from revenue streams related to climate change resilience.
- Support South Africa in meeting its international obligations by demonstrating progress on climate change adaptation, and also serve as South Africa's national adaptation plan.
- Guide stronger coherence and coordination on climate change adaptation between different institutions and levels of government.

## 3.2 Strategic vision and objectives

### 3.2.1 Vision

The vision for the NAS is to provide a framework through which South African society can develop resilience to the adverse impacts of climate change through implementation of effective short-, medium- and long-term adaptation responses, while achieving a more equitable and sustainable low-carbon development pathway and move towards the vision of a climate resilient South Africa.

### 3.2.2 Objectives

South Africa's "aspirational goal" on adaptation is to **build resilience and adaptive capacity to respond to climate change risk and vulnerability; whilst providing guidance on the integration of climate change responses into current and future development objectives; through optimising policy, planning, and implementation coherence of climate change adaptation actions.**<sup>65</sup>

This goal is outlined in the country's Nationally Determined Contributions, which it submitted to the UNFCCC. It is also informed by South Africa's National Climate Change Response Policy (NCCRP) white paper, which is a touchstone for climate change adaptation in the country, and the UNFCCC's guidelines on the preparation of a National Adaptation Plan (NAP).

The UNFCCC notes that the goals of a NAP are to:

- Reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience; and
- Facilitate the integration of climate change adaptation, in a coherent manner, into relevant new and existing policies, programmes and activities, in particular development planning processes and strategies, within all relevant sectors and at different levels, as appropriate.

In addition to the realization of the vision of a climate-resilient South African society, the NAS is also intended to support South Africa in its efforts to meet the goals of the Paris Climate Change Agreement:<sup>66</sup>

- (a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
- (b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and
- (c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

## 3.3 Developing South Africa's NAS: Key Process Elements

The process of building South Africa's NAS began with DEA launching the effort to create an up-to-date guidance document on climate change adaptation for the country, to provide clarity on national adaptation priorities.

One of the reasons why this process is driven by national government is because the complex task of prioritising responses while maintaining flexibility is most effectively supported at national level. Such tasks are expensive in terms of planning, research and development (R&D) resources, and monitoring and evaluation (M&E) efforts. It is also a process that is likely to require increased integration between national and subnational institutions, both horizontally and vertically. New publicly funded institutional arrangements and capacity may be needed, which would require additional targeted funding. In addition to integration within the public sector itself, improved collaboration with the private sector and civil society is needed to build societal resilience. Such major and complex interventions are best guided by a well-conceptualised, nationally driven, strategic development process. This is reflected in how South Africa's NAS has been developed.

DEA identified the following objectives for the NAS, i.e. for the NAS to achieve or to contribute towards these objectives, in support of the broader vision of a climate resilient South Africa:

- Build adaptive capacity to respond to and counteract climate risk, and thereby reduce vulnerability.
- Reduce sensitivity and exposure to climate impacts to reduce risk, and thereby reduce vulnerability.
- Integrate climate adaptation and resilience into current and future development objectives at national, provincial and local levels.
- Improve coherence in policymaking, planning and implementation to ensure balanced outcomes that support socioeconomic development.
- Facilitate sectoral and cross-sectoral adaptation, and promote coordination and a collaborative approach to adaptation.

Thereafter, NAS development was informed by extensive literature review of global as well as regional adaptation guidance. This included the IPCC's fifth assessment report, the UNFCCC's NAP guidelines, South Africa's INDC (subsequently the NDC), and climate change adaptation strategies prepared by other emerging economies.

The IPCC, for instance, suggests that national adaptation strategies should provide guidance across four broad areas of competency:

Table 3: Four areas of competency

FOUNDATION	PREPARATION	IMPLEMENTATION	EVALUATION
<ul style="list-style-type: none"> <li>• Climate science</li> <li>• Training and capacity building</li> <li>• Communication</li> <li>• Institution design and maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Analytical assessment and reporting</li> <li>• Compilation</li> <li>• Optimising integration (vertical/horizontal and across policy, e.g. with the National Development Plan)</li> </ul>	<ul style="list-style-type: none"> <li>• Priority setting</li> <li>• Roadmap</li> <li>• Funding arrangements</li> <li>• Alignment, coordination and synergy</li> <li>• Institutional development (integration and new institution building)</li> <li>• Capacity development</li> </ul>	<ul style="list-style-type: none"> <li>• Monitoring key indicators</li> <li>• Reviewing progress</li> <li>• Guidance for updating planning and implementation</li> <li>• Outreach</li> </ul>

In addition to the guidance provided by DEA, international documents, and domestic South African policies such as the NCCRP, the team developing the NAS kept in mind the following central principles to serve as common threads throughout the NAS:

- **Development planning should prioritise climate-resilient development:** Integration is a vital way of including adaptation issues within the development agenda. Incorporating adaptation into development planning (as well as implementation) is important for coherence in governance, and for making development more climate-robust. Expenditure on adaptation responses and capacity could represent the most significant acceleration of development investment since the achievement of democracy in South Africa. Planning and implementing development activities should therefore be seen as driving climate-resilient development, while advancing equity, equality and addressing poverty. This will enable access to significant resources, spur development and help automatically integrate adaptation responses within development.
- **Holistic societal resilience requires integrated sectoral and cross-sectoral approaches:** Sectoral adaptation planning and implementation engages well-established institutions and infrastructure, which come with their own associated efficiencies. However, given that climate change impacts on shared resources critical for multiple sectors, an integrated approach across sectors is more effective than siloed efforts within each sector. In particular, this will help identify inter-sectoral trade-offs and potential unintended consequences of one sector's efforts on another. Such cross-sectoral linkages will help build resilience across-the-board, which is critical to respond to and cope well with natural hazards and other economy-wide climate shocks.
- **Climate change adaptation and climate change mitigation are closely interlinked:** The linkages between adaptation and mitigation are increasingly important. This is because there is intensified international focus on keeping global warming below 2°C. Therefore, adaptation responses need to be cognisant of their mitigation

implications so that mitigation benefits are capitalised on, and so that there is an opportunity to redress (or mitigate) any emissions contributions with abatement efforts as necessary.

- **Climate change adaptation planning must be adaptive, flexible and able to evolve:** Future climate scenario uncertainty requires that some flexibility be retained in adaptation planning and investment in the short to medium term. New information from an effective adaptation M&E system, together with scientific advances, should inform shifts in emphasis in adaptation practice.

Most critically, development of the NAS has taken into consideration all existing sectoral, provincial, and local climate change adaptation strategies in South Africa, as well as those currently in development.

Drawing on this diverse range of resources, the NAS document has been developed in an iterative fashion. One of the crucial elements of this development has been stakeholder consultation including through a series of “roadshows” across different provinces.

### **3.5 Prioritisation – rationale and criteria**

A national strategic planning process is often a prioritisation exercise. Choices need to be made about which actions are prioritised, and this needs to be done on the basis of criteria that support the accomplishment of the overall objective.

In the case of the NAS, certain strategic actions have been elevated to national priorities, based on the adaptation responses identified in each sector, including existing sectoral adaptation strategies (discussed in chapter 5).

Priority actions were selected based on their meeting the following criteria:

- Enabling institutional and governance actions or responses that support adaptation interventions across sectors or regardless of them (so as to maximise the benefit of such responses economy-wide, including through coordinated efforts).
- Multi-sectoral actions or responses that are adaptation interventions in more than one sector (i.e. if a response is being implemented or has been selected by multiple sectors as a means to build sectoral resilience, it assumes greater importance within the NAS).
- No- or low-regret options that should be implemented with immediate effect to support resilience, especially those that boost responsiveness and recovery from natural hazards.
- Climate resilience actions or responses that bring significant, recognisable socioeconomic development co-benefits (so that development goals such as advancing equity and reducing poverty are promoted, spurring more broad-based resilience).
- Resource-efficient actions or responses that have, in relative terms, large benefits compared to levels of investment or expenditure required.
- Actions or responses that receive widespread stakeholder support for prioritisation (over the course of the NAS development process).

### **3.6 NAS strategic priorities**

Based on the evaluation criteria described above, the NAS elevates the adaptation responses listed below to the level of national strategic priorities for the medium and long term (as per NAP guidelines, which indicate that NAPs should focus on the medium to long term). However, this is not to suggest that short term priorities have been dispensed with. In fact, the priorities below can be viewed as being relevant in the short term as well, since many of them will have near-term benefits.

These priorities emerge from the linkages and cross-cutting themes visible in sectoral strategies (Chapter 5), communication and knowledge management (Chapter 6), research and development (Chapter 7), and training and capacity building (Chapter 8).

These priorities will guide ongoing and future adaptation efforts at the national level, and initiatives that align with these priorities will receive particular attention in terms of allocation of National Treasury funding.

While provinces and local government are empowered to identify and implement their own strategic plans, including climate change adaptation plans, it is intended that they use the NAS as a key reference and guide to ensure the greatest degree of alignment and coordination possible.

The strategic priorities for the NAS are:

13. Formalise climate change policy and legislation in the form of a National Climate Change Act that builds on the NCCRP White Paper and establishes the appropriate institutional arrangements for implementation, planning, engagement in research, and M&E. Such policy and legislation must enable the design and capacitation of appropriate institutions, facilitate cross-sectoral alignment in implementation, and integrate adaptation and mitigation efforts.<sup>2</sup> (See a more detailed discussion and rationale for this in Chapter 9).
14. Integrate climate change adaptation within existing development planning and implementation processes, by including key approaches that enhance adaptive capacity, enhance livelihoods, and reduce the risk of and adverse effects from climate-related disasters. These include ecosystem-based adaptation (EbA), sound catchment management, community-based adaptation, conservation agriculture and climate-smart agriculture (CSA) (including forestry and fisheries), climate-proof infrastructure development and settlement planning, among others.
15. Launch a joint planning and implementation process, involving all sectors, that integrates and operationalises necessary systemic changes across government, taking into account both adaptation and mitigation outcomes, and that supports economy-wide resilient development.
16. Assess the cost of integrated systemic changes and build a case to secure international resources to support implementation.
17. Conduct a scoping process to consider climate change vulnerabilities in sectors (such as energy, mining and transportation) that have been underserved in previous climate vulnerability assessments.
18. Ensure that future planning, growth and development within sectors that have traditionally taken a mitigation focus (such as energy, mining and transportation) explicitly take into account future climate change impacts for the sector as well necessary adaptation measures, while simultaneously considering how these sectors can contribute to climate resilience in communities implicated by their development.
19. Strengthen EPWPs to support climate resilience in ecosystems and people (such as the Land User Incentives Programme), to ensure sustainable land management into the long term.
20. Mandate that all public infrastructure be planned, designed, operated and managed after explicitly taking current and predicted future climate change impacts into account, to ensure optimal performance and value-maintenance of infrastructure despite a changing climate.
21. Grow the knowledge base of climate change impacts and solutions, fill gaps in current knowledge and reduce long-term uncertainties by investing in R&D, especially in integrated assessment of impacts, impacts modelling and adaptation assessment. Prioritise approaches that quantify socio-economic aspects of impacts to support key decisions. Create integrated knowledge management and information-sharing systems to improve access to climate change-related information and improve informed decision-making.

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<sup>2</sup> The NAS recommends the creation, capacitation and operationalisation of an institutional structure that allows for integration and coordination between climate change adaptation efforts across sectors and at all levels of government, as well as alignment between climate change mitigation and adaptation in South Africa. To this end, the national adaptation plan recommends that this new institutional arrangement be situated within CoGTA. It is envisioned that DEA would continue to provide guidance and direction on climate change adaptation and mitigation, but that the work would be carried out through the CoGTA architecture and network. For climate change adaptation, it is recommended that the NDMC be the channel of implementation, in close cooperation with DEA, and for climate change mitigation it is recommended that the departments of Transport, Energy, Mineral Resources and Agriculture, and key GHG-emitting sectors be the channels of implementation, in close cooperation with DEA. Both streams, however, would be housed within the CoGTA institutional framework. For this new arrangement to succeed, technical and financial capacity needs to be improved in the NDMC, DEA and CoGTA.

22. Build capacity to implement effective adaptation programmes across government and all sectors through focused and targeted training programmes and continuing education.
23. Implement an effective climate change adaptation response M&E system and ensure that it is fully integrated with all relevant aspects of the climate change framework.
24. Develop and implement an effective communication and outreach programme that informs all sectors and all levels of society about the risks and opportunities that exist due to climate change.

## 4. CLIMATE CHANGE TRENDS AND IMPACTS SCIENCE

Climate change science, as summarised by the IPCC, shows unequivocally that human industrial and land-use activities are responsible for warming in the air and oceans, changing rainfall patterns, melting land and sea ice, sea level rise, and increasingly changing ocean acidity, among other impacts. There is also overwhelming scientific consensus that climate change will affect human society. The IPCC reported in its Fifth Assessment Report that many observed changes are “unprecedented over decades to millennia”.<sup>67</sup> There is no longer a case for inaction on the grounds of scientific uncertainty; the only consequential uncertainties that remain are details of the rate of change, the likely impacts, and where these will occur with the greatest effects. Countries around the world have been taking decisive action that incorporates, and makes room for, levels of uncertainty where such ambiguity exists. In this context, adaptation responses that are flexible and offer advantages across (or regardless of) future scenarios are strongly advised. The NAS takes account of this, but further improved scientific guidance based on focused integrated impact assessments, would help to narrow uncertainties and support more cost effective allocation of scarce resources.

### 4.1 Evidence of climate change in South Africa from the past

There is ample evidence of national and local changes in the temperature and rainfall climatology of South Africa over at least the past five decades, based on several analyses of the weather station data of the South African Weather Service (SAWS) and the Agricultural Research Council, and internationally developed and maintained climate data sets such as those of the Climatic Research Unit in the United Kingdom. Analyses have also been conducted for southern Africa and the sub-Saharan African region.<sup>68</sup>

Observed changes and trends in key metrics are publicly available in peer-reviewed research papers published by researchers from several national institutions. In addition, several summaries are documented in the Long Term Adaptation Scenarios (LTAS) report of DEA and the IPCC’s Fifth Assessment Report.

#### 4.1.1 Temperature trends

Warming trends across southern Africa have tended to be up to double the global average over the past four to five decades. In South Africa this is generally the case, with a few local exceptions in the central interior where warming rates have been lower, and in some cases insignificant and even negative.

Maximum and minimum temperatures all show significant increases at virtually every station, both annually and seasonally.<sup>69</sup> Maximum temperatures have increased more significantly than minimum temperatures, and the strongest seasonal increases in both maximum and minimum temperatures have been in autumn and winter months.

A marked exception to the national temperature increases is in the central interior, where the minimum temperature either does not change or has even decreased. While these local decreases in minimum temperature occur throughout the year, the trends are strongest in winter. In general, nationwide, high temperature extremes have increased significantly in frequency, while the frequency of low temperature extremes has decreased.

Consistent with the local exception in trends in annual average temperature in the central interior, extreme low temperature events have increased to some extent. As a result, the country’s daily temperature range has widened, with the strongest increases recorded in the interior, and weaker increases in the daily temperature range in coastal regions. This could indicate a buffering effect due to the ocean’s influence on temperature change.<sup>70/71/72/73</sup>

### 4.1.2 Rainfall trends

South Africa's mean annual precipitation is highly variable from year to year,<sup>74</sup> making it impossible to identify trends over the past five decades with statistical confidence.<sup>75</sup> This is also true of global precipitation trends, which show statistically significant trends (of increasing rainfall) only at mid-latitudes in the northern hemisphere.

DEA recently analysed trends in 2013 rainfall metrics in South Africa.<sup>76</sup> The analysis used data from 72 SAWS weather stations, of which less than 20 percent of the data is missing for the 1960–2000 period. Overall, trends in rainfall totals are not significant, although there is a tendency towards a decrease in the number of rain days. There is also evidence of increasing trends in rainfall totals over South Africa's central interior, and an increase in extreme rainfall events, especially in spring and summer over the central interior. This is accompanied by a reduction in extremes in autumn. These results are consistent with those obtained by independent researchers.<sup>77/78</sup>

There is less certainty about rainfall trends than temperature trends, with a range of studies using different models producing disparate results.<sup>79</sup> South Africa's adaptation response thus needs to be robust to this critical uncertainty, and aim for low-regret/no-regret interventions to retain flexibility for an appropriate response to any long term trend that might emerge.

### 4.1.3 Extreme events: floods, droughts and heat waves

There is evidence that extreme weather events in South Africa are increasing, with heat wave conditions found to be more likely, dry spell durations lengthening slightly and rainfall intensity increasing. It must be noted that until 2015/16, South Africa had largely avoided adverse effects of El Niño conditions since 1991/92. Above-average rainfall over the past two decades has limited extreme drought conditions in South Africa and the region. As a result, flooding and storm conditions have featured more prominently as extreme events than drought until 2014. Globally, there is clear evidence of an increase in extreme weather events. The IPCC's Fifth Assessment Report states that it is very likely that human influence has increased the frequency and intensity of daily temperature extremes globally since the 1950s; more than doubled the likelihood of heat waves in some regions, increasing heat-related human mortality and decreasing cold-related human mortality in some regions; and increased the prevalence of heavy precipitation events.

## 4.2 Future projections of climate change in South Africa

The findings described here are based on material summarised in South Africa's Third National Communication to the UNFCCC. Global climate model projections of future climate change applied in the IPCC Fifth Assessment Report were used as the basis for regional climate models of Africa.

These global climate models typically have a horizontal resolution of about 200 km, while the regional climate models have typically been downscaled over parts of the African continent at a horizontal resolution of about 50 km, through the work of the Coordinated Regional Downscaling Experiment of the World Climate Research Programme.

The average air temperature across the land surface of Africa is projected to rise rapidly during this century, at 1.5 to 2 times the global rate of temperature increase. The southern African region and particularly the Mediterranean-type climatic region of South Africa are likely to become drier, while East Africa and most of tropical Africa are more likely to become wetter.<sup>80</sup> With respect to extreme climate events, more frequent occurrences of dry spells are plausible over most of the interior of southern Africa.<sup>81</sup>

### 4.2.1 Temperature change

Climate models indicate that South Africa is likely to experience significant warming over the next few decades at least, with the highest rates of warming occurring in the interior and the lowest warming rate occurring along the coastline, contrasting with the current trend of lowest observed warming rate in the interior.

#### Representative concentration pathways

RCPs are a series of GHG concentration and emissions pathways that have been developed to inform research on climate change impacts and possible policy responses.

RCP8.5 represents a high GHG emissions pathway, with a projected "radiative forcing" of 8.5 watts/square metre by the close of this century.



All models all agree that the amount of warming by 2035 will be 0.5°C to 1°C, depending on coastal to interior location. Model projections diverge by the mid-2000s, and by the end of this century there is disagreement between models and depending on emissions scenarios. By the end of this century, some models project warming by as much as 5°C for representative concentration pathways (RCP) 8.5 (see box<sup>82</sup>), while others project warming as low as 1.5°C for RCP4.5. This indicates a very strong dependence of climate change sensitivity in South Africa on emissions scenarios, even in a few decades.

#### **4.2.2 Rainfall change**

Projected changes in rainfall totals and other rainfall-related statistics generated by global climate models are more uncertain than temperature change projections. This is because global climate models simplify several aspects of the climate system relating to rainfall, including topography, convective rainfall processes, and processes of cloud formation and dynamics. In addition, some fundamental processes relating to moisture transport are inadequately captured, decreasing confidence in convective processes and related rainfall processes. These are of particular relevance for rainfall in tropical latitudes. Because of this, global climate models may not reproduce local- or regional-scale rainfall patterns accurately and often produce significant biases (too much rainfall or too little rainfall) in comparison with observations. Nonetheless, global climate models are able to reproduce large-scale circulation features well and in many cases agree on projected shifts in these large-scale processes into the future. For this reason, consideration should be given to large-scale shifts in rainfall patterns produced by global climate models rather than to local-scale changes, and to the investigation of downscaling approaches with full presentation of uncertainties to gain insights into local-scale precipitation changes as a result of large-scale circulation changes.

Up to 2035, models show mixed, relatively small and insignificant changes in annual total rainfall across South Africa. Towards mid-century, many models show significant changes, with the majority of models showing decreased rainfall, especially in south-western South Africa, and a few showing increased rainfall in various regions, particularly in the summer rainfall region. Towards the end of this century, these patterns are strengthened, with the majority of models showing significant drying over many parts of the country and a minority of models showing increased rainfall under RCP8.5. Under RCP4.5 a greater proportion of models continue to show increased rainfall in some summer rainfall regions through to the end of the century.

#### **4.2.3 Extreme events: floods, droughts and heat waves**

Two main aspects underlie future trends in extreme events. The first is driven by secular trends in climate due to climate change, and the second is due to the interaction of these trends with climate variability, which occurs on a range of timescales. Much less is known about the latter than the former, but some inferences can be made about both aspects.

Due to the high certainty in projections of increasing mean temperatures, an increase in the number of very hot days is clearly a major component of future extreme event management and adaptation. Using the metric of number of days warmer than 35°C, statistical changes in this variable up to 2035 are largely insignificant except for the Northern Cape, North West and Limpopo. However, for emissions scenario RCP8.5 for the end of this century, increases as high as 120 days are projected. There is an almost doubling in this variable for the Northern Cape, which is currently only around 60 days a year. Even under the lower emissions RCP4.5 scenario, some models project increases in this variable as high as 80 days a year by the end of the century.

With regard to rainfall and its variability, South Africa has a range of seasonal rainfall regimes, with winter rainfall in the southwest, summer rainfall in the northeast, and an intermediate seasonality in between. This seasonality is important for economic activities, and is also important for understanding extreme weather events. It is difficult to identify clear changes in future statistics of extreme weather events. Large-scale circulation changes indicate that extreme winter flooding events may occur less frequently over the southern parts of South Africa in response to a poleward displacement of the frontal systems that bring winter rainfall. Tropical cyclone tracks are projected to shift northward in the summer rainfall area, bringing more flood events to northern Mozambique and fewer to the Limpopo province in South Africa.<sup>83</sup>

Climate variability occurs in southern Africa on a range of timescales, driven by atmospheric and oceanic dynamics, in ways that are still not fully understood. The climate exhibits many modes of variability in global and hemispheric circulation patterns at intra-seasonal (of the order of one or two months) and inter-annual (year-to-year) timescales.

The El Niño-Southern Oscillation (ENSO) is recognised as the leading mode of inter-annual variability in the tropics and is driven by variations in sea surface temperatures in the equatorial Pacific Ocean. Links between ENSO and southern Africa's rainfall have been established: warm ENSO events (El Niño) are commonly associated with below-average summer rainfall over much of South Africa and cold events (La Niña) are typified by above-average rainfall in this region. Severe summer drought in South Africa tends to occur under El Niño conditions,<sup>84</sup> a relationship which seems to have strengthened since the 1970s.<sup>85</sup> Furthermore, seasonal prediction of summer rainfall in South Africa can be more accurate during strong ENSO phases.<sup>86</sup> However, the relationship between ENSO and future rainfall change in South Africa and the region remains uncertain. This uncertainty is amplified by the influence of other climatic modes, and interactions between these modes. Further research on the future changes in these drivers of seasonal and long term variability will help to reduce uncertainty and assist adaptation planning.

Other prominent inter-annual modes relevant to southern Africa include a dipole pattern in sea surface temperature anomalies between the south-western and south-eastern Indian Ocean, the Madden-Julian Oscillation, which is an eastward propagation of large-scale convective clusters in the tropics with a period of 30–60 days, and the Antarctic Oscillation, which is defined by pressure anomalies between Antarctica and the southern hemisphere mid-latitudes. A positive phase of the Indian Ocean Dipole is characterised by anomalously warm sea surface temperatures in the western part of the basin, and has been linked to increased summer rainfall over parts of southern Africa.<sup>87</sup>

At an intra-seasonal timescale, the Madden-Julian Oscillation has a noticeable impact on South African rainfall.<sup>88</sup> Convection over South Africa tends to be more strongly affected by the Madden-Julian Oscillation during warm phases of ENSO and warm tropical Indian Ocean temperatures, such that intra-seasonal variability is higher and convection is less active during El Niño events.<sup>89</sup> There is also a link between a positive phase of the Antarctic Oscillation and enhanced rainfall over central South Africa, which tends to be stronger during La Niña years.<sup>90</sup> Particularly wet winters are associated with a negative phase of the Antarctic Oscillation for the winter rainfall region of the south-western Cape.<sup>91</sup>

A roughly 18-year cycle in southern African rainfall has been identified in instrumental and proxy records extending as far back as 600 years.<sup>92</sup> It is not clear what lies behind this, but an “ENSO-like” multi-decadal pattern of variation has been identified at multiple timescales.<sup>93</sup> It is possible that interaction between phases of the multi-decadal and inter-annual variations improves or mitigates regional responses.<sup>94</sup>

Up until the intense El Niño of 2015/16, South Africa had not experienced ENSO-related drought since 1991/2. The globally damaging 1997/8 El Niño did not adversely affect southern Africa, although such effects were projected at the time. El Niño conditions in the eastern Pacific appeared to be developing in 2014, but did not eventuate, only to reappear in 2015 and intensify to levels never before recorded. Early drought conditions in South Africa began to take hold during 2014, and at the time of writing (December 2015) were intensifying substantially, indicating a repeat of ENSO-related drought intensities of 1991/2 and 1982/3. The 2015/6 drought conditions over large areas of South Africa indicate the vital importance of a better predictive understanding of these drivers.

It is likely that the secular changes in climate will interact with these periodic shifts to drive changing patterns in extreme events, and these require careful research and consideration through increasing uncertainty in projections of the frequency and intensity of extreme events that is not yet possible to quantify with a degree of confidence.

### **4.3 Broad impacts of climate change in South Africa (in relation to trends)**

The IPCC's Fifth Assessment Report framed climate change as an additional stress that is beginning to interact with a complex set of existing stresses, such as poverty, in human society. The outcomes are difficult to project, but it is possible to start identifying key sectoral effects that do not yet fully consider complex interactions. These complex interactions seem likely to amplify potential adverse impacts.

The international scientific community has summarised a significant body of information on observed risks, impacts and vulnerabilities as a result of climate change, but there is a major gap in information on this topic at a national level in South Africa. As a result, South Africa has few demonstrable examples of the effects of long-term climate trends. The most comprehensive analyses have been carried out in natural and semi-natural terrestrial and marine ecosystems. Both reveal

some trends, but they are also highly complex ecosystems, which challenges attribution to any single cause. SAWS and the NDMC are synthesising observed climatic conditions risks, their recent trends and their impacts. In addition, several national scientific facilities and institutes gather data on trends in climate-affected sectors. The South African Environmental Observation Network is building a national network of observation nodes to monitor a range of environmental variables and, increasingly, social variables over the long term.<sup>95</sup>

Most medical facilities collect a range of data on human well-being and health trends, and DEA and the Department of Health are working together to maximise opportunities to analyse the data. Although university-based institutions do not frequently conduct studies to monitor long-term trends, the Wits Rural Facility<sup>96</sup> has gathered data on social well-being in a rural area since the early 1990s and the South African Bird Atlas Project<sup>97</sup> has gathered data on observed changes in the number of wild bird species since the late 1980s. Several industries, including the insurance industry and agriculture, gather data. Unfortunately it is not always freely available for analysis and synthesis. As a result, South Africa does not yet have an integrated view of these trends, but there is great potential to integrate the data using a national system, such as the South African Risk and Vulnerability Atlas.<sup>98</sup>

The strongest evidence of long-term climate change effects is found in natural ecosystems. For example, coral reef bleaching in the tropical coastal waters of northern KwaZulu-Natal is increasing,<sup>99</sup> and the geographic ranges and/or timing of migration in migrating wild birds<sup>100</sup> and coastal marine fish species are shifting.<sup>101</sup> Another strongly supported and well-researched trend is the increasing encroachment of woody vegetation (shrub and bush encroachment), possibly enhanced by increased shrub and tree growth as a result of carbon dioxide fertilisation.<sup>102</sup> This encroachment could have major effects on hydrology, livelihoods and biodiversity.

In the agricultural sector, crops sensitive to temperature may have shown early responses to the effects of climate change, but producers have already addressed these by, for example, using shade netting and evaporative cooling, or shifting to alternative crops.

South Africa's Second National Communication under the UNFCCC<sup>103</sup> calculated that extreme events in the country had a financial cost of about R1 billion a year between 2000 and 2009, although it was estimated that this amount could be around twice as high due to under-reporting.

Since then, the NDMC and its provincial nodes have begun gathering and reporting data on the economic and financial impacts of extreme events. Data on a wide range of impacts are available for at least three provinces (the Western Cape, Mpumalanga and KwaZulu-Natal).

#### **4.4 Socioeconomic dimensions of climate change**

South Africa, like other developing countries, is especially vulnerable to climate-related impacts. Sustained warming and increasing rainfall variability over the short term (next decade) will have increasingly adverse effects on South Africa's economy in the absence of effective adaptation responses. A recent Stanford University study suggests that by the year 2100, South Africa's gross domestic product (GDP) may shrink by as much as 66 percent due to climate change.<sup>104</sup> Climate change affects all sectors. For example, increasing temperatures and drying trends will significantly affect subsistence farmers and those dependent on rain-fed agriculture. Similarly, the increasing frequency of extreme weather events is likely to have a disproportionate impact on the poorest in society (rural and urban), amplifying existing social inequalities.

South Africa is particularly vulnerable to climate change because of its dependence on climate-sensitive economic sectors, high levels of poverty and the interrelated impacts of HIV/AIDS.<sup>105</sup> The poor typically have limited opportunities and, consequently, are disproportionately affected by the negative impacts of climate change.

This is especially true as climate change will directly affect the sectors on which the poor are dependent, namely agriculture, biodiversity, ecosystems and water supplies.<sup>106</sup> Individuals need to address the impacts of natural events and disasters, and to increase their ability to recover and adapt to climate-induced effects.

Climate change and development have a dual relationship in that climate change is seen as a threat to many development targets such as the sustainable development goals. The impacts of climate change will often be mediated through interacting development pressures. Indeed, people seldom adapt to the direct impacts of climate change, such as gradual increases in average temperature, decreases in total annual precipitation or greater seasonal variability.<sup>107</sup> Instead, climate change is typically felt indirectly, through wider development processes, such as rising food prices, the spread of disease and illness, and conflicts over natural resources and their management.<sup>108</sup> These indirect impacts are then influenced by a combination of such determinants as age, ethnicity and gender.

At the local level, rendering services (such as potable water, electricity, waste, sanitation and infrastructure services) to communities and ensuring sustainable service delivery remains a challenge. Climate change and climate variability directly impact on the ability of municipalities and cities to meet their service delivery objectives.<sup>109</sup> Recent years have shown important extensions of environmental management mandates emerging in response to policy changes and legislative policies with a focus on environmental management.<sup>110</sup>

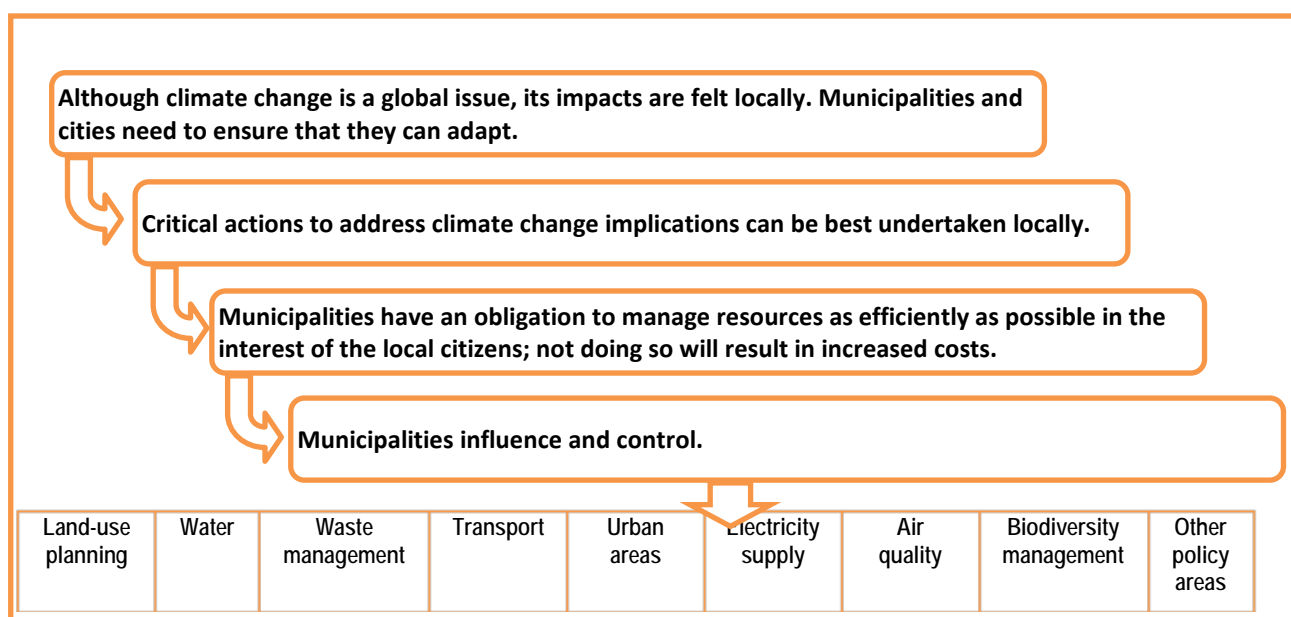


Figure 1: Local government and climate change

The vulnerability of a system (i.e. a settlement or community) may be described as the extent to which the system is exposed and sensitive to negative impacts, and the degree to which the system is able to anticipate, resist, cope with, adapt or recover from such impacts. The existing or projected climate vulnerabilities are specific to the local context and include the regional climate variability, institutional infrastructure and mechanisms in place, available financial resources and capacity to respond timely.

For example, communities may experience increased exposure to raging fires, exacerbated by changes in climatic conditions like extended dry, hot spells and fanned by strong, unseasonal winds, while communities located in a different province may experience extensive floods caused by excessive downpours, sea level rise, aging stormwater infrastructure or inadequate designs to deal with the rate of urban growth and development experienced in recent years. Urban migration is also driven by the impacts of climate change on rural areas, as extended drought leads to repeated crop failure, impacting on livelihoods and resulting in job losses and increased food insecurity.

It is therefore essential to build resilience and enable members of society to adapt to climate-related impacts. As discussed in Appendix B, this can be achieved by reducing the vulnerability of the population (by either decreasing exposure or sensitivity) or by increasing adaptive capacity (strengthening people's ability to cope with change, regardless of change in exposure or sensitivity). For this to be successful, it is essential that a cross-sectoral, integrated approach towards building climate resilience is adopted and that climate change resilience is mainstreamed into economic development planning.

More broad-based resilience through increased education, income and access to services is critical. Without such an effort, sector-based strategies will not bring about the required climate resilience.<sup>111</sup>

## 5. SECTORAL VULNERABILITIES AND ADAPTATION INTERVENTIONS

This chapter outlines the vulnerabilities and proposed adaptation responses in nine sectors: disaster risk reduction and management; human settlements; water; agriculture, forestry and fisheries; biodiversity and ecosystems; health; mining; energy; and transport and public infrastructure. These sectors were selected because of the important role they play in South Africa's economy by helping to support livelihoods, create opportunities for individual and collective socioeconomic upliftment, and provide essential and enabling goods and services. They are also vulnerable to the impacts of a changing climate and are likely to experience detrimental effects in coming decades, with ripple effects on the broader economy if they do not proactively adopt adaptation responses and build resilience to climate change.

It should be noted that the NAS goes beyond the sectors identified previously in the NCCRP to include the energy, mining, and transportation and infrastructure sectors. This broadening of coverage reflects how South Africa's thinking on both mitigation and adaptation has evolved since the NCCRP. Conventionally, sectors such as energy, mining and transport were regarded as central to a mitigation discussion, but less relevant within the adaptation context.

However, as policy and strategic approaches in South Africa become more sophisticated and we better understand the complex interlinkages between adaptation and mitigation, it is clear that broader, economy-wide resilience requires action in all major sectors. Even sectors that have a strong role to play in mitigation are affected by, and need to adapt to, climate change. The collective contribution of these now included sectors to the nation's economy, the value of their assets and operations, and their role in employment is such that it is imperative to support them in building climate resilience.

The NAS's primary strategic recommendation is that all existing sectoral, provincial and local climate change adaptation strategies or plans (and those under development) be fully implemented, operationalised and enforced. For those sectors that do not yet have adaptation strategies, the priority is to develop such strategies (with guidance from the NAS) and implement them. The NAS does not supplant or obviate existing sectoral climate adaptation strategies, which form the core of South Africa's climate change response, but rather emphasises the need for them to be actioned, so as to improve sectoral and cross-sectoral resilience. Taking this into account, the discussions that follow (for nine sectors) should be regarded as providing additional guidance or insights for existing strategies as they continue to evolve and be rolled out.

### 5.1 Disaster risk reduction and management sector

#### 5.1.1 Overall climate change impacts for the sector

The impacts of climate-related disasters are wide-ranging and affect multiple sectors. Climate change thus increases the urgency of integrating risk management into our development interventions and current disaster management approaches, with a focus on being proactive rather than reactive. In relation to climate change, South Africa is particularly vulnerable to droughts, floods, and storm-related events such as high winds, coastal storm surges, and hail, all of which are likely to be exacerbated by climate change. The Long Term Adaptation report in 2015 on early warning systems and disaster management<sup>112</sup> identified a wide variety of socio economic impacts arising from climate change which have the potential to result in disasters, which include:

- Health impacts including mortality due to increased vector borne diseases, pests and pathogens which affect humans, animals and plant diversity.
- Impacts on human settlements which include damage to property, access to basic services, resettlement and forced-migration.
- Impacts of extreme rainfall events on public and private infrastructure, resulting in costly repairs, road closures, limited or no access to electricity, and failure of sewage and storm water systems.
- Temperature anomalies affecting infrastructure sensitive to temperature extremes such as roads.
- Rainfall and temperature impacts on agriculture and food security.
- Extreme weather events affecting tourism and livelihoods that depend on the sector.

- Flooding impacts on water resources including contamination of water, including groundwater, and increasing the threat of acid mine drainage.
- Decreased rainfall and higher temperatures (including heat waves) resulting in water restrictions and increased demand for water and energy for cooling in domestic, commercial and industrial sectors.
- Extreme rainfall impacts resulting in soil erosion, land degradation, loss of ecosystems and ecosystem services, alien species invasion, salinization of groundwater and flood trails containing pesticides and fertiliser etc. In terms of sedimentation related impacts, the impacts of sedimentation on the storage capacity of dams due to changes in climate will differ across the country and are most likely to impact on smaller capacity dams.<sup>113</sup>

The three most significant drivers of climate-related disasters in South Africa are drought, floods and veld fires. Drought affected an estimated 15 million South Africans between 1980 and 2013 – the highest number of people affected by a climate-related disaster in the country. Droughts, which have a slow onset and often extend over a number of years in South Africa, tend to affect more people than those living in the immediate locality and therefore having far reaching impacts. Floods occurring from 1980-2013, have affected about 483 000 people in the country whereas other natural hazards, such as hail storms tend to affect far fewer people.<sup>114</sup> Costs from all disasters above R3 billion a year were incurred in 1987, 2007, 2010, 2011 and 2013, with 2010 and 2011 being the highest, incurring costs of over R6 billion each. It is important to note that the accuracy of these figures is questionable due to difficulty in compiling and verifying data.<sup>115</sup> Damages caused by veld fires also have a significant impact in South Africa, especially in the agriculture and forestry sector. Disasters such as coastal storms also have implications for coastal developments, fishing communities and infrastructure as well coastal biodiversity.

Climate change thus increases the urgency of integrating risk management into development interventions and current disaster prevention and management approaches to reduce the potential impacts of climate.

### **5.1.2 Existing climate change strategies for the sector**

South Africa has an advanced institutional framework for disaster management. The South African National Disaster Management Act (2002)<sup>116</sup> and the National Disaster Management Framework (2005)<sup>117</sup> provide guidance in this regard. The Disaster Management Act, as amended in 2015, refers to climate change and the responsibility of national, provincial and local government to "provide measures and indicate how it will invest in disaster risk reduction and climate change adaptation, including ecosystem and community-based adaptation approaches; develop early warning mechanisms and procedures for risks identified in its functional area; and regularly review and update its plan".<sup>118</sup> This new legislation is important in terms of supporting adaptation through the requirement for providing measures and investment in ecosystem and community based adaptation for DRR-M. South Africa's legislative landscape relating to Disaster Risk Reduction and Management is also guided by a variety of Acts, each of which has a specific role to play to improve adaptation. There is currently no strategy in place for coastal access regarding disaster management. However, DEA's Oceans and Coasts Branch has plans to develop a coastal adaptation strategy.

The branch's research unit is currently conducting coastal vulnerability research, which will be used in the development of the strategy. The focus is vulnerability/adaptive capacity to erosion and flooding or inundation.

### **5.1.3 Responses**

The key response options for the disaster risk reduction and management sector, including the implementation of actions in the sector adaptation strategy, are:

- Finance and staff the national and provincial disaster management centres, including conducting a cost analysis and applying for finance to achieve this objective and identify appropriately qualified staff within metropolitan, district and local municipalities to serve as disaster management focal or nodal points.<sup>119</sup> Coordination between national, provincial, district and local disaster management centres should be ensured.
- Develop further early warning systems to prevent major impacts from climate-related disasters and to strengthen adaptive capacity across sectors extending to areas that do not currently have cover. Strengthening early warning systems improves alignment between climate change impacts and disaster risk reduction and management.
- Prioritise and integrate disaster risk reduction, prevention and preparedness and climate adaptation into local integrated planning and design. This should include appropriate infrastructure design and identification of

development areas, for example outside of flood prone areas and important wetlands. Ensure local knowledge (indigenous) and practices on adaptation, ecosystem-based adaptation approaches and early warning systems are integrated into this planning.

- Enhance integrated drought planning and management to include long term systemic and structural changes as well as physical, ecological and/or engineering solutions.
- Identify and establish short-term drought adaptation options that include developing and making available new drought-tolerant varieties for farmers (seed and livestock) as well as water-wise technologies.
- Complete and operationalise the coastal management guidelines being developed by DEA's Oceans and Coasts Branch as a spatial planning tool to guide municipalities in their land-use developments and in building climate adaptation resilience.
- Invest in disaster risk reduction and climate change adaptation, including Ecosystem and Community Based Adaptation approaches, at a catchment scale such as restoration/rehabilitation of natural systems, removal of invasive alien plants, and rehabilitation of wetlands.
- Create new strategic partnerships between the insurance sector, civil society and government to support innovative insurance mechanisms that build adaptive capacity and allow people to proactively reduce their risk and increase their response capacity. Partnerships should be developed with the insurance industry to assess loss and damage threats, and assess opportunities for international support for loss and damage to these sectors from climate change.
- Maintain and improve infrastructure for resilience (such as stormwater drains, agriculture water infrastructure) for accelerated weathering and deterioration.<sup>120</sup> Other non-climatic issues, such as vandalism, illegal connections and disposal of foreign substances, that affect the longevity of infrastructure, prevent water loss and provide overall climate resilience, also need to also be addressed.
- Support improved fire management and planning at the local and provincial level to control fires within urban and rural areas.

#### **5.1.4 Cross-sectoral implications**

Effective disaster management not only requires collaboration between providers of weather and climate information and early warnings and disaster management structures at a national level.

It also requires collaboration among disaster management and related sectors (especially water, agriculture, fisheries, health, human settlements, infrastructure, transport and biodiversity) and structures at all levels of government i.e. national, provincial and local level, to plan for and respond to climate related risks together<sup>121</sup> both in terms of effective disaster response and proactive disaster risk reduction. There are existing relationships between departments, such as between National and Provincial Treasury, COGTA, DWS and the National Disaster Management Centre around drought management, which needs further coordination and can be strengthened to improve the ability of the country to respond to climate related disaster risks. Other departments and levels of government need to also be included in the governance arrangements, including the Departments of Rural Development and Land Reform, and municipalities to enhance disaster prevention strategies in particular. Ecosystem based adaptation is (EbA) one approach to improving disaster risk reduction as is enhanced infrastructure planning and design, and both of these require significant cross sectoral collaboration. Ecosystem-based adaptation (EbA) includes the sustainable management, conservation and restoration of ecosystems in order to provide better services for people adapt to climate change.

## **5.2 Human settlements: Urban, coastal and rural**

### **5.2.1 Overall climate change impacts for the sector**

South Africa is a diverse country, not just in terms of populations and biodiversity, but also in terms of its human settlements. These settlements face severe challenges, even before climate change is taken into account. The implications of the compounding impacts of climate change will be profound, and human settlements therefore represent a crucial part of national adaptation strategies. The overarching strategic framework for the development of human settlements is described in the National Development Plan (NDP) and, more specifically in relation to the implications for climate change, in the National Climate Change Response Policy (NCCRP). However, to develop appropriate adaptation responses a more nuanced understanding of the challenges and options for human settlements is required, taking into account the unusually

diverse urban forms of human settlement in the South African context, and the importance of ecological infrastructure in supporting service delivery and building resilient communities.<sup>122</sup> Human settlements are vulnerable to several climate change-related impacts (see the table below). Urban settlements with high population densities are exposed to flooding, fires and storms, with implications for damage to infrastructure and people. Coastal settlements are at risk because they are directly exposed to extreme weather events, such as storm surges. Rural human settlements are particularly vulnerable to disasters such as floods, droughts, severe storms and fires because of the increased reliance of many rural households on natural resources to support livelihoods, and to high rural poverty rates. This is often exacerbated by the remoteness of many locations and inadequate transport and communications infrastructure. In urban areas, people living in informal settlements are often most at risk due to the location of the settlements, the difficulties of getting emergency teams into the areas, and the density of the housing.

**Table 4: Specific impacts of climate change on settlements**

OVERALL WARMING	HEAT WAVES AND DROUGHT	STORMS AND RAINFALL WEATHER EVENTS	EXTREME SEA LEVEL RISE
<ul style="list-style-type: none"> <li>Intensified heat island effect in urban areas.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced water availability and water quality issues.</li> </ul>	<ul style="list-style-type: none"> <li>Infrastructure damages and impacts on households, business, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Higher tides and more intense storm surges.</li> </ul>
<ul style="list-style-type: none"> <li>Increased energy demand for cooling.</li> </ul>	<ul style="list-style-type: none"> <li>Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and poor.</li> </ul>	<ul style="list-style-type: none"> <li>Increased risk of deaths, injuries and post-traumatic stress disorders.</li> </ul>	<ul style="list-style-type: none"> <li>Decreased availability of fresh water due to intrusion of salt water into aquifers.</li> </ul>
<ul style="list-style-type: none"> <li>Declining air quality in cities from energy and waste pollution.</li> </ul>	<ul style="list-style-type: none"> <li>Food shortages as crops and livestock die due to water shortages.</li> </ul>	<ul style="list-style-type: none"> <li>Adverse effects on quality of surface and groundwater, and contamination of water supply if infrastructure is damaged.</li> </ul>	<ul style="list-style-type: none"> <li>Increased coastal erosion and damage to infrastructure.</li> </ul>
<ul style="list-style-type: none"> <li>Reduced energy demand for heating.</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of water restrictions.</li> </ul>	<ul style="list-style-type: none"> <li>Large displacement of people and migration to urban areas as infrastructure is damaged and livelihoods are lost.</li> </ul>	<ul style="list-style-type: none"> <li>Impacts on ecosystem services (e.g. mangrove swamps and coastal wetlands).</li> </ul>
<ul style="list-style-type: none"> <li>Reduced disruption to transport due to flooding, hailstorms, ice, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Increased migration from rural to urban areas</li> </ul>	<ul style="list-style-type: none"> <li>Loss of property and withdrawal of risk coverage in vulnerable areas by private insurers.</li> </ul>	

There are many barriers to the adaptation of human settlements (as per the draft Third National Communication), including the need to shift urban planning processes, in particular the current system of municipal financing, investments in ecological infrastructure and design standards.

### 5.2.2 Existing climate change strategies in the sector

The Department of Rural Development and Land Reform developed an adaptation strategy for rural human settlements in 2013<sup>123</sup>. there is however no current strategy specific for adaptation in urban settlements except for the Integrated Urban Development Framework and Implementation Plan (IUDF) but does not specifically talk to adaptation. DEA's Oceans and Coasts Branch is planning to develop a coastal adaptation strategy, which will link to the NAS.

### 5.2.3 Responses

The key response options for the sector, including the implementation of actions in the sector response strategy, are:

- Utilise the enabling framework of The Spatial Planning and Land Use Management Act SPLUMA and The Integrated Urban Development Framework (IUDF)<sup>124</sup> to provide guidelines for adaptive and integrated human



settlements. There is a national coordinating forum dealing with SPLUMA implementation and this should support climate change integration and implementation of guidelines.

- New cross-sectoral approaches should be designed to ensure that the new design, location and implementation of all human settlements is adaptive. There are many opportunities for location and design of settlements where ecosystems and development work together to create more resilient, communities that have access to adequate services and that also promote the health and wellbeing of communities. This will require looking at aspects such as design, orientation, selection of materials, spacing and greening and guidelines should be developed to guide implementation of these approaches, building on the "Green book" settlements design guidelines for adaptation currently under development by CSIR. An example could be to climate proof all the new Strategic Infrastructure Projects (SIPS).
- Develop guidelines for and implement retrofitting of existing housing settlements to build adaptive capacity, including for example through, rain water tanks, composting toilets etc.
- Design and develop new systems for municipal finance, which allows for access to finance that supports appropriate investment in human settlements that are resilient to climate change.
- Integrate Ecosystem-based Adaptation within human settlement development, in rural, urban and coastal settlements to enhance resilience and support livelihoods and health. Develop and implement public programmes and activities for these such as: installing green roofs, increasing urban vegetation, etc.
- Identify and implement decentralised energy, water and wastewater systems in rural and urban settlements that are more resilient to projected climate change impacts.
- Develop or enhance approaches and programmes (including Expanded Public Works programmes) to ensure rural livelihoods are enhanced secured and which may also assist to manage migration to urban areas. The Integrated Urban Development Framework (IUDF) also prioritises the importance of strengthening the urban/rural linkage which should be addressed.
- Coastal settlements should regulate shorelines at risk and implement their shorelines and coastal management programmes as per the Integrated Coastal Management Act. Enforcement is needed to regulate seashore development, NEMA regulations and Coastal Management Lines.
- Build local adaptive capacity within communities to understand the implications of climate change and the role they can play in building resilience.

#### **5.2.4 Cross-sectoral implications**

The above responses indicate the importance of cross-sectoral collaboration between departments responsible for settlements and agriculture, biodiversity and ecosystems, health, disaster risk reduction and management and water. Many trade-offs will, however, be required, such as between growth development and infrastructure needs for human settlements versus water requirements and biodiversity conservation. This might result in conflict, especially where there is migration from rural to urban settlements putting potential pressure on resources. Ensuring a balance between a focus on disaster risk reduction and proactive adaptation versus response measures and disaster management after the event is crucial.

### **5.3 Water**

#### **5.3.1 Overall climate change impacts for the sector**

Water is a key economic driver, which underpins economic activity in other sectors (such as agriculture, industry, fisheries, forestry, human settlements etc.) Water is also the primary medium through which the impacts of climate change are going to be felt in South Africa.<sup>125</sup> Climate change will change the availability, seasonality and timing, volume and quality of water available, which has implications for water users across all sectors.

Previously, South Africa assessed the observed and projected impacts of climate change on the country's water resources by studying impacts in each of its six water-based hydro-climatic zones (the Limpopo, Olifants and Inkomati basins; the Pongola-Uzimkulu region; the Vaal River system; the Orange River system; the Mzimvubu-Tsitsikamma region; and the Breede-Gouritz and Berg-Olifants basins).<sup>126</sup>

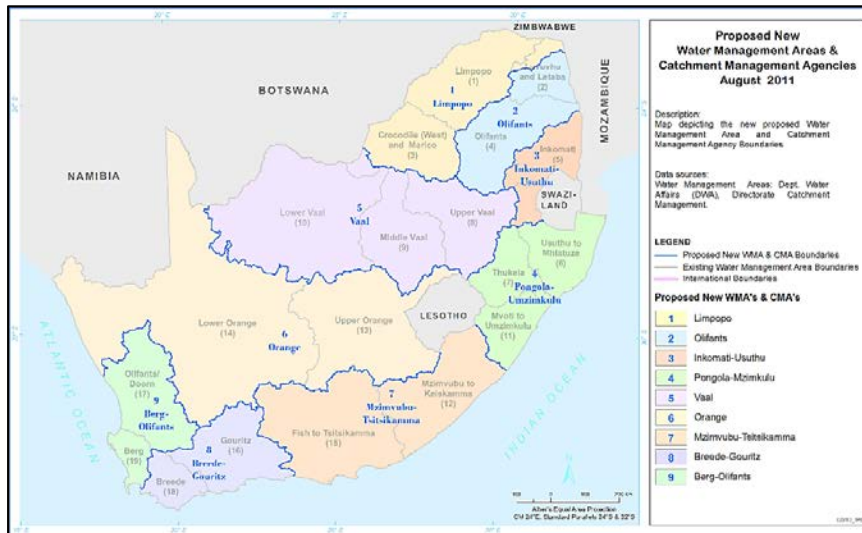


Figure 2: Water management authorities in South Africa

Presently, however, South Africa's Department of Water and Sanitation is realigning its climate change strategy towards the country's nine water management areas (WMAs) for greater clarity on implementation and to capacitate catchment management agencies on the adaptation responses needed within their jurisdiction to combat the effects of climate change.

While detailed new studies identifying climate change impacts on water resources within each WMA are yet to yield results, what is clear is that South Africa's water resources are going to face the consequences of climate change.

Hydrological regimes are likely to shift due to changes in temperature, precipitation (location, timing and volume), and evaporation. Changes in rainfall result in amplified hydrological impacts; for instance, it is estimated that a 10 percent reduction in rainfall will lead to a far greater reduction in water availability.<sup>127</sup> Specific areas of high risk have been identified, such as the south-west of the country (Berg-Olifants WMA), the central-west region (Vaal and Orange WMAs) and some parts of the extreme north (Limpopo and Olifants WMAs).<sup>128</sup> Changes in runoff, in particular, pose a major challenge for South Africa.

While climate models display a level of uncertainty (ranging from a 20 percent decrease in a dryer future to a 60 percent increase in a wetter future), the impacts of change are nevertheless very serious.<sup>129</sup>

Expected impacts include (but are not limited to):

- Increased erosion and sedimentation, causing loss of fertile topsoil and reductions in the fertility and quality of agricultural produce as well as disruptions in aquatic ecosystems.
- Increased transportation of water pollutants (salts, nutrients, sediments and hazardous substances/chemicals, among others) through surface water, groundwater and soil systems, resulting in human health risks, contamination of drinking water, impacts on ecosystem health and aesthetic impacts on water resources.
- Increased flooding or drought, resulting in loss of life, livelihoods and assets; damage to infrastructure; contamination and/or limitation of water supplies; loss of crops; and community displacement.

### 5.3.2 Existing climate change strategies in the water sector

The Department of Water and Sanitation is currently developing a Climate Change Response Strategy for Water Resources in South Africa. This strategy is expected to be ready by 2017. However, many of the principle tenets of the new strategy are likely to remain aligned with a previous version of the strategy developed in 2012. Most critically, the new strategy is expected to reflect key priorities articulated in 2013's second edition of the National Water Resource Strategy (which includes a discussion about managing water resources for climate change).<sup>130</sup>

### 5.3.3 Responses

The key response options, including the implementation of actions in the sector response strategy, are identified as follows:

#### *Water Governance Strategies*

- **Adaptive Governance and Institutions:** Ensure that institutions responsible for water resources management in South Africa incorporate adaptive management responses in the development of their strategies (e.g. catchment management strategies developed by Catchment Management Agencies), so that they are able to respond to changing conditions. The engagement of stakeholders in the development of these strategic approaches will provide important support in enabling such adaptive management approaches.
- **Intra and Inter Departmental Coordination:** Strengthen coordination of climate change related activities within various line-functions of DWS, as well as to improve coordination between different National Departments, as well as across provincial Departments and municipalities. In particular, a more cohesive approach is needed between DWS and other Departments to preserve and improve water quality, reducing damaging impacts from various sectors.
- **Transboundary Cooperation:** Strive towards transboundary agreements that enable adaptive response. These international arenas are complex and require sustained and committed engagement by all member states. DWS should work closely with SADC, the various member states, as well as the National Planning Commission to develop shared water solutions in SADC, that support sustainable development in the context of climate change.

#### *Water Infrastructure Development, Operation, and Maintenance Strategies*

- **Assurance of Water Supply:** Adopt a low or no regrets approach with regards to decisions about water infrastructure, in the context of climate change, to balance socio-economic considerations with ecological considerations.
- **Infrastructure Safety:** Address the issue of climate change impacts in the Asset Management Plans of all water sector institutions managing water infrastructure.

#### *Water Management Strategies*

- **Reconciliation Studies:** Integrate climate change into reconciliation studies. This will help ensure that approaches to manage water demand and supply are determined within the context of climate change, and at a system-wide level.
- **Water Allocation:** Integrate intra and inter-annual variability in water resources, due to climate change, into water allocation tools.
- **Integrated Water Resources Management (IWRM):** Strengthen and expand IWRM to better integrate climate change considerations, particularly at different spatial scales. Integrate ecosystem-based approaches into IWRM.
- **Ecological Reserves:** Integrate climate change into reserve determination methodologies, informed by steadily improving science.
- **Groundwater Assessments:** Conduct robust assessments to identify how better use of groundwater (including artificial recharge) can strengthen climate change resilience in South Africa.
- **Catchment Management Strategies:** Provide guidance to CMAs on integrating climate change considerations in the Catchment Management Strategies that will articulate how the water resources within each WMA will be adaptively managed.

The Department of Water and Sanitation's new climate change sector strategy for water, currently under development, will supplement the priority strategies indicated above.

### Local government actions on water sector adaptation strategies

Local governments in South Africa have to fulfil their mandates as water service providers and authorities. This makes climate change a significant challenge for them. A few municipalities have started to develop or have put in place climate change adaptation plans, frameworks or strategies that include responses for the water sector, e.g. Bergriver, Thulamela, Kwadukuza, Mbombela, Mogale City and Sol Plaatje among local municipalities; West Coast, Eden, Chris Hani, Amathole, uMgungundlovu, Vhembe, Nkangala, Alfred Nzo, West Rand, Bojanala Platinum, Capricorn, Namakwa and Mopani among district municipalities; and Cape Town, Johannesburg, Durban Tshwane, Ekurhuleni, Mangaung, Buffalo City and Nelson Mandela Bay among metropolitan municipalities.

#### 5.3.4 Cross-sectoral implications

Given the reliance of South Africa's different economic sectors on water, all water-sector strategies have implications for other sectors. Some of these linkages are complementary; for example, the removal of alien species by DEA to protect biodiversity will likely have a positive impact on the ecological health of the country's water bodies, enabling them to be more resilient. Similarly, improved integration of climate change into catchment management strategies will likely make catchment areas more robust, which could provide opportunities for the forestry sector (through afforestation programmes, which themselves could enhance climate adaptation).

However, some of the cross-sectoral linkages could involve negative trade-offs; for example, strengthened catchment management strategies could mean greater short-term constraints on agricultural activity within watershed areas (offset in the long term by greater security of water supply overall, despite climate change), which has implications for food security. Industrial activity could also face some constraints as a result of water conservation and management efforts, unless they in turn adapt and increase efficiency.

## 5.4 Agriculture, forestry and fisheries

### 5.4.1 Agriculture

#### Overall climate change impacts for the agriculture sector

*Potential impacts of climate change on food production, agricultural livelihoods and food security in South Africa, are significant national policy concerns, and are also likely to have implications beyond the country's borders. Overall, many agricultural sub-sectors are sensitive to projected climate change. Certain crops in South Africa are more resilient to climate change, while others are more sensitive. Similarly, climate change impacts for some crops are projected with more confidence than for others. Additionally, much of the food production and food security which may be at risk is linked to future projected water supply constraints, declines in water quality and competition from non-agricultural sectors.*

*There is evidence that subsistence dryland farmers are more vulnerable to climate change than commercial farmers, while large-scale irrigated production is probably least vulnerable to climate change, conditional upon sufficient water supply for irrigation being available."<sup>131</sup>*

In May 2016 the United Nations National Assembly highlighted the importance of sustainable rangelands for the livestock sector in order to maintain and restore healthy ecosystems in the face of climate change, and the importance of these rangelands for carbon sequestration benefits.

Climate already limits agricultural activities and predicted climate changes will have further, significant impacts on the agricultural sector in South Africa. There are however opportunities for new technologies and techniques to overcome some of the expected impacts arising from temperature increase, enhanced evapotranspiration, enhanced cold spells, water quality and quantity changes and flooding. Results from recent LTAS reports<sup>132</sup> show the potential impact on dry-land crop yields are mixed with some crops showing an increase in yields, while others show a reduction in potential yields. Some spatial shifts in optimal growing regions as well as impacts on yields are likely by mid-century for field crops such as wheat, barley, maize, sorghum, soybeans and sugarcane; pasture/rangeland grasses such as *Eragrostis curvula* and Kikuyu (*Pennisetum clandestinum*), horticultural crops such as apples and pears; viticulture crops and major commercial forestry

trees such as eucalyptus, pine, and acacia.<sup>133</sup> Projected climate change-induced effects on plant and animal diseases and insect distributions could also adversely affect both crop and livestock production, and animal health.<sup>134</sup> [Add in picture on showing the changes in maize distribution due to changes in climate and maps on some impacts for agriculture]

Of particular importance is the likely reduction in the total average annual yields of maize and wheat (around 3.5 percent and 4.3 percent respectively) for the median impact scenario by 2050. There is, however, a very wide range of potential impacts, from a worst-case 25 percent reduction in the total average annual maize yield to a possible increase of 10 percent under some very wet scenarios. It is also possible that some of the climate scenarios could decrease the ability of households to engage in agricultural production as an additional source of food. The areas most affected by reduction in maize and wheat yields include Water Management Areas of the Olifants/Doorn and Berg Rivers in the Western Cape.<sup>135</sup> There could also be localised impacts for farmers dependent on these commodities. Impacts on rangelands systems include water provision, potential woodying, increases in wildfires, changes in invasive species, heat stress, livestock diseases and grazing potential for livestock. Food access is a major constraint at household level and the situation is further compounded by the fact that at household level South Africa remains highly vulnerable to food security. Food supply stability is influenced by food price fluctuations. Food utilization is affected indirectly by food safety hazards associated with pests and animal as well as human diseases.<sup>136</sup>

In addition, overgrazing exacerbated by increased flooding due to climate change may result in higher rates of soil erosion, affecting ecosystems and livelihoods based on livestock production, as well as increased siltation of irrigation dams and canals.<sup>137</sup> Increases in the number of days humans experience thermal discomfort have been projected over South Africa under future climate scenarios with serious implications for the productivity of agricultural labour, especially in summer and with multi-year crops.<sup>138</sup> Impacts on biofuels need further investigation but canola has been identified as vulnerable.<sup>139</sup> These impacts of climate change will exacerbate current pressures on agriculture arising from land degradation, population increase, increasing demand for agricultural resources, and loss of agricultural land to expansion of municipal and other sectors.

#### Existing climate change strategies in the agriculture sector

In 2013, the Department of Agriculture, Forestry and Fisheries (DAFF) developed a Climate Change Sector Plan.<sup>140</sup> The plan was developed to address vulnerability assessments, mitigation, adaptation and institutional arrangements. DAFF is currently developing a climate change adaptation and mitigation plan for the agriculture, forestry and fisheries sectors.<sup>141</sup> DAFF is also developing a sectoral cold spell management plan that aims to reduce the vulnerability of farmers to more frequent and extended cold spells, which will be exacerbated by climate change.

#### Responses

The key response options for the agriculture sector, including the implementation of actions in the sector response strategy (including the draft), are identified as follows:

- Ensure that land and agricultural policy and legislation increases resilience of land users, natural resources, and biodiversity to climate change, and supports food security is implemented and enforced. This includes policy and legislation relating to spatial planning, veld and livestock management, and conservation and development of agricultural resources, which should also align with current strategies developed by DAFF on climate change.
- Integrate climate change into land reform processes, including building on platforms such as Operation Phakisa, which aims to support sustainable land reform which contributes to agrarian transformation and improved land administration and spatial planning for integrated development in rural areas.
- Implement more efficient Climate Smart Agriculture and Conservation Agriculture practices. The three pillars of Climate Smart Agriculture (CSA) are increasing productivity and incomes; enhancing resilience of livelihoods and ecosystems; and reducing / removing GHG emissions and increasing Carbon sequestration. The CSA approach

combines policy, technology and financing to achieve sustainable agricultural development under climate change, it directly incorporates climate change adaptation and mitigation into agricultural development planning and investment strategies and its practices require scaling up which is facilitated through institutional and governance mechanisms.<sup>142</sup> It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges, and includes the agriculture, forestry and fisheries sectors. Training on CSA at all levels, including the development of knowledge platforms and ways to integrate indigenous knowledge into CSA, needs to be provided to support this implementation. Conservation agriculture refers to resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while conserving the environment. Conservation agriculture should be included with CSA as part of training and knowledge management for implementation. Carbon sequestration benefits should also be explored and maximised as part of these approaches. Low-carbon agriculture case studies, including renewable energy, should be developed for further upscaling.

- Develop systems to support food production and security. This response should include building on existing programmes such as the Agriparks project (focused on food security, resourcing small towns with infrastructure and funding farmers close to the hub) and other CSA and permaculture programmes nationally in order to support food security. Climate-proofing food and agriculture processing should form part of these approaches.
- Use and manage water sustainably. Enhancing water availability through adaptation options that consider sustainable water use and management (also included under EbA, conservation agriculture and CSA practices) is an important strategy for increasing agricultural productivity and securing food security in South Africa. Collaborative integrated catchment management also improves water resources and supports job creation. Ways to integrate these approaches need to be further explored.
- Develop effective early warning systems for farmers to help prevent disasters. The capacity to adapt to climate change is unevenly distributed across and within the agricultural sector. Several barriers to effective climate and disaster risk management and adaptation exist. These include a lack of accessible and reliable information and early warning which should be addressed.
- Integrate Ecosystem and community-based adaptation practices, where feasible. In addition to EbA, Community-based adaptation is an important component of the larger scope of adaptation to climate change impacts and pressures by local communities, and these approaches should be embedded in agricultural programmes and activities where possible. Examples include improved grazing management for rangelands and livestock production and restoration to enhance soil stability. Regulation measures need to be strengthened to improve this protection of natural resources.
- Build resilience in rangeland farming. Enhancing incentive mechanisms to support landowners to manage their rangelands sustainably and support healthy livestock will provide for more sustainable production and allow farmers to access more formal markets. It will also help support informal stewardship approaches to conserving our natural resources in future. The UN resolution on the importance of rangelands and grasslands advocates this by supporting economic growth, resilient livelihoods, freshwater availability, soil and biodiversity conservation, and carbon sequestration, which signifies the importance of rangelands for adaptation. Programmes for building resilience in rangeland farming should build on existing mechanisms such as DEA Natural Resource Management Land User Incentives programmes and platforms such as Operation Phakisa.
- Build and expand capacity in extension support, especially to small-scale, smallholder and commercial farmers, with climate-smart, ecosystem-based approaches. In order to expedite adaptation to the added uncertainties of climate change farmers need efficient and informative agricultural extension services to provide advice on how to adapt for climate variability and change. These services need to be strengthened in number and capacity and should include guidelines specific for adaptation, (for example on how to deal with heat stress for livestock).
- Expand tree planting and food garden programmes, building current efforts, to help reduce food insecurity and hunger and establish food markets at various transport hubs, which will enable farmers/producers to supply local communities.

#### Cross-sectoral implications

Cross-sectoral adaptation approaches as highlighted above, can provide both mitigation and adaptation benefits such as implementing sustainable crop, livestock and rangeland management which also provides for carbon sequestration benefits as well as potential decrease in emissions. The agricultural sector will need to work closely with sectors involved in integrated development and land use planning, local economic development; mining, disaster management, biodiversity and water in order to ensure adaptation responses are appropriate and not maladaptive. Ultimately, there needs to be a balance between agriculture and other sectors so that agricultural land is preserved to the extent that ecosystem services, especially water and biodiversity, can support agricultural production and other sectors also are able to develop in the face of a changing climate.

## **5.4.2 Forestry**

### Overall climate change impacts for the forestry sector

There are two different elements to the forestry sector – one pertaining to the management and protection of natural forests, and the other pertaining to the development and management of plantations, usually of exotic commercial species. Under the possible wetting predicted in some climate scenarios, the total area suitable for commercial forestry plantations in KwaZulu-Natal, Mpumalanga and the Eastern Cape Provinces could increase over the eastern seaboard and adjacent areas.<sup>143, 144</sup> However, such scenarios are not guaranteed, and the sector is not protected from vulnerability to potential climate change impacts including: changes in growing conditions; increased vulnerability to fire due to hot and dry conditions and increased lightning strike potential from storms; increased survival and spread of insects and pathogens directly impacting forest ecosystems; and an increase in the spread of invasive species impacting on biodiversity. While there may be possible positive carbon dioxide benefits for enhanced growth of forest ecosystems, this requires more research.

Climate change will also impact on the distribution of the Natural Forest Biome. This biome only covers 428 000 hectares of the country's total land surface. Drier conditions as well as future development may lead to a reduction in the land area covered by the biome and every effort to conserve this is critical. It is predicted that woodlands, which are currently extensive at around 40 million ha, will further expand within savannah and grassland biomes which could have negative impacts on the ecology of these systems but this needs to be researched further and approaches established to control this.

### Existing climate change strategies in the forestry sector

Building on DAFF's 2013 climate change sector plan, DAFF is currently developing a climate change adaptation and mitigation plan for the agriculture, forestry and fisheries sectors,<sup>145</sup> which highlights adaptation approaches for the sector. There are no other specific adaptation strategies for forestry of all types.

### Responses

The key response options for the forestry sector, including the implementation of actions in the sector response strategy, are identified as follows:

- Develop a specific forestry sector climate change adaptation strategy, building on the climate change mitigation and adaptation plan for the agriculture, forestry and fisheries sectors that would look at natural forest, woodlands and commercial plantations.
- Develop community based- small, medium and micro-sized enterprise development to restore and protect natural forests whilst supporting livelihoods.
- Use the results of available local risk and vulnerability studies to identify climate resilient land-uses, which would need to consider natural forest protection and management.
- Reduce impacts on natural forests such as high dependence on these natural resources within rural areas to restore their ecological integrity and improve the communities resilience to climate change.
- Integrate CSA and EbA approaches into forestry practices for natural forests, and woodlands. These approaches should focus on protecting and restoring natural forest, which is the smallest biome and constantly affected by land-use changes. They should also look at the impact of climate change on woodlands species and their impact on other biomes such as savannah and grasslands, and determine the best ecological approach going forward.

Natural forest rehabilitation projects produce job opportunities, such as alien clearing and restoration work under EPWP, and these projects could extend to the management of woodlands depending on further research.

- Identify appropriate areas for commercial forestry activities to prevent inefficient water use, biodiversity loss, catchment degradation, and to minimise climate risks such as fire and optimise mitigation opportunities.
- Use early warning systems to give timely warnings of adverse weather and possibly related pests and disease occurrence within commercial and natural forest systems.

#### Cross-sectoral implications

Trade-offs between biodiversity and forestry will be required if areas of forestry can expand under certain scenarios. We also need to understand the implications of forestry on the biodiversity sector, especially around the potential relocation of plantations. Water use and forestry will also be a potential trade-off area and the implications of expanded forestry on the water sector under climate change need to be understood. Cross-sectoral planning should occur with disaster management, biodiversity, land use planning and water that looks at all the implications of climate change and these cross sectoral approaches included in agricultural extension training and forest curricula.

### **5.4.3 Fisheries**

#### Overall climate change impacts for the fisheries sector

Climate change is likely to affect the productivity and diversity of South Africa's fisheries by changing the distribution and abundance of resources; their habitat, extent, condition and connectivity; their physiology and behaviour; and the catchability of resource species. Changes in sea surface temperature, storm frequency, freshwater flow and runoff patterns, productivity, oxygen levels and wind will all impact on estuarine, inshore and offshore ecosystems, affecting recruitment, fish behaviour and physiology, influencing fish size, and increasing fish mortalities. This could result in significant adverse impacts on subsistence fishing livelihoods as well as commercial and recreational industries. Tropical species may move polewards in response to warming temperatures, resulting in an expansion of the subtropical region. In contrast, temperate regions may contract, with coastal species being affected by changes in upwelling, related extremes in temperatures, reduced runoff and habitat loss, ultimately leading to a decrease in temperate species diversity and abundance. Stocks under intense exploitation pressure are likely to be more vulnerable to the effects of climate change than optimally exploited or underexploited populations. Overfishing may result in reduced genetic variability, which may negatively affect the possibilities of an evolutionary response to climate change and the ability of depleted stocks to recover. Directional shifts in the spatial distribution of several marine species, which are possibly attributable to climate change trends, have already been recorded around South Africa's shores affecting intertidal, shallow coastal and offshore species.<sup>146</sup>

Two further projected consequences of climate change that could have significant implications for fisheries are accelerated sea level rise and increased frequency of high-intensity coastal storms and high water events.

These events, such as reduced/increased freshwater flow, pose a significant risk to estuarine and inshore fisheries. Reduced/increased freshwater flow, sea level rise and increased storm activity will reduce estuarine nursery habitat, and decreased rainfall may cause temporarily open/closed estuaries to close more frequently, and may even result in closure of permanently open estuaries. On a regional scale, KwaZulu-Natal and West Coast estuaries are likely to be the most affected from a structural and functional perspective. Scenarios of more extreme rainfall and dry spells, coupled with sea level rise, could cause damage to or even the loss of nursery habitats essential for prawns and estuarine fish.

On the other hand, increases in summer rainfall could result in some estuaries like the St Lucia Estuary opening more frequently, with a positive impact on the abundance of shallow water prawns on the trawl grounds, as long as existing water uses in the catchments feeding these estuaries are better managed. For both estuarine and marine species, the positive impacts of increases in rainfall could be offset by seasonal shifts in rainfall that could confuse behavioural cues at critical life-history stages such as spawning or migration. Increased storm activity under a changing climate will have a significant impact on fishing activity by reducing the number of viable sea-fishing days, and damaging shore-based offloading facilities and fishing vessels.<sup>147</sup>

In a recent process undergone by the fisheries sector under DAFF, of the 28 fisheries sectors, 21 were identified as most vulnerable to climate change were: aquaculture; commercial line fish; small scale and net fisheries and small pelagic



fisheries including sardine, and anchovy and round herring. Small scale fishing was identified as most vulnerable within these sectors.

#### Existing climate change strategies in the fisheries sector

In 2013 DAFF developed a climate change sector plan.<sup>148</sup> DAFF partnered with DEA in 2013 to develop LTAS for Climate Change for the fisheries sector.

The fisheries sector has been proactively involved in a project that aims to build resilience to climate change in the major fisheries of the Benguela Large Marine Ecosystem, in compliance with South Africa's commitment to the Benguela Current Commission. These outputs served as a baseline for the initial Climate Change Sector Plan for Agriculture, Forestry and Fisheries,<sup>149</sup> which has now being updated to a Climate Change Mitigation and Adaptation Plan for Agriculture, Forestry and Fisheries.<sup>150</sup> The department is currently implementing the following policies that are important for climate change considerations: the Small-scale Fisheries Policy, which aims to introduce fundamental shifts in government's approach to the small-scale fisheries sector; the National Policy on Extension and Advisory Services, which aims to facilitate the establishment of effective and efficient extension and advisory services; and the National Research and Development Policy, which aims to promote research and innovation in the agricultural, forestry and fisheries sectors.<sup>151</sup> There is also ongoing research around vulnerability and situational analyses.

#### Responses

The key response options for the fisheries sector, including the implementation of actions in the sector response strategy, are identified as follows:

- Finalise, adopt and implement the Climate Change (Agriculture, Forestry and Fisheries) Adaptation Strategy, to ensure sustainable and equitable use of marine resources. This should include the development and adaptation of the 21 fisheries sectors which are particularly vulnerable to climate change, starting with the most vulnerable as identified by DAFF as small scale and net fisheries and small pelagic fisheries including sardine, anchovy and round herring. It is also critical to develop a monitoring unit for these sectors to track adaptation activities.
- Build on Operation Phakisa to ensure that climate resilient Marine Protected Areas are effectively managed. It is anticipated (in DAFF 2013), that Operation Phakisa will be a further platform for increasing the ability of the fishery sector to adapt to climate change particularly regarding MPAs and maintaining genetic potential and ability to adapt to changing conditions.
- Establish credible third-party eco-certification as an incentive for responsible fisheries that can deliver additional socioeconomic benefits through improved market access and security.
- Promote EbA as part of fisheries management and to support resource recovery. The current move towards the Ecosystem Approach to Fisheries Management (EAF) is in itself a generic adaptation measure, since it is designed to build greater resilience in the fisheries sector by securing existing fisheries and biodiversity, and assisting the recovery of impacted resources and whole ecosystems (e.g. by protecting spawning and nursery areas and other essential habitats).
- Enforce action against illegal harvesting of coastal and offshore fishery resources to increase the resilience of natural fish populations to climate change. Current levels of poaching should also be reduced to ensure recovery of key resources and to secure livelihoods of legitimate fishermen and their dependent communities.<sup>152</sup>
- Support small-scale fishermen to be more resilient, including safety at sea mechanisms, early warning systems and building on systems such as the Abalobi<sup>153</sup> approach.
- Line fish management: Target other species, improve catching efficiency and vessel safety, put catches (particularly by-catch) to better use, move to larger vessels and introduce specific management measures to alleviate fishing pressure on the most vulnerable species.  
These include adapting existing marine protected areas and creating new ones, to cater for changes in fish distribution due to climate change, and increasing the adaptability of line-fishing communities by promoting better cooperation among them, and with government, through the new Small-scale Fisheries Policy.

- Manage small pelagic fish: Make better use of present resources, develop fisheries for alternative pelagic species and mesopelagic fish, move to alternative catching methods and larger vessels, and allow for increased uncertainty in abundance and availability in operational management procedures.
- Protect existing fish farms from increased storm activity and rising sea level; control the in-farm environment more effectively; switch to, and/or develop, more climate-resilient farmed species; and improve longer-range prediction of harmful algal blooms and other harmful events and trends, such as ocean acidification.
- Develop and apply municipal planning and decision-making guidelines around coastal activities, especially within 200 metres of the coastline (i.e. establish more stringent set-back lines) to ensure nursery habitats essential for prawns and estuarine fish are maintained and coastal ecosystems are protected to buffer against impacts of storm surges.

### Cross-sectoral implications

Adaptation strategies should centre on sound integrated ecosystem-based management approaches, including integrated coastal management.

Other stakeholders that will need to be collaborated with include integrated development planning and local economic development; disaster management, for climate information and early warning systems; research institutions; the fisheries industry and private sector companies; independent consultants; and NGOs (e.g. the World Wildlife Fund's Southern African Sustainable Seafood Initiative (SASSI)).<sup>154</sup> Trade-offs between economic production, conservation, sustainability, and biodiversity and ecosystem health are critical. This may result in impacts on production and livelihoods where harvesting of some species or certain fishing approaches may be limited. However, if this is done sustainably it can for example result in a healthier ecosystem, allowing for better harvesting and yield in future.

## **5.5 Biodiversity and ecosystems**

### **5.5.1 Overall climate change impacts for the biodiversity and ecosystems sector**

Biodiversity is crucial to ecosystem health and function, and healthy ecosystems are central to human well-being. Healthy ecosystems form the ecological infrastructure of the country and are the foundation for clean air and water, fertile soil and food. All South Africans depend on healthy ecosystems for economic and livelihood activities.<sup>155</sup> Rates of loss and degradation of natural habitat in terrestrial, freshwater and marine environments is very high in many parts of the country and is the primary threat to species loss. The resulting fragmentation of the remaining natural vegetation is a problem for species, especially those that need large areas of natural habitat to survive. Fragmentation also prevents landscape-scale ecological processes, such as fire, from functioning effectively and further impacting on livelihoods.

The national drivers of loss and degradation of natural habitat include conversion to cultivation and overgrazing in terrestrial and wetland ecosystems, invasive alien species in terrestrial and freshwater ecosystems, coastal development in coastal ecosystems, certain fishing activities, such as trawling in marine ecosystems, and mining in all ecosystems. In addition, climate change will exacerbate the existing threat to biodiversity in certain areas.<sup>156</sup> The LTAS report on the Climate Change Implications for Biodiversity<sup>157</sup> indicates that climate change is likely to result in significantly different climate patterns within each of South Africa's biomes by mid-century. This does not mean that vegetation in each biome will change, but does indicate that vegetation in each biome will face major stresses as the favourable climatic envelope for that vegetation type changes. Other changes include the following:

- Areas with an Albany thicket climate envelope may be replaced by Nama Karoo and savannah conditions under the high-risk scenario.
- Many forest areas are likely to be under increasing pressure.
- The desert climate envelope expands substantively under the high-risk scenario, encroaching on current areas of both the Succulent Karoo and Nama Karoo biomes.
- The eastern and northern sections of fynbos are likely to experience climate stress, with the climate envelopes in these areas becoming more like the Succulent Karoo or Albany thicket for all climate scenarios.

- The core south-western portions of the fynbos (especially the mountainous areas) remain within the current biome envelope, but probably with significant up-slope movement of suitable climate envelopes for particular species and habit types.
- The grassland biome appears to be one of the biomes most at risk of significant change under all the scenarios.
- Indian Ocean coastal belt shifts to a savannah climate envelope.
- The climate envelope found in large areas that are currently Nama Karoo is likely to resemble an arid savannah under the low-risk and intermediate scenarios, and a desert climate envelope under the high-risk scenario.
- Although the climate envelope suitable for savannah is likely to expand significantly in the future, and specific savannah species are likely to benefit, this does not necessarily benefit existing habitats and species assemblages.
- Areas with climate envelope characteristics of Succulent Karoo largely persist in all scenarios.
- There is potential for woodying within grassland and savannah ecosystems.

To include map of shifts from LTAS/Biome reports

### 5.5.2 Existing climate change strategies in the biodiversity and ecosystems sector

In 2014 DEA developed a biodiversity sector climate change response strategy,<sup>158</sup> which highlighted adaptation options for the sector and emphasised the importance of EbA as part of an overall adaptation strategy.

Subsequent to the 2014 response strategy, the Council for Scientific and Industrial Research (CSIR) – working with DEA – developed Climate Change Adaptation Plans for South African Biomes, in 2015. In 2015, DEA revised the National Biodiversity Strategy and Action Plan (NBSAP). The vision of the NBSAP is to conserve, manage and sustainably use biodiversity to ensure equitable benefits to the people of South Africa, now and in the future. SANBI and DEA are currently working on an EbA strategic framework and overarching implementation plan for 2016-2021,<sup>159</sup> which includes pilots, research, and mainstreaming and communication of EbA. The plan is also aligned with the NBSAP and should align with the NAS.

### 5.5.3 Responses

The key response options for the biodiversity and ecosystems sector, including the implementation of actions in the sector response strategy, are identified as follows:

- Enforce implementation of all strategies and plans pertaining to biodiversity and ecosystem management such as the Biodiversity Sector Climate Change Response Strategy, Climate Change Adaptation Plans for South African Biomes, the NBSAP, the Ecosystem-based Adaptation Strategic Framework and Overarching Implementation Plan, the National Protected Areas Expansion Strategy, Biodiversity Management Plans for Ecosystems and Species, and the National Action Programme to combat desertification, land degradation and drought.
- Implement EbA under the South Africa biome adaptation plans across all biomes, as well as the EbA overarching Implementation Plan for ecosystem restoration and maintenance and improved livelihoods. EbA supports the inherent ability of ecosystems, including their human inhabitants and organisms, to adapt to climate change, principally by reducing the other stresses which might impede that capacity, and restoring ecosystem function where it has been damaged, thus providing services on which people can depend.
- It is imperative that EbA and biodiversity considerations are integrated into development planning and implementation at the local government level. These approaches should include working with existing national and provincial programmes such as the EPWP and continuing to focus on the removal of alien invasive plants, as well as protecting, restoring and sustainably managing ecosystems. Some district municipalities such as Namaqualand (Northern Cape) and Alfred Nzo (Eastern Cape) have undergone vulnerability assessments, which have also included EbA priority areas maps. These maps are guiding decision-making regarding adaptation implementation in these regions.
- Strengthen institutional arrangements to further develop Expanded Public Works Programmes for building ecosystem and community resilience through the removal of alien invasive plants, restoration of wetlands, controlling wildfires, and other sustainability programmes such as the land user incentives programme. Integrate these approaches into development planning and implementation at the local government level.

- Include provincial and local climate change adaptation response plans in provincial and local biodiversity plans, and include climate change projections in long-term biodiversity management plans. Develop spatial planning approaches that support climate resilience in given biomes, including the possibility of abandoning some land uses completely and introducing new ones.
- Support biodiversity stewardship approaches to extend protected areas and areas under formal or informal conservation. Expand protected areas on private land and promote sustainable land management through management agreements to form corridors (for greater ecological connectivity) that will improve the adaptive capacity outside of state-owned protected areas. The expansion of the protected area network is in line with the National Protected Area Expansion Strategy and relevant provincial protected area expansion strategies, which promote climate resilience.
- Improve nature-based tourism opportunities with multiple benefits for both people and ecosystems, including job opportunities.
- Enhance incentive mechanisms to support landowners along priority catchments, to improve their land management practices in order to protect ecosystems and enhance productivity.
- Develop a biodiversity checklist to ensure biodiversity is included in funding mechanisms in local, provincial and national spheres. This can be done in partnership with government, the National Treasury and the private sector.
- Monitor and control alien invasive species that benefit from climate change to reduce risks of biodiversity loss through the EPWP and other mechanisms.  
This should include improving existing programmes to combat the spread of terrestrial and marine alien invasive species to integrate climate change into decision-making and to link with longer-term benefits for ecosystems and people.

#### **5.5.4 Cross-sectoral implications**

For the biodiversity sector, agriculture and forestry and water represent the most significant areas for cross-sectoral synergies and complementary strategies or response options.

There is potential to gain adaptation benefits whilst mitigating GHG emissions through reforestation and restoration, managing invasive species, implementing climate smart sustainable agriculture and forestry and improved rangeland management practices. Conservation of biodiversity should be seen as a land use and these sectors need to work closely together to ensure for benefits for both sectors. The Health sector should also work in collaboration with agriculture, biodiversity sectors to further understand the linkages between human health, animal health, biodiversity and climate change. This is particularly important within the livestock sector and impact of climate change on particular diseases.

Adaptation responses or interventions in the fisheries sector also have implications for biodiversity and ecosystems. Fisheries that are successfully managed to achieve resource sustainability will be better positioned in the long term to adapt to the effects of climate change. There are potential trade-offs with the biodiversity sector that may be required for example with mining and human settlement/ infrastructure development – however synergies can also be created between these sectors where for example mines/ renewable energy developments take biodiversity implications into consideration. Because the biomes in South Africa are not limited to single municipal areas, a ‘transboundary’ approach with neighbouring municipal areas is required for spatial development and building climate change resilience.

## **5.6 Health**

### **5.6.1 Overall climate change impacts for the health sector**

South Africa faces complex and pressing public health challenges exacerbated by adverse socio-economic conditions including dense informal settlements which constrain effective service delivery. These health challenges include a disease complex with the highest global prevalence of Human Immunodeficiency Virus (HIV) and tuberculosis (TB), complicated by water-borne and chronic respiratory disease. Under-nutrition and socio-economic stress are important contributors to poor human resilience and contribute to conditions that facilitate the emergence and propagation of disease. Malnutrition and disease interact strongly, and there is a key relationship between environmental quality, food security, and the disease burden of communities. Adaptation to the potential effects of climate change on human health is usefully viewed in this

context. However, significant knowledge and information gaps are preventing well supported quantitative projections of human health impacts in South Africa.<sup>160</sup>

The LTAS<sup>161/162</sup> highlight health risks in South Africa that would be aggravated by climate change over the next few decades; including heat stress, which particularly affects the interior of the country;<sup>163</sup> vector-borne diseases such as malaria, which is currently of particular concern in Limpopo;<sup>164</sup> extreme weather events; air pollution; communicable diseases (such as HIV/AIDS, TB and cholera); and non-communicable diseases (such as cardiovascular and respiratory diseases). Those most vulnerable include the elderly and young children; people with pre-existing medical conditions such as hypertension, diabetes and cardiovascular conditions; and people without adequate shelter. Some of the main impacts from climate change are included in the table below.

**Table 5: Climate change impacts expected for the health sector**

FLOODING, WHICH COULD LEAD TO:	DROUGHT, WHICH COULD LEAD TO:	FIRE, WHICH COULD LEAD TO:
<ul style="list-style-type: none"> <li>• Increased or decreased vector (e.g. mosquito) abundance (e.g. if breeding sites are washed away).</li> <li>• Increased risk of respiratory and diarrhoeal diseases.</li> <li>• Drowning.</li> <li>• Injuries.</li> <li>• Health effects associated with population displacement.</li> <li>• Impacts on food supply.</li> <li>• Mental health impacts.</li> </ul>	<ul style="list-style-type: none"> <li>• Changes in vector abundance if a vector breeds in dried-up river beds.</li> <li>• Food shortages.</li> <li>• Illness.</li> <li>• Malnutrition.</li> <li>• Increased risk of infections.</li> <li>• Death (starvation).</li> <li>• Health impacts associated with population displacements.</li> </ul>	<ul style="list-style-type: none"> <li>• Burns and smoke inhalation.</li> <li>• Soil erosion and increased risks of landslides.</li> <li>• Increased mortality and morbidity.</li> <li>• Increased risk of hospital and emergency admissions.</li> </ul>

Given South Africa's significant economic challenges, it is important to also consider the socioeconomic implications of the health-related impacts of climate change. Health impacts on people have huge implications for livelihoods and job losses as people affected by disease are unable to work and potentially face losing their livelihoods permanently. Furthermore, those who work outdoors are exposed to the deleterious effects on occupational health.

Businesses are affected by the death of workers as well as workers off on sick leave, which affects production and income generation. There are also implications as children and youth will not be educated adequately, if they are malnourished or ill.

An increase in diseases and health issues will also impact on the public and private healthcare system, with the spread of vector-borne diseases such as malaria into new areas; the spread of communicable water-borne diarrhoeal diseases such as cholera; and an increase in non-communicable diseases such as respiratory infections. Death and injury from extreme weather events will also put increased pressure on healthcare systems. It is important to note that there are direct correlations between environmental quality and human health. For instance, the City of Johannesburg's Environmental Quality Survey found that in the most polluted areas in the province, townships and informal settlements were among the most severely affected by air, water and noise pollution. The direct impacts on people and property from extreme weather events are significant, including impacts from extreme weather, storms, hail, high winds, floods, drought, fire, extreme heat and air pollution. There are also deleterious effects on mental health, which would be worsened by food insecurity, access to clean drinking water and sanitation, hunger and malnutrition.

### 5.6.2 Existing climate change strategies in the health sector

South Africa has developed a National Climate Change Health and Adaptation Plan 2014–2019.<sup>165</sup> The implementation of the plan will be guided by prevention, community participation, inter-sectoral cooperation and collaboration, synergies between climate change and other public health initiatives, equity and evidence-based planning.<sup>166</sup>

### 5.6.3 Responses

The key response options for the health sector, including the implementation of actions identified in the sector strategy, are identified as follows:

- Convene a national climate change and health committee on a regular basis to plan implementation processes. As part of this, convene a national inter-sectoral committee on water, sanitation and health issues exacerbated by climate change that can look at the development and implementation of cross-sectoral adaptation approaches.
- Develop local climate change and health committees to discuss local issues around health and climate risks, needs and priorities, and support implementation. Community partnerships should also be created with these committees to raise issues and help implement approaches.
- Mandate that national, provincial and local disaster management plans address climate change-related health concerns (such as outbreaks of pests and diseases, and heat stroke and dehydration). As part of this process identify communities that are most vulnerable to climate change health impacts such as floods or heat waves and implement measures to reduce their level of risk including ecosystem and community based approaches.
- Ensure fresh water and clean sanitation services are provided to reduce impacts on health such as water-borne diseases. Water quality tests should be done regularly and made available to the public and monitor and manage the incidence and spread of climate-related water-borne disease vectors.
- Evaluate effective public health interventions for extreme weather events, such as warning systems to reduce the impact of heat waves.
- Develop, design and roll out special working conditions for outdoor workers across a range of sectors to protect against heat-related health risks.
- Equip healthcare facilities to manage climate change-related health impacts by ensuring sufficient medical supplies are available and sufficient capacity is on hand to deal with an increased number of cases of climate-related health conditions (including heat stroke, dehydration, burns, smoke inhalation and respiratory tract agitation, and water-borne diseases like diarrhoea).

#### **5.6.4 Cross-sectoral implications**

It is important to develop cross-sectoral climate resilience approaches with water, disaster management, human settlements, biodiversity, agriculture and other sectors to reduce health impacts resulting from climate change. There will be an increased demand for water, for example, with improved sanitation and access to municipal water systems whereas this water might not actually be available due to drought. There are also synergies with disaster management to ensure minimal health impacts from extreme events, disasters and outbreaks.

Close collaboration between the agriculture sector and health are required to respond and prevent disease. Health and human settlements are closely linked, with better urban planning and design being able to dramatically reduce health impacts.

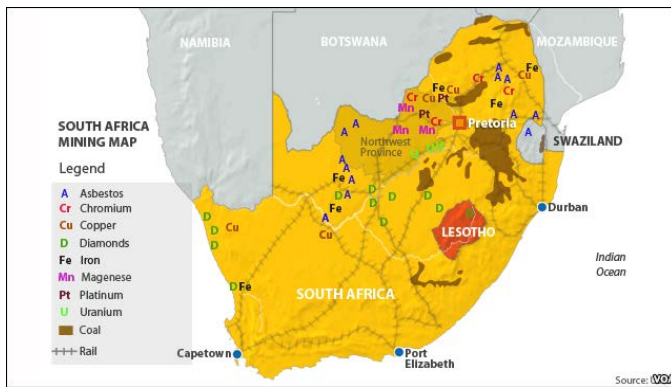
Cross-sectoral collaboration around food production, health and security is critical and would include, for example, the Department of Health working with the business sector on issues such as food storage and transportation. Improving water service delivery will also be able to reduce impacts on health. It is important therefore for cross-sectoral interventions to be considered to promote aligned adaptation responses.

## **5.7 Mining**

### **5.7.1 Overall climate change impacts for the mining sector**

Climate-related risks to the mining sector in South Africa arise primarily from the impacts of climate change on water, as well as the direct impacts of rising temperatures.

Water availability in South Africa is expected to decline as a result of rainfall variability coupled with higher evaporation rates.<sup>167</sup> By 2030, South Africa is likely to face a 17 percent gap between available water and projected demand.<sup>168</sup> This is particularly true of the northern and north-eastern parts of the country,<sup>169</sup> where most mining operations are situated. Mining in South Africa is heavily reliant on water. Recent estimates suggest that between 2.5 percent and 3 percent of the country's water resources are allocated to the mining sector.<sup>170/171</sup> Water insecurity is thus a risk for the mining sector in the short, medium and long term.<sup>172</sup>



**Figure 3: Location of South Africa's mines**  
(Source: VOA News)

In an average platinum plant, for example, 36 percent of the water footprint lies in evaporation from the mineral processing unit, and 19 percent from the tailings storage facility.<sup>173</sup> In the North West province, mining activities are already largely concentrated in the relatively more water-scarce regions of the province.

Water scarcity may potentially lower water availability for the mining industry's operations. In addition, conditions of water stress or scarcity may result in regulatory risks or restrictions on certain aspects of its operations. For example, many mines "dewater" dolomite aquifers in order to safely conduct mining below a certain depth. In a situation of growing water scarcity, such practices may be limited in the public interest. Water scarcity from climate change could also result in further environmental standards for the mining industry, to ensure that it does not negatively affect the water quality of limited freshwater through its discharge of mining waste. Another regulatory risk is a carbon tax, which mining operations must adapt to.

An increase in heavy rainfall, which is likely in the north, also poses risks for the mining industry. More rainfall, especially heavy rainfall events and increased surface runoff, would likely exacerbate the problem of acid rock drainage or acid mine drainage. Flash floods and heavy water runoff can also cause scour in mining areas, as well as heavy erosion within ecosystems and further degradation.<sup>174</sup>

The mining industry is also vulnerable to changing work conditions for mine labourers due to climate change. Rising temperatures may pose health hazards and reduce labour productivity, and worsen air quality conditions within mines.<sup>175</sup> Local communities can also be negatively affected by health and environmental degradation.

The mining sector's vulnerability to reduced water availability is further compounded by its own contribution to the degradation of available water resources, in the form of effluent discharge from mining operations, which causes acid mine drainage.<sup>176</sup>

In addition to its impact on water resources, the mining industry has a huge overall impact on biodiversity. The National Mining and Biodiversity guidelines need to be implemented under a climate change context in order to provide resilience for ecosystems. At present, it does not appear that the Mining and Biodiversity guidelines are implemented with a climate change lens, which is a gap. Communities can also benefit both positively and negatively from mining operations. Even after a mine closes there can be negative consequences for environmental and human health, and consequences of job losses leading to further environmental degradation as people have to consider other livelihoods or impacts on urbanisation, all of which will be further exacerbated by climate change.

### Understanding climate change impacts on mining operations

In 2016, the International Council of Mining and Metals launched an interactive online mining climate assessment tool that enables members to easily access relevant, comparable future climate projection data sets for anywhere in the world. Accessing such data is an important first step in developing and implementing plans that respond to material climate risks that could impact assets and operations. South Africa can learn from these international examples and start to build climate change data into our risk assessment and operations in the mining industry. The council has also published *Adapting to a changing climate: implications for the mining and metals industry*, which provides guidance on developing strategies to adapt to such change. See <https://www.icmm.com/en-gb/environment>

#### 5.7.2 Existing climate change strategies in the mining sector

South Africa's mining sector does not have a climate change adaptation strategy or plan at present. At the national level, the Department of Mineral Resources has a division of Mine Environmental Research and Sustainable Development, which focuses on environmental and sustainability issues more broadly, and climate change falls within their purview.

Under the Water Conservation Demand Management Flagship Programme, the Department of Water Affairs produced a specific water conservation and water demand management strategy for the industry, mining, and power generation sectors.<sup>177</sup> While climate change was not a consideration in this strategy, the water conservation and demand management measures suggested therein are nevertheless useful approaches to reducing the mining sector's heavy reliance on water, thereby serving as potential adaptation approaches.

Additionally, mining unions have become active on the issue of climate change. NUMSA has been vocal about climate change as a threat, and have developed a policy position on the issues.

#### 5.7.3 Responses

The key response options for the mining sector are identified as follows:

- Conduct a sector climate change risk and vulnerability assessment
- Develop a sector climate change adaptation and resilience strategy, taking into account impacts on assets, systems, operations and resources.
- Follow and implement global best practices in climate change adaptation and resilience for the mining sector before, during and after mining operations.
- Take into account mining and biodiversity guidelines when identifying priority areas for extractions to avoid reducing ecosystem resilience to climate change, and adopt environmentally responsible mining development and closure to support ecosystem resilience.

In terms of factors to take into consideration for the development of a sectoral adaptation strategy (i.e. 2, above), the following guidance may be taken into account:

- Work with host communities to develop concrete climate adaptation plans. Mining companies can share scientific information from site planning to inform community preparation, advice on emergency planning practices, and advocate for climate-resilient economic growth with local authorities and development agencies.
- Integrate climate-compatible development into initiatives for sustainable local benefit from project operations. Explore development projects that do not further degrade but restore and maintain natural resources; strengthen community resilience and security; build capacity for sound structural engineering; and develop government planning and emergency response capabilities.
- Communities outside of mining areas should be included in development projects that also support ecosystem services (see below) through corporate social responsibility funding that builds the resilience of these local communities.
- Explore how investments in ecosystem services can improve local resilience, which would also improve the mine site's own resilience. This could include investment in integrated watershed management programmes, improving



local water supplies, and protecting existing sources outside of the project areas, which can help secure the availability of sufficient clean water to meet company and community needs, even in light of increasing scarcity and competition.

#### Local government perspectives

The relationship between mining companies, mining activities and local governments becomes increasingly important for climate change planning. Climate change is likely to affect not just mine operations and the landscapes in which they are located, but also the well-being of mining and surrounding communities. Collaboration between mining companies and local government appears to be lacking. It could well be central if mutually beneficial adaptation strategies are to be developed in the future for the South African mining sector. Infrastructure damage and loss due to extreme weather events is likely to impact on local communities that also use these structures. Increased dust due to hotter, drier conditions, increased use of groundwater in mining activities, and the potential escape of material from tailings dams due to flooding will be of concern to local communities. Biodiversity loss will also impact on local communities. As water becomes less available under future hotter and drier conditions, there is potential for conflict between mining, community and other sectoral users (e.g. agriculture and manufacturing) of this resource.

#### Supporting host communities to adapt to climate change

The mining and metals industry has a responsibility to support its host communities in adapting to climate change. Members of the International Council of Mining and Metals, for example, are working to strengthen the availability of fresh water to communities. The council uses a water stewardship framework to consider water users beyond the boundaries of mining operations. This is based on international best practices and can be extended to areas such as biodiversity or social development. Mining companies do need to engage communities in participatory approaches to help them prepare for and response to the impacts of climate change. (Source: [www.icmm.com/en-gb/environment](http://www.icmm.com/en-gb/environment))

### 5.7.4 Cross-sectoral implications

Adaptation responses that the mining and extractives sector undertakes have linkages predominantly with the water sector, and with biodiversity and ecosystems. Efforts by the mining sector to conserve, preserve quality of, and better manage water resources – in order to adapt to climate change-related water constraints – will improve the country's overall water security.

However, this involves a risk: water sector adaptation programmes that better regulate and conserve water – with a view to dealing with a water-constrained future – would further diminish the mining sector's access to and use of water resources. Implications for the biodiversity and ecosystems sector stem from the possibility that better sited and managed mine operations (resulting from the need to adapt to less favourable environmental conditions through greater efficiency) would also make mining operations more sustainable, and reduce damaging impacts on nearby ecosystems and biodiversity. Again, stronger climate change adaptation in the biodiversity and ecosystems sector carries a risk for mining, stemming from more stringent or restrictive siting opportunities and tighter environmental safeguards.

## 5.8 Energy

### 5.8.1 Overall climate change impacts for the energy sector

South Africa's economy is extremely energy-intensive, largely due to the energy-intensive nature of the country's mining and extractive industries and minerals processing.<sup>178</sup>

Much of the discussion on climate change in the context of South Africa's energy sector centres around mitigation, i.e. reducing GHG emissions from the country's energy supply industry and lowering the sector's contribution to climate change by expanding the role of renewable, low-carbon technologies and promoting energy efficiency.

However, climate change also poses a threat to the energy sector. In recognition of this, Eskom is investigating the impacts of climate change that have a bearing on the country's energy systems and infrastructure, so as to be better prepared and invest in the national utility's resilience.

It has conducted several vulnerability assessments and other studies (including hydrological studies as well as studies looking at extreme weather threats) in association with the University of Cape Town's Climate Systems Analysis Group, the CSIR, and the University of KwaZulu-Natal.

South Africa's electricity sector is dominated by coal. Coal mining uses significant volumes of water in multiple processes, including coal extraction, dust control, coal washing, and slurry dam evaporation. Thermal energy production from coal-fired power plants also requires large amounts of water for plant operations, including for processes like the steam cycle, cooling, air pollution control, and disposal of by-products. Since water is a vital input to the process, Eskom needs a high level of assurance of water supply.<sup>179</sup> Currently, Eskom uses about 2 percent of South Africa's total water for electricity production (water in the coal mining sector is not included in this).<sup>180</sup> In seven seconds, Eskom uses the same amount of water that an average South African household would use in an entire year.<sup>181</sup>

South Africa is already facing water stress in several regions, which will be exacerbated by climate change. Several river basins have seen more water being drawn from them than can be naturally replenished. In order for coal mines and coal-fired power stations to receive adequate supplies of water, these allocations will have to come from other sectors (such as agriculture), and in several cases from areas far away from the power plants, through pipelines and pumps (because the regions around the plants are getting drier). These types of costs are likely to escalate with climate change, due to greater pressures on limited amounts of water.

South Africa's hydropower facilities are also at risk from altered water availability in river catchments and changing flow regimes as a result of climate change. Another form of climate change risk that the energy sector in South Africa faces is the growing risk of infrastructure damage from extreme weather events. This includes more intense and frequent floods, wildfires (bushfires) and extreme droughts. Similarly, in coastal areas, energy infrastructure may be exposed to sea level rise and damage by saltwater.

Impacts of climate change (temperature, rainfall, evaporation, etc.) on energy sector assets has not been studied comprehensively in South Africa, but Eskom has begun commissioning such studies to better understand what climate change means for its operations. Even beyond the direct physical impacts on infrastructure, higher temperatures negatively affect electricity production. The efficiency of power plants decreases in high temperatures, as there are greater cooling requirements. Elevated water temperatures can also be problematic, as warm water cannot be used for cooling purposes.

The efficiency of transmission lines also decreases when ambient temperatures are high, causing power lines to sag or overheat.<sup>182</sup> Other risks to the power sector include flood risk, water abstraction, heat-related damage (and the resultant maintenance costs) and transmission capacity risks (from de-rating, i.e. reducing the amount of electrical current passing through power lines and transformers by lowering voltage, to avoid overheating, but this also reduces system capacity).<sup>183</sup>

Over and above all this, there is the risk of heightened power demand for cooling during more frequent and intense heat waves. Such higher demand would create additional pressure on South Africa's electricity system, which is already unable to cope with existing demand.

South Africa's energy sector is also subject to regulatory risk. Because South Africa's energy mix is dominated by coal (and is thus a major contributor of the country's GHG emissions), South Africa's power generation industry, as well as its most energy-consumptive industries, may be exposed to future international regulatory restrictions or trade barriers designed to disincentivise fossil fuel use.<sup>184</sup>

### **5.8.2 Existing climate change strategies in the energy sector**

Eskom has a climate change policy in place, as well as a climate change strategy. The strategy was developed by 2005, and has since been revised and updated several times. It is, however, an internal strategy that is not publicly accessible and is not available for review by the general public. Eskom has also started addressing climate change adaptation specifically,

and since 2013 it has included a particular climate change adaptation component to its internal strategy. At a broader, system-wide level, Eskom's Resilience Programme commenced in 2014. There is internal recognition that as a provider of essential services, Eskom needs to ensure the continuity of priority business processes regardless of the disruption.

### 5.8.3 Responses

The key response options for the energy sector are identified as follows:

7. Conduct a sector climate change risk and vulnerability assessment (Note: Eskom has one for its operations, but it is important from a governance perspective that the Department of Energy does this for the sector as a whole, at a national level).
8. Develop a sector climate change adaptation and resilience strategy, taking into account impacts on assets, systems, operations and resources. (Note: Eskom has one for its operations, but it is important from a governance perspective that the Department of Energy does this for the sector as a whole, at a national level).
9. Promote Energy Efficiency and lead by example: the government should implement a drive to improve energy efficiency in all state owned buildings – showcase where it works and by how much it saves, then invite the community to participate and help accelerate community uptake of energy efficiency with incentives (such as rebates, tax breaks, and a host of well-tested instruments that global best practice points towards).
10. Integrate climate-resilience and robustness in energy infrastructure: the government should revise building codes to take climate change into account for all future buildings and retrofits, and should collaborate with the insurance industry to “build back better,” i.e. to ensure that reconstruction after damage from a natural hazard results in adaptive infrastructure.
11. Create a more adaptive, dynamic, nimble electricity system in South Africa, to reduce high dependency on a centralized system. Develop and operationalize mini grids, micro grids, and smart grids, and enable more distributed generation;
12. Support the emergence of a more climate resilient South Africa by reducing dependence on coal, and by increasing low-carbon energy.

#### Local government actions on energy sector adaptation strategies

Few cities and municipalities have explicitly developed climate change strategies for the energy sector. A few notable examples are the city of Tshwane (2006), Ekurhuleni (2007) and Sol Plaatje (2009) (Mangaung is currently developing one). Given the role of local governments in South Africa as energy service providers (delivery to customers), climate change adaptation in this sector at the local level is an area that merits greater attention and resources.

#### Helping communities adapt in renewable energy developments

Renewable energy developers have an important role to play in conserving biodiversity in and around their developments as well as helping the surrounding communities to adapt. Conservation South Africa and the Endangered Wildlife Trust developed a booklet that aims to help wind energy project developers to understand the social and biodiversity considerations applicable to South Africa. It also advises on strategic planning for wind energy projects, helps to guide projects in making informed decisions to avoid negative environmental impacts, supports local communities and helps them build resilience to climate change.

### 5.8.4 Cross-sectoral implications

Adaptation responses in the energy sector carry implications for and link with other sectors. A shift away from thermal energy towards more renewable energy (driven by the need to adapt to a carbon-constrained regulatory environment) would have beneficial impacts on the water sector – due to the reduced use of water in coal mining and coal-based power generation (in relative terms, renewable energy has lower water consumptive needs).

Adaptation in the water and ecosystems sectors also have potential linkages; efforts to manage and better maintain catchments – to counteract the impacts of climate change on river hydrology – could in some cases help maintain river flow levels necessary for hydropower generation. It is also critical to note that enhanced disaster management can help reduce climate change risks to energy infrastructure in South Africa.

## 5.9 Transport and public infrastructure

### 5.9.1 Overall climate change impacts for the transport and infrastructure sector

Physical infrastructure (such as buildings, pipelines, roads and railway lines) is vulnerable to the impacts of climate change. The biggest risk arises from physical damage from extreme weather conditions such as flash floods, wildfires and heat waves. Similarly, coastal infrastructure is at risk from sea level rise and storm surges. Even without extreme weather, the shifts in climatic envelopes around an infrastructure asset can cause depreciation and wear and tear, since infrastructure is not usually designed or built with environmental conditions in mind.

Examples of such physical impacts include the buckling and cracking of road surfaces in high temperatures (in some parts of the world, tarred roads have even been known to melt during heat waves), flood damage to roads and bridges during heavy rainfall events, cracks in underground pipelines due to the buckling land around them (plus intermittent expansion and contraction resulting from temperature shifts), and damage to water supply and sanitation infrastructure due to increased sedimentation and scouring due to heavy rainfall.<sup>185</sup>

### 5.9.2 Existing adaptation strategies in the transport and infrastructure sector

The Department of Public Works' Strategic Plan 2012–2016 only mentions climate change once, in relation to its Green Buildings Framework.<sup>186</sup>

However, even the draft Green Building Policy Framework leans strongly towards mitigation, i.e. to reduce the impact of buildings on natural resources, reduce GHGs and operate in more resource-efficient ways, rather than considering how adaptive and resilient green buildings can contribute to more resilient and adaptive societies.<sup>187</sup>

In much the same way, the Department of Transport also has a climate change mitigation strategy in place or in development. Policymakers' attention thus far has been devoted to reducing the transport sector's contribution to climate change, i.e. to mitigation, rather than adaptation, and discussions have not dealt with the impacts that the transport sector will face from climate change or how it can make itself more resilient and cope with such impacts.

Transnet is developing a climate change adaptation and response strategy, and is actively implementing it. This strategy is, in fact, considered a model by other publicly owned enterprises in South Africa (such as Eskom). It can be a useful reference for the Department of Transport as it develops a sector-wide strategy.

### 5.9.3 Responses

The key response options for the transport and public infrastructure sector are identified as follows:

7. Conduct a transport sector climate change risk and vulnerability assessment (Note: Transnet has one for its operations, but it is important from a governance perspective that the Department of Transport does this for the sector as a whole, at a national level).
8. Develop a transport sector climate change adaptation and resilience strategy, taking into account impacts on assets, systems, operations and resources. (Note: Transnet has one for its operations, but it is important from a governance perspective that the Department of Energy does this for the sector as a whole, at a national level).
9. Develop climate change risk and vulnerability assessments for priority public infrastructure assets (based on importance for national socio-economic development as well as asset value) – for (non-transport) state-owned infrastructure this should be done by the Department of Public Works.
10. Invest up front in high quality public infrastructure to ensure long term climate resilience
11. Integrate climate change resilience into local government planning, given that transportation planning and development falls within the local government mandate, to ensure transport systems are climate-robust and help actively strengthen community climate change adaptation.
12. Partner with the insurance industry to identify priority needs and opportunities for climate resilience in the transport and critical infrastructure areas, linked with loss and damage debates.

### Local government perspectives

Extreme weather events place increased pressure on the urban and rural built environment. This can cause damage to infrastructure and resultant problems such as disruption to public water supplies, power outages and public transport delays or cancellations. The economic and social impact of climate change on communities cannot be understated, and the rapid depreciation of transport networks due to climate change impacts has already been identified in the LTAS (2015) as potentially having the most significant economic impact for South Africa. If robust infrastructure is designed and implemented, the upfront cost is high, but reduces over time.

Local government's mandate for service delivery includes the optimisation of public transport connectivity across all scales of the urban network, i.e. pedestrian, motorised and public transport movement. Maintaining an effective public transport system includes maintenance of infrastructure for road, rail and non-motorised transport. In this context, climate change resilience can be improved through optimal spatial planning and transformation of central business districts and urban hubs through effective transport links and activity corridors.

#### 5.9.4 Cross-sectoral implications

Improved disaster management would improve climate change adaptation of transport and other public infrastructure. A move towards more integrated as well as non-motorised transport systems – as a means to create more climate resilience in the transport sector – would also have beneficial implications for the human settlements sector (particularly urban settlements).

#### 5.10 Trade-offs

At least two types of trade-offs will face policy makers dealing with climate change. Firstly, as the climate changes, South Africa will face increasing stress on limited environmental resources that are shared between sectors. How should decisions be made on the future partitioning of such resources? The second trade-off relates to adaptation and mitigation objectives. Which objectives should be prioritised when these are in conflict?

One obvious resource allocation trade-off exists for water, which is already fully subscribed but may see greater supply limitations due to climate change. At the same time, a greater demand for water results simply from population growth and urbanisation trends, and has even further pressing requirements in order to achieve agricultural development aspirations under the NDP. Partly linked to such changing resource limitations, the country may be challenged to adapt and shift its workforce to appropriate sectors of the economy, as identified in integrated assessment conducted under the LTAS Economics Report<sup>188</sup>. This report also identified that investment in new and upgraded infrastructure will also be needed. In all these cases, decisions about trade-offs between sectoral investments of natural, human and financial resources will be necessary.<sup>189</sup> Trade-off decisions between sector aspirations will be required where adaptation in one sector is either unable to strengthen another in terms of its ability to adapt, or even negatively affect this ability. The type of trade-offs required between sectors depend strongly on the climate change scenario that South Africa ultimately faces as identified by the LTAS process<sup>13</sup>. Nexus-type approaches are relevant to addressing such resource allocation issues that are exacerbated by climate change, and particularly between sectors such as Agriculture, Water, Energy (and Mining), and Urban development.

In an attempt to manage the impacts of climate change around water for example there is a risk that South Africa could select interventions that are emissions intensive. This would have implications for how South Africa participates in global emissions commitments. For example, it is reasonable to assume that in a drying world efforts could be made in coastal urban areas to introduce large scale desalination technologies.

While effective in increasing water supply, these technologies are highly energy and emissions intensive. Without a significant focus within South Africa on renewable energy as a power source, this risks 'lock-in' of the use of energy intensive technologies such as coal which has further impacts on biodiversity and water resources and will require additional trade offs.<sup>190</sup> Mining has significant environmental impacts and decision-making in future with further threat to our natural

resources through climate change will need to be guided by what the most appropriate adaptation approach is for South Africa.

Further expansion of the agricultural sector will be required due to population increases and subsequent food demand, this will however also require additional water resources, and may also have emission implications. In certain climate scenarios, this might not be feasible as available water may need to be provided for other sectors such as industry or housing, and strong mitigation needs may preclude the resulting emissions. Land use is an important source of trade-offs in the balance between allocation for carbon sequestration and biofuel production vs food production and biodiversity and ecosystem services considerations.

The land-energy-water nexus will need the appropriate scientifically-based support to find robust solutions to balance these needs and priorities, while also addressing sustainable development and equity imperatives.

Effective adaptation responses are founded on delivering balanced developmental objectives. A healthy, educated and financially secure population, living in a sustainable environment, will be better able to withstand and cope with extreme climate events. Capacitated communities, with access to basic services (water, healthcare and markets) and robust infrastructure will also be better able to recover from such events<sup>13</sup>. These development objectives will require significant infrastructure development.

These infrastructure demands need to also be carefully balanced with our environmental resource requirements and availability. These resources are already challenged but under climate change will be further stressed and competition between sectors for these resources will be exacerbated.<sup>191</sup> Ecosystem based Adaptation approaches can support development and enhance livelihoods as well as protect ecosystem services. In some instances trade-offs between sectoral investments of natural, human and financial resources may be required where development objectives conflict with what will be required in terms of adaptation and new objectives will need to be considered.

In order to be able to establish the specific trade-offs between sectors, discuss potential adaptation response options that support both sectors and determine the best way forward, significant coordination between government departments will be required.

## 6. RESEARCH AND DEVELOPMENT

### 6.1 The science–policy interface

*Effective decision-making to limit climate change and its effects can be informed by a wide range of analytical approaches for evaluating expected risks and benefits, recognising the importance of governance, ethical dimensions, equity, value judgments, economic assessments, and diverse perceptions and responses to risk and uncertainty. This requires high-quality information, which hinges on good research and development.*<sup>192</sup>

Policymakers in any field need strong, credible and easily accessible information to serve as an evidence base for their analysis and decisions. In the same vein, officials administering or implementing programmes or activities also need to understand the rationale behind the interventions they are responsible for, regardless of the field. Climate change is no exception.

Policy on climate change must be evidence-based for it to be both defensible and effective. However, the field of climate change poses some additional complexities in the form of varying levels of certainty in data. Due to the extremely complex nature of the planet's climate systems and the interactions within the systems, climate impacts are not linear and completely predictable in every sense. In several cases, there is less clarity than policymakers would ideally like. However, even in such cases, long-term trends are discernible, and can point policymakers in the right direction, at least enough to choose a pathway of action while better information becomes available.

The availability of ever stronger and more definitive information depends on improved R&D, to produce more rigorous and robust evidence. Within the adaptation context, this includes R&D on the impacts of climate change, as well as on response measures and interventions, to equip policymakers with an understanding of what measures are effective and why.

There is also a concurrent need for climate change science to be communicated in more clear and accessible ways to policymakers. The science-policy interface can allow for constructive engagement only when dense scientific data is translated into actionable information that speaks to the policymaker's area of mandate and responsibilities. Thus, even as more R&D on climate science should be prioritised to strengthen adaptation, making sure available scientific information is grasped by and thereafter used by policymakers is as much of a priority for South Africa. In essence, the emergence of a common language and a community of practice between scientists, policy-makers and those responsible for implementing response measures will ensure a robust response.

### **6.1.1 Prioritising R&D as a strategic priority**

South Africa has existing international legally binding obligations (UNFCCC and the Kyoto Protocol) to develop and support research and the relevant institutions, networks and programmes focused on climate change.<sup>193</sup>

The National Climate Change Response White Paper thus emphasises the need to:

*...prioritise research, systemic observation, knowledge generation, information management and early warning systems that increase our ability to measure and predict climate change and the implications of its adverse effects on the economy, society and the environment, [and] prioritise cooperation, and promotion investment in technologies, practices and processes for employment by various sectors.*

To achieve this, the White Paper recommends:

- Establishing a robust research agenda that quantifies labour requirements for the green transition and on other societal adaptation strategies and needs.
- Establishing incentives for climate change research and training, such as bursaries.
- Encouraging tertiary and research institutions to develop national monitoring, reporting and verification guidelines for a climate-resilient South Africa.
- Promoting further medium- and long-term modelling, and increasing domestic modelling vulnerability assessment capacity by finalising and implementing the 10-year Global Research Plan for South Africa.
- Creating an institutional mechanism to foster climate change-related R&D, such as a Climate Change Science Council. DEA would engage the relevant partners in the Department of Science and Technology, the National Research Foundation, the Technology Innovation Agency and the Department of Trade and Industry.

The Department of Science and Technology identified five key Grand Challenges for South Africa, which, if addressed, will bring about social, economic, political, scientific and technological benefits. These are:

- The "Farmer to Pharma" value chain to strengthen the bio-economy.
- Space science and technology.
- Energy security.
- Science and technology for global change with a focus on climate change.
- Human and social dynamics.

Each of these challenges is designed to stimulate multidisciplinary thinking, and will contribute to South Africa's transformation into a knowledge-based economy by developing human capital, generating new and relevant knowledge, facilitating the establishment of research infrastructure and bridging the divide between research results and socioeconomic outcomes.<sup>194</sup>

### **6.1.2 Research implications for policy**

Climate change has cross-disciplinary and cross-sectoral implications in South Africa. Understanding the concept as well as the options to mitigate it and adapt to it is fundamental to future development pathways and the well-being of South African

society.<sup>195</sup> Consequently, mainstreaming climate change entails moving away from a situation where climate-related objectives tend to be considered as an additional constraint on development policy. To mainstream climate-resilient development, all government departments and state-owned enterprises will need to review the policies, strategies, legislation, regulations and plans falling within their jurisdictions to ensure full alignment with the National Climate Change Response.<sup>196</sup>

Climate policy integration implies acceptance that all sectoral policies must take heed of climate change causes and consequences. Challenges, however, regarding mainstreaming climate change into the policy space relate to a perception that climate change mainstreaming is a constraint to development priorities; the range of existing definitions determining success in mainstreaming; and the highly fragmented environmental policy space into which climate change needs to be integrated.<sup>197</sup>

The LTAS study stated that it is important to support integration of climate change considerations within national planning initiatives such as the National Development Plan, to develop approaches for resource-centric national development planning, as well as to enhance approaches to modelling economically autonomous adaptation responses that are based on flexibility of labour and capital investment.<sup>198</sup>

The implementation of existing policies and programmes, such the National Development Plan, National Water Resource Strategy and Strategic Infrastructure Programmes, needs to be guided by the environmental constraints created by climate change to avoid maladaptive development leading to costly investments in stranded assets and unsustainable land-use decisions.<sup>199</sup>

Additional benefit could be realised by ensuring that all new central planning efforts incorporate a climate change lens. This could help ensure that the risks posed by climate change are identified early and plans made to limit any detrimental impact.<sup>200</sup> In addition, the coordination and alignment of policies and actions is central to achieving climate resilience.<sup>201</sup>

### **6.1.3 Research to create enabling environments**

The chapter on adaptation planning and implementation in the IPCC Fifth Assessment Report identified the following research needs to create and maximise adaptation, and enable the effective implementation of adaptation strategies:<sup>202</sup>

- Research on operational strategies and approaches for adaptation can help maximise available resources for adaptation to climate change, focusing on:
  - Expanding knowledge of the connections between adaptation and development in different contexts and at different governance levels.
  - The role of multiple stresses (not just climate) in adaptation planning and its implementation.
  - The role of low-regret strategies strengthening operational approaches for adaptation.
- An emphasis on climate impacts and defensive infrastructure in a number of early adaptation plans.
- Research on defensive infrastructure, and a better understanding of how early adaptation plans can transcend from defensive but fragmented approaches to multidimensional policy process recognising adaptation planning and its implementation as learning processes.
- Expanding research on institutional arrangements focused on approaches that:
  - Improve multilevel institutional coordination between different political and administrative levels in society, focusing on balancing a combination of top-down and bottom-up activities.
  - Overcome the institutional rigidity limiting the horizontal interplay within local governments, where climate adaptation is seen as the isolated task of a singular sector. This hinders mainstreaming horizontal coordination across sectors and departments, and constrains the extent to which systems can learn or adapt to climate change.
  - Improve coordination between formal governmental and administrative agencies and social and private stakeholders in order to create participatory approaches maintaining regard for the highly localised and contextual nature of climate adaptation, and facilitating collaboration for production of knowledge and interactive learning.
- Expanding research seeking to build a better understanding of the limitations and strengths of planning. Research efforts considering adaptation planning and implementation as learning processes can help in carrying out



periodical adjustments to accommodate changes in climate, socioeconomic conditions and emergent risks in order to strengthen the role of planning as a societal tool for adaptation. The literature recognises M&E as important learning tools in adaptation planning, but also acknowledges that these are under-researched.

- Expanding the research on the metrics to characterise the success of the goals of adaptation, the trade-offs involved, and recognising the importance of context can help avoid generalised assessments about the contribution of adaptation to managing the risks posed by climate change, and to identify what builds adaptive capacity and what functions as limits and barriers to adaptation.
- Research on holistic approaches afforded by linking adaptation to development; by coupling adaptive improvements in infrastructure with ecosystem services, governance and community welfare; by improving community resilience through enhancing local ownership; and by creating organisations able to respond to climate change issues through increased adaptive capacity.

## 6.2 Research institutions

South Africa has several key research institutions that have an interest in climate change-related research. These are situated in Gauteng and the Western Cape. In addition, The South African Weather Services conducts focused research on climate variability and climate change, and several other institutions conduct climate change-related research, often guided by national funding under the National Research Foundations grand challenges and other initiatives, or supported by international funding. Research institutions are encouraged to lead the quest of addressing the research needs of the various sectors in South Africa.

### Key institutions for climate change-related research

- Tertiary institutions (especially those that are home to departments and centres of excellence relating to climate change, environmental sciences and sustainable development).
- All South African scientific and research councils, institutes, and commissions working on climate change related research

### Ad hoc institutions for climate change-related research

- Tertiary institutions from each of the nine provinces other than those that have directly relevant research departments.

Beyond the realm of academia, private sector and civil society organisations already play an important R&D function and synergies and collaborations between academic institutions and these sectors can contribute to the evolution of a climate change R&D community of practice. In addition, scientific knowledge can be enhanced through calibration with indigenous knowledge.<sup>203</sup>

## 6.3 Needs and priorities

### 6.3.1 Sectoral needs

The lack of adequate research is identified as a significant barrier to climate adaptation. To be able to adequately adapt to climate impacts, it is essential that these needs are addressed. The R&D needs and the recommended priority response actions for the various sectors, at national, provincial and local government, are outlined in Annex 3. Importantly, in addition to climate science, R&D should consider the conditions under which government is able to initiate the process of climate adaptation mainstreaming and strengthen relationships with tertiary institutions. Therefore, these response options should not only bring about the most benefits towards climate adaptation, but they should be no-/low-regret research options (as discussed in Annex 2) and should also build resilience.

### 6.3.2 Priority interventions

In building climate resilience and adapting to climate change, it is important to select strategies that are either low-cost and easy to implement, or strategies that are either win-win or no-/low-regret options (i.e. where the investment in the research will result in benefits regardless of the extent of climate change, and would not cause detriment). Similarly, priority interventions for R&D need to be no-/low-regret strategies that also address the gaps identified by the different sectors.

The following priority interventions are recommended in terms of R&D. These priorities respond to the needs identified in this strategy, aim to deepen the understanding of climate risk, and contribute to adequate climate adaptation and resilience building.

**1. Investigate the barriers and institutional constraints to climate adaptation.** Institutions that are responsible for climate adaptation need to have enabling conditions to overcome barriers and institutional constraints. Seizing opportunities, overcoming constraints and avoiding limits, however, can involve complex governance challenges and may necessitate new institutions and institutional arrangements to effectively address multi-actor, multiscale risks.<sup>204</sup> This requires adequate comprehension of the various constraints to adaptation, focusing on issues such as knowledge and awareness, technology, human resources, and institutional and competing values, and issues of a physical, biological, economic, financial, social and cultural nature. Continued development of this knowledge through research and practice could accelerate more widespread and successful adaptation outcomes.

It is essential that **current research is incorporated into policy and influences the decision-making process.** This will enable effective environmental decision-making at all levels, which rests on both improved (and efficient) policies and methods for climate and environmental assessment and management, as well as evidence-based policies that are up to date, relevant and implementable.<sup>205</sup>

**2. Conduct research on climate-related risks, impacts and opportunities for different sectors (at all scales), as well as developing M&E frameworks for monitoring and sharing the changes in climate risks and impacts.** Scientific knowledge on climate change and impacts is increasing all the time, as are practical experiences in responding to adaptation needs. This knowledge needs to be exploited.<sup>206</sup> Such knowledge can be attained from research institutions, NGOs, the private sector and civil society (where indigenous knowledge is manifested through lived experience). Based on the needs identified for each sector (expanded in section 6.3.2), research should be focused on identifying climate-related risks, impacts and opportunities for different sectors (at all scales). The implications of climate change for sectors, particularly key industry value chains, should be further analysed, with particular focus on how local climatic impacts interface with globally integrated supply chains. A specific focus in integrated impacts assessment is urgently needed.

Opportunities arise as actors learn from experience with climate variability and climate impacts. These lessons are incorporated and considered for disaster risk reduction efforts. This promotes learning and adaptive management, and enables the improvement of research and technology options to improve adaptation. An **information-sharing network** will enable a process in which different stakeholders can share and access relevant information in a timely manner.

In addition, South Africa needs a countrywide monitoring system to measure climate variables at scales appropriate to the institutions that must implement climate change responses.<sup>207</sup> The changes in climate risk and impacts should be monitored and shared by an M&E framework.

**3. Explore innovative technical solutions and ways to transfer technology that is focused on building climate resilience.** The development and diffusion of technologies, know-how, and practices for adaptation should be promoted by addressing identified adaptation priorities and building on lessons learned from current adaptation projects and strategies.<sup>208</sup>

While an adaptation option may not be available today or require impracticable levels of effort, in time it may become available through innovation or changes in attitudes.<sup>209</sup> Technology development to support adaptation is critical. This knowledge should also be shared. R&D, knowledge, and technology transfer and generation should therefore be promoted to improve adaptive capacity.

**4. Create an institution (or extend the mandate of an existing institution) that focuses on identifying South Africa's climate research agenda, and also ensures that accessible and relevant information is disseminated to the appropriate sectors.** Providing information does not mean that users will be able to make effective use of it, and this information will often have to be tailored or translated to the individual context.<sup>210</sup>

Information documentation and dissemination are important to ensure different stakeholders take appropriate action to respond to the challenges presented by climate change.<sup>211</sup> It is therefore essential that research is documented and disseminated. To be effective, it is essential that research is tailored to specific stakeholder needs, is shared timeously and is understandable at different scales (e.g. small- scale farmers versus large commercial farmers).

5. **Effectively finance R&D, and create financial incentives to increase skills in climate science and climate adaptation.** South Africa needs to mobilise financial resources to effectively address climate change. To this end, government should use existing financial institutions and instruments and help to develop new ones. This includes international financial assistance specifically for climate change response actions. During the initial period of transition to a climate-resilient and lower-carbon economy and society, government should establish an interim climate finance coordination mechanism to secure the necessary resources for priority programmes.<sup>212</sup> Securing the necessary resources for such programmes hinges on effective communication of the research agenda to the relevant financing institutions.

Successful implementation of adaptation actions depends on the availability of information, access to technology and funding. In some cases a supposed lack of relevant and legitimate information (on scientific, technical and socioeconomic data) has been used as a rationale for inaction.<sup>213</sup> Organisations bridging science and decision-making, including climate services, play an important role in the communication, transfer and development of climate-related knowledge, including translation, engagement and knowledge exchange.<sup>214</sup> In addition, South Africa needs a robust and highly functional climate change science and technology platform to enable the development and implementation of appropriate actions to minimise the negative impacts of climate change on the economy and the people of South Africa. More specifically, South Africa should aim to be a leading supplier of climate change knowledge, technologies and services.<sup>215</sup>

## 7. TRAINING AND CAPACITY BUILDING

Building capacity for climate adaptation involves strengthening the skills and expertise of individuals, as well as relevant organisations. The UNFCCC has emphasised the need to build capacity on the global level related to adaptation. South Africa also recognises this need, indicated in policy guidance instruments such as the NCCRP and the LTAS sector reports, and provincial and even local climate change strategies. There is a strong call for the transdisciplinary skills we will need to ensure robust adaptation responses both within and across sectors, at all levels of government.

This chapter outlines the strategic priorities for training and capacity building, drawing on international trends, on local assessments of the status quo and on identified sectoral needs. In view of these strategic priorities and needs, training and capacity building for adaptation needs to attend to the following focus areas:

- Building capacity and training public sector employees (national, provincial, but particularly local government) with regards to climate change adaptation.
- Enhancing and building on institutions and networks that are already focusing on climate change adaptation planning, capacity building and action responses.
- Seeking out links (within each of the sectors) between the strategic and operational response to climate change.

### 7.1 Global perspectives on training and capacity building

The IPCC has highlighted strengthening institutions and building capacity as priorities in developing countries.<sup>216</sup> It is therefore essential that South Africa addresses issues around the sharing of climate change-related knowledge and proposed capacity-building measures to meet the institutional and technical capacity needs of the various actors. Addressing these needs requires collaboration between the public and private sectors, as well as the existence of an enabling environment.

Institutional learning is an important component of effective adaptation. Both the public and private sector have critical roles in ensuring successful adaptation. Specific capabilities to strengthen operational adaptation approaches include:

- Creating learning processes that incorporate various knowledge systems and experiences.
- Enhancing M&E of adaptation planning and implementation.
- Improving cross-level coordination within government structures at the national, provincial and local levels.
- Enhancing participation of stakeholders in assessing vulnerability and the design and implementation of operational adaptation approaches.

## 7.2 The national picture

### 7.2.1 The National Development Plan

The National Development Plan identifies South Africa's overall climate adaptation needs with timelines for capacitation and pay-offs by 2015 and 2020 respectively.

*South Africa's primary approach to adapting to the impact of climate change is to strengthen the nation's resilience. This involves decreasing poverty and inequality, increasing levels of education, improving healthcare, creating employment, promoting skills development and enhancing the integrity of ecosystems. This strategy requires ensuring that local, provincial and national government embrace climate adaptation by identifying and putting into effect appropriate policies and measures.<sup>217</sup>*

Economic resilience in particular necessitates strong innovative capacity, and a skilled and flexible workforce. With South Africa's systemic shortage of skills and capacity, equipping the workforce with the necessary adaptation skills has the dual benefit of improving skill levels while addressing poverty and inequality.

### 7.2.2 Environmental Sector Skills Plan for South Africa

*The Environmental Sector Skills Plan Systems Documents are aimed at influencing and informing wider skills planning processes in South Africa. They are designed to ensure that the government's Medium Term Strategic Framework goal 'Sustainable Use of Natural Resources' is included in national skills planning and development processes.<sup>218</sup>*

According to the Environmental Sector Skills Plan, there is a need to develop skills related to various drivers associated with climate change. The key drivers are policy, macro-economic, macro-ecological, and new science and technology. The plan details the associated skill sets. The present demand for skills in the environmental sector (which currently encapsulates the largest number of adaptation experts) relate to leadership, scarce skills (e.g. climate change risk assessors and long-range modellers), sustainable development planning and climate change risk assessment, mainstreaming environment into development, and developing and expanding the sector (environmental education and training).

## 7.3 Sectoral capacity needs and priorities

### 7.3.1 Sectoral needs

The sectoral needs assessment provided in Annex 4 indicates that the awareness and mainstreaming of climate change needs to be increased across all sectors. The assessment intends to provide guidance as to capacity gaps and focus areas; it includes the findings of a sectoral needs review<sup>219</sup> carried out by ENS Africa, which identified the adaptation capacity, skills and training needs according to the national policy and planning documents for some sectors, and noted where policies support capacity building. Training and capacity building needs must be viewed alongside R&D needs to ensure that these needs are complementary

### 7.3.2 Priority interventions

In building climate resilience and adapting to climate change, it is important to select strategies that are either low-cost and easy to implement, or strategies that are either win-win or no-/low-regret options (i.e. where the investment in the research will result in benefits regardless of the extent of climate change, and would not cause detriment). Similarly, priority interventions for training and capacity building need to be no-/low-regret strategies that also address the gaps identified by the different sectors.

The following priority interventions are recommended in terms of training and capacity building. These priorities respond to the needs identified in this strategy, aim to raise awareness of climate risk, and instilling a knowledge-based approach to climate adaptation and resilience building.

- 1. Awareness raising and knowledge dissemination with regards to climate change adaptation.** Knowledge sharing events, repositories of information on climate change impacts, climate change forums, and resources that enable spheres of government and sectors to operationalise and respond to climate change are essential.
- 2. Translation of climate science into actionable policies and plans.** Scientific knowledge on climate change and impacts is increasing all the time, as are practical experiences in responding to adaptation needs. However a common language that bridges the understanding between academia, government, civil society, private sector and communities does not yet exist with respect to climate change. Innovative ways of sharing knowledge need to be developed, as climate impacts will continue to be fraught with uncertainty, and communication modalities can be used to aid decision-making in the face of uncertainty. There is also ample opportunity to develop customised climate change decision support through applied R&D.
- 3. Developing key skills in the different spheres of government and within the various sectors.** Technical capacity can be developed within the various spheres of government and within key sector institutions that help build climate resilience and develop risk response strategies.
- 4. Building capacity to mainstream climate change adaptation into planning, programmes and new developments or projects throughout all spheres of government.**  
Funding needs to be allocated toward building this kind of capacity through programmatic approaches, and also through modifying existing curricula at schools and universities. A growing body of best practice experience with building resilience in various sectors and spheres of government can be collated so that such capacity building to be formalised
- 5. Developing a cross-sectoral approach to climate change capacity building, and improving co-ordination between line departments.** A cross-sectoral an approach is particularly important for the agricultural sector and with respect to disaster management planning.
- 6. Obtain further feedback on training and capacity building needs in sectors where this information may be lacking.** The needs of certain sectors such as mining, energy and transport and infrastructure have not yet developed an understanding of their training and capacity building needs, and the input from key players in these sectors must be sought.

Successful implementation of adaptation actions depends on the availability of information, access to technology and funding. In some cases a supposed lack of relevant and legitimate information (on scientific, technical and socioeconomic data) has been used as a rationale for inaction.<sup>220</sup> Organisations bridging science and decision-making, including climate services, play an important role in the communication, transfer and development of climate-related knowledge, including translation, engagement and knowledge exchange.<sup>221</sup>

## **7.4 Provincial and local needs and priorities**

Provincial and local governments face relatively new risks in the form of climate change and need assistance in filtering information down through their various levels of operation. As climate change is not specific to one particular area of these institutions, an entity at the national level should be established to take responsibility for sharing at these levels, and of internalisation processes.

### **7.4.1 Provinces**

Capacity within the provinces needs to be improved in order to implement effective climate change responses. To this end, government needs to:

- Establish climate change-specific units with dedicated staff within each province.
- Build capacity within line departments to roll out adaptation efforts and include adaptation in staffs' daily work.
- Reinforce the role of provincial climate change structures in providing training opportunities and disseminating information in order to build the capacity of both dedicated climate change and line department staff.
- Hold climate change training events to build the capacity of provincial stakeholders.
- Reinforce the role of the national climate change website in providing provincial stakeholders with resources they can easily access for self-study.
- Promote interprovincial dialogue so that provincial line departments can co-build capacity. For example, exchanges between provincial agriculture departments on implementing CSA initiatives.

#### **7.4.2 Local government**

In order for local government to become more climate-resilient, municipalities need knowledge of climate change and its associated risks, impacts and vulnerabilities, and the appropriate adaptation response actions available. For municipalities to be responsive to climate change, integrating and mainstreaming climate change adaptation responses into local government management and intervention programmes is essential.

Building capacity within all spheres of government is needed, as is aligning projects and programmes between local municipalities, district municipalities, and provincial and national departments to ensure efficient and effective use of available resources.

At the local level, training city staff and councillors on climate change should be scaled up. Staff and councillors need to understand why biodiversity management and conservation, and environmental compliance and management systems are important. Municipal staff in the various utility services, such as waste, water and sanitation, and electricity services, will benefit significantly from environmental education and training. Training modules for municipal staff members and volunteers to improve adaptive capacity to weather extremes need to be developed.

Knowing about these tools and concepts will strengthen the collective sense of responsibility, ensure that staff work in a more environmentally sensitive manner and increase their environmental compliance, thus securing the cities' natural resources. Practical information on ways to adapt to (and mitigate) climate change in education and training programmes will help staff to take positive actions.

Municipalities may also consider becoming a signatory to the Global Covenant of Mayors, which requires municipalities to report on climate mitigation and adaptation actions.

The adaptation component of the compact includes a commitment to addressing climate change risks, reporting on hazards, conducting vulnerability assessments and developing an adaptation plan. Training will be required to fulfil these requirements either in-house or through commissioning the work through consultancies, on behalf of the municipality.

## **8. COMMUNICATION, AWARENESS AND KNOWLEDGE MANAGEMENT**

One of the most important enablers of effective strategy implementation is communication. Whether it be communication within key line departments, between departments or between different spheres of government, stronger dissemination of information to relevant actors is a prerequisite for improved coordination. Similarly, better knowledge sharing with stakeholders and awareness-building within key constituencies can help government officials engage in more constructive dialogue with external audiences, once such audiences are empowered with key information. In fact, a desirable outcome of knowledge sharing, outreach and information dissemination is for external stakeholders such as communities to become more involved in supporting and even implementing adaptation responses, thereby becoming strong partners with the government in creating a more resilient future for South Africa.

[Communication section to be finalised following clarity on target audiences and intention; awaiting direction from DEA]

## 8.1 Communication

There needs to be an urgent, efficient and coordinated response to enable mitigation of and adaptation to climate change. The NAS provides the framework for such a response, and this communication strategy serves as a tool to support its adoption and implementation.

This strategy aligns with international and national obligations on communicating climate change. At the international level, it fulfils the obligation set out in Article 6 of the United Nations Convention on Climate Change that addresses public awareness, education and training.<sup>222</sup> At the regional level, it aligns with the communications framework set out in the Africa Ministerial Conference on the Environment's Climate Change Communication Strategy 2010–2012.<sup>223</sup> At the national level, it supports the obligations set out in the regulatory and legislative framework of the National Environmental Management Act (1998), the National Climate Change Response Green Paper (2010), the LTAS and Outcome 10 of the Presidential service level outcomes. It adheres to the guidelines for public communication as outlined by the Government Communication and Information System.<sup>224</sup>

This overview communication strategy aims to outline an effective approach to communicating the strategic elements of South Africa's NAS by national, provincial and local government. It states the strategic principles and objectives of the communication strategy, outlines the context for communicating climate change, provides guidance on how to identify key stakeholders and effective communication channels, and on how to align messaging with particular target audiences. It also provides guidelines to effectively use media and intermediaries. It has been developed in alignment with best practice as set out in the Government Communicators' Handbook 2014–2017,<sup>225</sup> among other international guidelines on communicating on this subject.

### 8.1.1 A framework for communicating on climate change issues

Adapting to climate change rests on new and unprecedented levels of cooperation, innovative policymaking, using novel technologies, grappling with difficult trade-offs, and new ways of thinking and behaviour.<sup>1</sup> Climate change communication plays a vital role in shifting thinking and behaviour patterns. However, communicators face particular challenges in crafting and broadcasting climate change messages:<sup>226</sup>

- The causes of climate change (such as greenhouse gas emissions) are often invisible
- The impacts are seen more significantly in remote areas where people do not live (such as the Arctic or coral reefs).
- There is a general tendency not to believe that human actions can have global impacts. This is compounded by the inherent difficulty in modelling future climate change and determining likely localised impacts.
- The effects are not always felt at the individual level and people are more likely to focus on more immediate challenges, such as feeding their families, getting an education, finding and keeping a job and staying healthy.

There are also few clear signals in the public domain indicating the need for change and the benefits of adaptation are not likely to be felt within the short term. This has implications for how climate change issues are communicated. Communication needs to overcome the traditional way in which we process information and our "apparently deep-seated psychological need to deny and suppress existential threats".<sup>227</sup>

The basic elements for effective communication on climate change issues are:

- **A compelling and unifying framework** [Adapting to build a strong South Africa, for example] that enables people to understand the need for adaptation and encourages behavioural change.
- **Consistent and sufficiently strong messaging** aligned with the principles and priorities of the NAS. Messaging around adaptation must be consistent across all government channels. This includes consistency in the use of particular terms and images to help stakeholders internalise the need for adaptation and direct their actions towards productive adaptation measures.<sup>228</sup> Ideally, all sectoral, provincial and local government communication strategies around climate change or related aspects (agriculture, water, etc.) should be brought into alignment with the national strategy.

- **Clear and accessible language** and a support narrative that portrays climate protection as a socially desirable. Note that the Africa Ministerial Conference on the Environment recommends developing appropriate climate change terminology in local African languages.<sup>229</sup>

According to the United Kingdom Department for Environment, Food and Rural Affairs, communication aiming to catalyse behavioural change rests on enablement, engagement, leading by example and encouragement.<sup>230</sup> Communication needs to enable people with an understanding of how climate change will affect them, educate them on how best to respond and support them via access to current and easy-to-understand information.<sup>231</sup> It needs to engage them in adaptation initiatives and encourage them to involve others to ensure collaborative action against climate change.<sup>232</sup> And it needs to encourage them to make attitudinal changes towards the environment, which results in behavioural changes.<sup>233</sup>

### **8.1.2 The NAS framework and key messaging**

The NAS provides a unifying adaptation framework by linking South Africa's willingness and capacity to adapt in an innovative way with the country's ability to advance and realise the objectives set out in the National Development Plan and attain the Sustainable Development Goals. Such a framework will also guide the conceptual framing of policies and interventions<sup>234</sup> and should clearly link climate change and sustainable development.<sup>235</sup>

National sectoral departments, provincial government and district and local municipalities should use the NAS as a key reference and guide to ensure coordinated and effective communication on adaptation needs and initiatives.

#### Key messaging

**Adapting to build a strong South Africa** has been conceptualised as the key message of the NAS. This message will be central to all NAS related communications during both the strategy development phase and implementation phase. In addition, there are a number of subsidiary messages which reinforce the key message:

**South Africa needs to adapt to climate change:** Sustained warming and increasing rainfall variability over the short to medium term (the next two to three decades) will have increasingly adverse effects on key sectors of South Africa's economy in the absence of effective adaptation responses.

**Climate change threatens development:** The projected adverse effects of ongoing climate change in South Africa are likely to threaten the achievement of urgent national development needs, and well-founded aspirations to address historical inequities.

**The poor are most vulnerable to climate change impacts:** The increasing frequency of extreme weather events is likely to have a disproportionate impact on the poorest in society (both rural and urban), amplifying existing social inequalities.

The poor typically have limited opportunities and, consequently, are disproportionately affected by the negative impacts of climate change.

**The NAS will give South Africa an advantage in the future:** Planning for climate change ensure that South Africa is in a position to leverage opportunities that arise due to changing climatic conditions and enhance its global competitiveness.

**Climate change presents investment opportunities:** New funding flows to support adaptation represent the biggest acceleration of development investment since the achievement of democracy in South Africa. This provides a unique opportunity to both ensure climate resilience and achieve development aspirations.

**Transformational change:** Transformational, systemic change is required to address the challenges presented by climate change.

**The need for integration and collaboration:** Sectoral and integrated cross-sectoral approaches are essential to building societal resilience in a holistic way.

**Linkages between adaptation and mitigation** are increasingly vital. This is because there is an intensified international focus on keeping global warming below 2°C, and therefore adaptation responses need to be cognizant of their mitigation

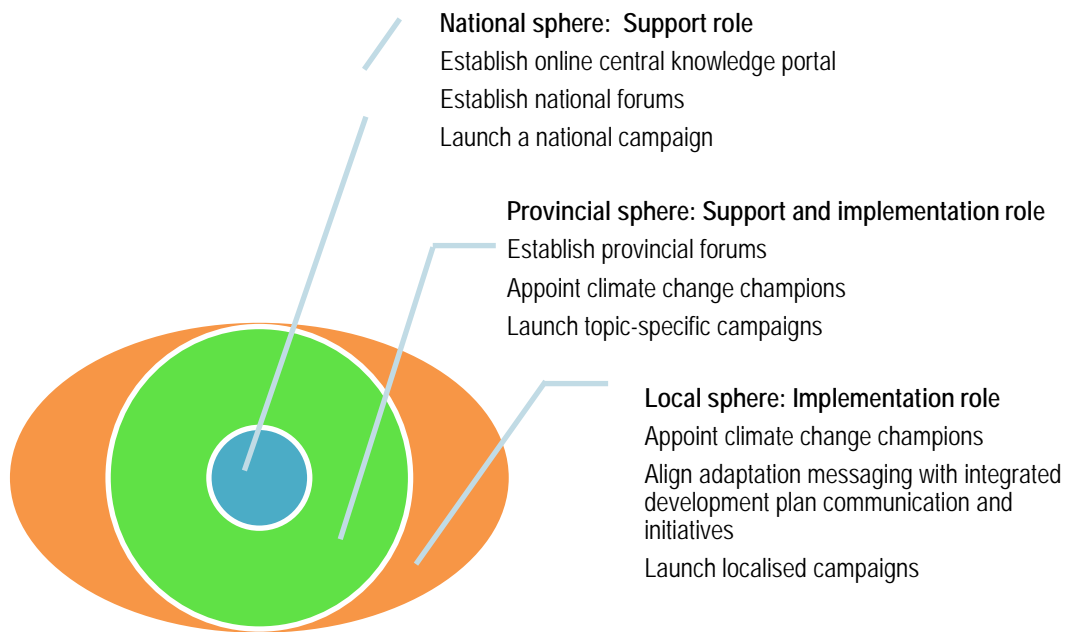


implications. At the same time, the adverse impacts of climate change on resource availability potentially limits energy development options. Adaptation and mitigation strategy requires integrated planning.

### 8.1.3 Roles and responsibilities

The NAS identifies communication as a national strategic priority: **To develop and implement an effective communication and outreach programme that informs all sectors and all levels of society about the risks and opportunities that exist due to climate change.**

DEA, in collaboration with other government actors, is responsible for implementation of this priority. The figure below is indicative of the roles and responsibilities for the three spheres of government.



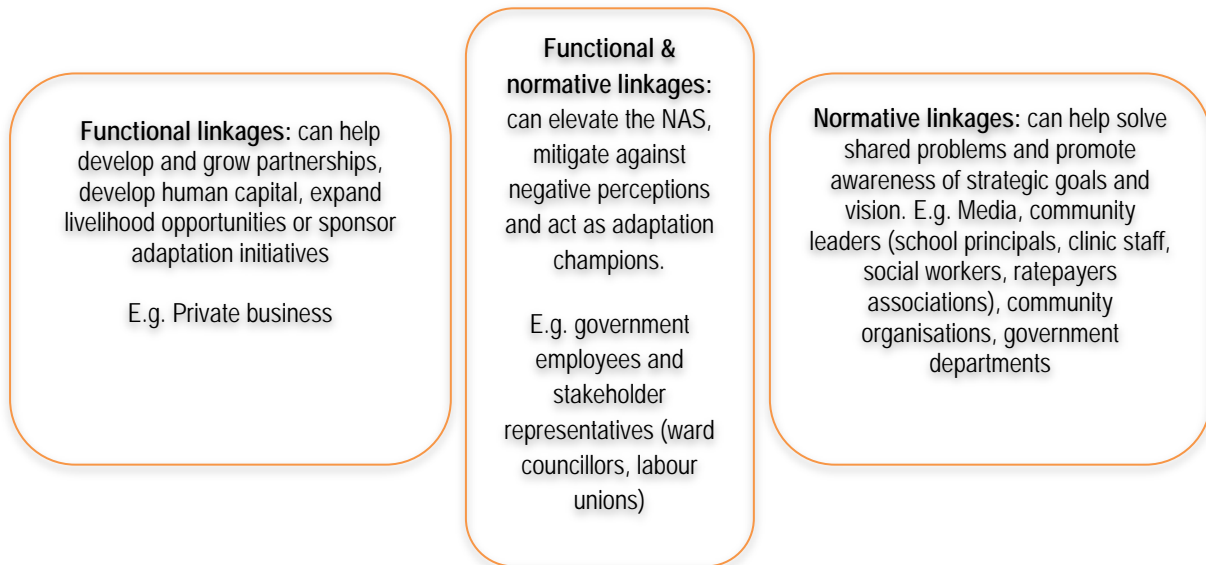
The national strategic priority is linked to several objectives and associated actions. These are outlined in the table below.

Strategic principles, priorities, objectives and actions of the communication strategy<sup>236/237/238/239/240/241</sup>

STRATEGIC PRINCIPLES	STRATEGIC PRIORITIES	OBJECTIVES	ASSOCIATED ACTIONS
<p>All South Africans understand the need for adaptation to climate change and ways in which they can reduce their vulnerability.</p> <p>All spheres of government understand best practice in communicating on climate change and adaptation issues.</p>	<p>Develop a long-term, cohesive framework (such as <b>Adapting to build a strong South Africa</b>) to guide the conceptual framing of policies and interventions. The framework should provide guidance on delivering key messages on climate change issues to various target audiences.</p> <p>Improve availability and accessibility of localised climate change data and information for public access as well as to equip government officials, climate change actors and decision-makers at the technical and policy levels with timely and relevant information.</p> <p><b>Develop an effective communication and outreach programme that informs all sectors and societal actors about the risks and opportunities that exist due to climate change.</b></p>	<p>Provide evidence-based information and messaging on climate change for adaptation actions and solutions aligned with the NAS.</p> <p>Enable high-quality policy advice, technical expertise and scientific information to inform decision-making processes.</p> <p>Promote the creation of a community that is well informed about climate change and able to take appropriate actions for risk reduction.</p> <p>Encourage the sharing of best practices and lessons learned.</p> <p>Coordinate information flows between strategic target audiences.</p>	<p>Establish an online central knowledge portal providing current information in formats accessible to a range of audiences. Information should include data, relevant policy and technical documents, and available tools.</p> <p>Build relationships between climate change experts, government and development practitioners.</p> <p>Build a local media network to raise awareness of the NAS and aligned adaptation actions.</p> <p>Create a flexible early warning communications plan for vulnerable communities.</p> <p>Identify and appoint climate change champions to monitor and evaluate the effectiveness of climate change response actions integrated into local government service delivery plans.</p>

### 8.1.4 Strategic stakeholders and communication channels<sup>242</sup>

Stakeholders are all those affected by and that affect the decisions made by government (at all spheres) regarding adaptation measures. Key stakeholders are those that are crucial to government achieving its key objectives. Communication planning and implementation must focus on key stakeholders and must be tailored to the objectives identified regarding each group. Stakeholders can be categorised into functional and normative linkages. Some groups can perform both functions.



The following table provides an overview of strategic stakeholders at the national level that provide both functional and normative linkages. These stakeholder groups have the ability to support or hinder the achievement of the NAS's strategic objectives.

Provincial communication efforts should focus on the equivalent counterparts, as well as working through provincial forums. Local government is best placed to bring about individual and community behavioural change. For example, at the local sphere, key stakeholders would include external actors such as business organisations, labour unions and civil society organisations, and internal actors would include municipal employees and ward councillors.

TARGET AUDIENCE	STRATEGIC GROUPS AT THE NATIONAL SPHERE	
<p><b>Government</b></p> <ul style="list-style-type: none"> <li>• National and provincial sectoral departments</li> <li>• Interministerial committees/joint operational centres</li> <li>• Public institutions/state-owned entities</li> </ul>	<ul style="list-style-type: none"> <li>• Department of Human Settlements</li> <li>• Department of Water and Sanitation</li> <li>• Department of Agriculture, Forestry and Fisheries</li> <li>• Department of Environmental Affairs: Biodiversity Conservation Branch</li> <li>• Interministerial Committee on Disaster Management</li> <li>• Provincial Joint Operational Centres</li> <li>• Water Catchment Management Agencies</li> <li>• South African National Biodiversity Institute</li> <li>• South African National Energy Development Institute</li> </ul>	<ul style="list-style-type: none"> <li>• Department of Health</li> <li>• Department of Mineral Resources</li> <li>• Department of Energy</li> <li>• Department of Transport</li> <li>• National Disaster Management Centre</li> <li>• Water Boards</li> </ul>
<p><b>Private business</b></p>	<ul style="list-style-type: none"> <li>• Nedbank</li> <li>• Goldfields</li> </ul>	<ul style="list-style-type: none"> <li>• Anglo Platinum</li> <li>• Santam &amp; other short-term insurance companies</li> </ul>
<p><b>Business associations</b></p>	<ul style="list-style-type: none"> <li>• National Small Business Chamber</li> <li>• South African Association of Business Communities</li> <li>• The National Business Initiative</li> <li>• African Water Association</li> <li>• Southern African Alternative Energy Association</li> </ul>	<ul style="list-style-type: none"> <li>• Southern African Association for Energy Efficiency</li> <li>• Chartered Institute of Logistics and Transport</li> <li>• South African Road Federation</li> <li>• Railroad Association</li> </ul>
<p><b>Civil society/NGOs/humanitarian and environmental organisations</b></p>	<ul style="list-style-type: none"> <li>• International Committee of the Red Cross</li> <li>• Habitat for Humanity</li> <li>• Development Action Group</li> <li>• Afesis-Corplan</li> </ul>	<ul style="list-style-type: none"> <li>• Endangered Wildlife Trust</li> <li>• World Wildlife Fund</li> <li>• Planact</li> </ul>
<p><b>Private institutions</b></p>	<ul style="list-style-type: none"> <li>• Public Health Association of South Africa</li> <li>• Hospital Association of South Africa</li> <li>• South African Mining Association</li> <li>• Mining Association of South Africa</li> <li>• Chamber of Mines of South Africa</li> <li>• The South African Mining Development Association</li> <li>• Southern African Institute of Mining and Metallurgy</li> <li>• Built Environment Support Group</li> </ul>	<ul style="list-style-type: none"> <li>• Association for Water and Rural Development</li> <li>• Water Institute of Southern Africa</li> <li>• AGRISA</li> <li>• Agricultural Economics Association of South Africa</li> <li>• Disaster Management Institute of Southern Africa</li> <li>• AgriSA: Drought Disaster Fund</li> <li>• The South African National Energy Association</li> </ul>
<p><b>Labour</b></p>	<ul style="list-style-type: none"> <li>• Southern Confederation of Agricultural Unions</li> <li>• The National Economic Development and Labour Council</li> </ul>	

### A note on proactive engagement with the media

The media can be a useful communication tool that has the ability to reach a larger group of stakeholders, but it is essential that they are provided with the relevant communication material and background. The following actions are recommended regarding engagement with the media around climate change issues:<sup>243</sup>

- Compile a media briefing package with fact sheets, policy briefs and images.
- Maintain regular contact regarding adaptation experiences – both positive and negative – to promote adoption of the NAS.
- Conduct media training on basic climate science, localised climate change effects and adaptation measures.
- Facilitate media participation at key meetings.
- Organise communication training sessions for scientific leaders that are often approached for comment by the media to enable them to provide coherent messaging aligned with the NAS and localised adaptation strategies.
- Use international, regional, national and provincial events and environment-related days as platforms.<sup>244</sup>
- Engage with community-based initiatives.<sup>245</sup>

### A focus on partnerships and using intermediaries

Communicating the need and ways to adapt to a changing climate cannot happen in isolation to the work being done on this issue by others. It is important to work in partnership with those already active in this field, such as NGOs and CSOs.<sup>246</sup>

These groups are generally trusted by communities, are already entrenched in adaptation work, and have their own communication channels capable of reaching larger stakeholder groupings. Using intermediaries (respected members of the community) is a low-cost and effective way to communicate the NAS to individuals and communities. Intermediaries (such as church leaders, municipal employees, school teachers, clinic nurses or ward councillors) often have captive audiences, as well as an in-depth understanding of their community's behavioural patterns and the best way to shift these. It is, however, crucial that the messages entrusted to intermediaries are clear and targeted to mitigate the risk of not being able to control the way in which the message is conveyed.

### Communicating with communities

The understanding and use of modern scientific information is filtered through a community's lived experience, indigenous knowledge, traditional and religious beliefs, and cultural practices. Understanding these factors will help ensure that communication is relevant and effective. The following guidelines should be applied when creating localised communication strategies:

- Use a long-term communication framework to craft short-term messages.
- Use local languages and metaphors to enable the community to understand and use the information they are given.
- Use appropriate communication channels: posters, radio shows, music, etc.
- Use relevant religious and cultural metaphors that resonate with the community.
- Use two-way channels to ensure that communities can easily access the source of the information, supply updated data, and receive updated advice.
- Use social/religious/community groups where possible to create communication platforms; this contributes to building a sense of identity regarding adaptation measures.
- Use relevant levels of sophisticated data depending on the geographical location (urban/rural) and levels of formal Western education.

## **8.1.5 Guidelines to developing adaptation communication campaigns**

All communication focused on adaptation should align to the strategic framework provided by the NAS. However, the nature of each campaign will differ according to its objectives, stakeholder groups and delivery (media choices, language, sectors, etc.). A communication strategy aimed at individuals and communities with the largest carbon footprints (the urban wealthy) needs to be very different from a communication strategy aimed at the individuals and communities most vulnerable to climate change impacts (the rural poor).<sup>247</sup>

The following general guidelines apply. An example of a Water Saving campaign at the local government sphere is used below as an illustrative example.

1. Determine specific objectives (for example, raising awareness about water scarcity, encouraging reduced use of water at specific levels – household, irrigation, etc.).
2. Identify key stakeholders (urban households, peri-urban farmers, schools, etc.).
3. Identify messengers (municipal spokesperson, ward councillors, relevant municipal employees, school principals, clinic staff, etc.).
4. Identify available communication mediums (local newspapers, rates bills, municipal website, notice boards) and budget for additional mediums (roadshows, etc.).
4. Compose key messages relevant to each stakeholder group.
5. Build a monitoring and evaluation system to determine the effectiveness of the campaign.

Note that while campaigns are once-off communication activities, it is possible to undertake ongoing communication efforts by reorienting existing communication channels to reflect adaptation concerns. Examples of such activities include:

- Using rates bills to send consistent messaging to residents.
- Profiling adaptation information on government websites.
- Ensuring that adaptation issues are a permanent feature at regular forums.
- Building relationships with local media, business groups and civil society organisations so that they can act as disseminators of information to the broader public.
- Publishing easy-to-understand information to be disseminated to schools, clinics, retirement villages, etc.

## 8.1.6 Examples of best practice in climate change communication<sup>248</sup>

### Using community radio to communicate adaptation measures

In 2010, the Community Media for Development organisation launched the multifaceted Bravos do Zambeze (Zambezi Braves) initiative in Mozambique for the International Organisation for Migration, as part of a larger United Nations project. Part of the initiative, which aimed to inform people about disaster risk reduction and floods, was a 26-episode radio drama. The drama was produced in Portuguese and a local language and distributed through community radio stations located in areas prone to flooding. The initiative also focused on building local capacity for reporting on disasters and climate change. The story focused on a village soccer team captain and his girlfriend whose village had been hit by a terrible flood for which residents were unprepared. The radio drama covered issues of displacement, the lack of preparedness and the importance of community unity, as well as providing guidance on how to rebuild in a more resilient way and how to prepare for and manage future climate uncertainty. An evaluation of the project indicates that the drama supplied people with the information they needed to react faster and more effectively to flooding, and how to mitigate instances of damage. More examples of effective use of community radio stations to communicate climate change and adaptation information can be found at [www.cmfd.org](http://www.cmfd.org). Other initiatives using broadcast media to support adaptation to climate change include the 'Shamba-Shape Up' television show, which reaches about 10 million people in Kenya, Uganda and Tanzania.

### Using mobile technology to raise awareness of climate-related risk

Small-scale farmers that practice rain-fed agriculture are particularly at risk from a changing climate, which affects the onset, duration and intensity of rainfall. A project run by the IGAD Climate Predictions and Applications Center in Kenya provides 10-day, monthly and seasonal climate outlooks for the Greater Horn of Africa region. The project translates seasonal climate outlooks from the Kenyan Meteorological Department into general advisories that are accessible – in language and style – to a wide range of stakeholders, including extension officers, farmers and local leaders. The advisories are discussed with local stakeholders in a participatory process to decide on the best seasonal farming activities. The advisories contain information on planting times, good farm management practices, choice of fertilisers, suitable crop types, prevention and control of diseases and pests, among other aspects, within a framework of climate uncertainty. The project uses a mobile SMS platform to disseminate forecasts and updates. Feedback from community members notes that agricultural production has increased, as has food and nutritional security, because of their ability to make more informed decisions. More information on this and other projects can be found at [www.careclimatechange.org](http://www.careclimatechange.org).

### Using participatory scenario planning to support adaptation communication in Kenya

This initiative aimed to facilitate community-based adaptation to climate change by supporting the communication of climate information to pastoralists and agro-pastoralist communities in Garissa, Kenya. The team engaged with stakeholders and used workshops to collect and interpret climate information. Workshop participants included representatives from the national meteorological department, local NGOs, community leaders and members, and agriculture and livestock extension officers. Meteorological information was drawn from scientific and local sources and analysed to produce three probable hazardous scenarios and the likely impacts. The effect that these would have on food security, the resource base and livelihoods was discussed before the participants developed actions for each scenario. Participants assigned responsibility for actions to different stakeholder groups. From this process, the project team developed advisories relevant to the local context that supported informed decision-making and increased adoption of adaptation practices. These advisories were communicated to the broader community through radio, institutional systems, religious leaders, chiefs, NGOs, media and government departments. The project helped government officials make better planning decisions, enhanced diversification of livelihoods and informed community decision-making.

## 8.2 Awareness and social change

Developing climate resilience requires us to change our behaviour and become conscious of our individual carbon footprints.<sup>249</sup> Enhancing the awareness of individuals, organisations, and institutions about climate change vulnerability, impacts, and adaptation can help build individual and institutional capacity for adaptation planning and implementation.<sup>250</sup>

It is also recognised that people will only make climate-friendly decisions if they have convenient, reliable and safe climate-friendly alternatives and if they know about these options.<sup>251</sup> Therefore, more research is needed to understand and demonstrate where effective interventions (such as ecosystem-based approaches) are being used. Behaviour change and social cohesion are critical to community-based adaptation at all levels of society. There is a need to bring a similar focus and level of research effort to achieving behaviour change and social cohesion in relation to climate change.<sup>252</sup>

Efforts must be directed to develop and implement education, training and public awareness programmes on climate change and its effects to promote and facilitate scientific, technical and managerial skills, as well as public access to information and public awareness of and participation in addressing climate change.<sup>253</sup> In addition, there is a need to mainstream climate change knowledge into education and training curricula. Climate change education should be part of the broader framework of education for sustainable development, and should equip South African citizens to reorient society towards social, economic and ecological sustainability.<sup>254</sup>

## 8.3 Information sharing and knowledge management

One of the important communication challenges is to disseminate information to interested and affected people as quickly as possible and to ensure that the information is in a format that is accessible and useful to the target audience. This is especially important for early warning systems where people need to take specific actions to reduce risks to themselves, their households and property.<sup>255</sup>

According to the Nairobi Work Programme, information and knowledge management needs include:<sup>256</sup>

- Information and views on matters relating to the availability of information on the socioeconomic aspects of climate change and improving the integration of socioeconomic information into impact and vulnerability assessments, including ways and means to improve availability and access to relevant information, and information on costs and benefits.
- Developing and disseminating climate change literature in local languages for the benefit of marginalised populations and the general public, thereby encouraging their involvement in adaptation and mitigation programmes. Scientific data and terminologies should be well explained and simplified in literature, which could be in the form of brochures, illustrated pamphlets, billboards and journals.
- Information and views on how the work of relevant organisations could contribute to improved understanding of current and historical climate and its impacts, including information on the identification of gaps and deficiencies in data and observations, stakeholder information and capacity needs (especially at regional and national levels) and ways to improve technical infrastructure.

Information-related adaptation needs in Africa include additional vulnerability and impact assessments with greater continuity, country-specific socioeconomic scenarios, and greater knowledge on costs and benefits of different adaptation measures.<sup>257</sup> To enable this, developed and developing countries have increasingly started promoting information sharing as a priority by establishing institutions to provide information services at national, regional and global scales. There is an ongoing need to promote information acquisition and dissemination.<sup>258</sup>

Recent research indicates that multiple factors influence how knowledge is perceived, including political affiliation, educational attainment, and the confidence placed on different information sources.<sup>259</sup>



Research partnerships and networks can facilitate knowledge sharing and awareness raising at all levels, from small groups of individuals to large institutions.<sup>260</sup> In addition, the engagement of national government actors can help mobilise political will, support the creation and maintenance of climate research institutions, establish horizontal networks that promote information sharing, and, in some cases, facilitate the coordination of budgets and financing mechanisms.<sup>261</sup>

## 8.4 Climate information and services

South Africa is actively investing in climate information services, including through ongoing capacity additions and improvements at SAWS, as well as the strengthening of technical data collection by DEA. Enhanced access to reliable and actionable climate and weather data over the short, medium and long term is critical for climate change adaptation.

South Africa is also working to implement the Global Framework for Climate Services (GFCS). The GFCS provides a clear conceptual framework for understanding and developing climate services,<sup>262</sup> which it defines as information systems that help individuals and organisations make decisions on issues of climate variability and climate change. This suite of data collection, management and dissemination systems measures and provides information on meteorological and climatological matters (such as temperature, rainfall, wind, soil moisture, ocean conditions, maps, risk and vulnerability analyses, assessments, and long-term projections and scenarios). The key components include “observations and monitoring (the essential infrastructure for generating the necessary climate data); research, modelling and prediction (to advance the science needed for improved climate services that meet user needs); a Climate Services Information System (the production and distribution system for climate data and information products that address user needs); a user interface platform (so users can make their voices heard through the platform and ensure climate services are relevant to their needs); and capacity building (to support the systematic development of the institutions, infrastructure and human resources needed for effective climate services).”<sup>263</sup> Beyond this core content, climate services also require combining meteorological and climatological data with demographic and socioeconomic data, such as agricultural production, health trends, population distributions in high-risk areas, road and infrastructure maps for the delivery of goods, and other development-related variables.

The primary objective of the GFCS is to enable better management of the risks of climate variability and change at all levels, by developing and incorporating science-based information and prediction services into planning, policy and practice.

It addresses the entire value chain for the production and application of climate services, designed to help mainstream climate science into decision-making and ensure every climate-sensitive sector is equipped to access and apply the relevant information.

A diagrammatic representation is presented below.

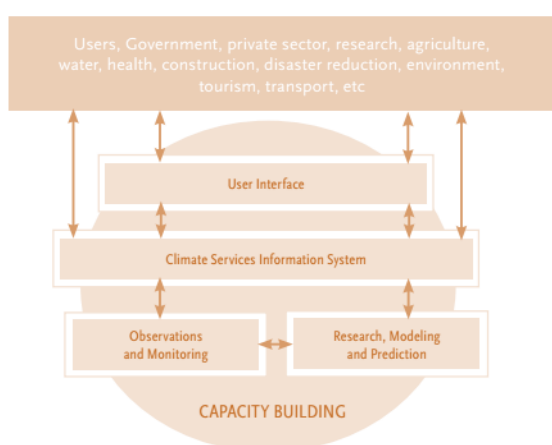


Figure 4: Key elements of the GFCS

### 8.4.1 South Africa's framework for climate services

South Africa's National Framework for Climate Services (NFCS), which is being developed, is intended to create an enabling environment for climate services at national level, guided by the principles and approach of the GFCS, but taking into consideration national needs, priorities and capacity. South Africa's NFCS will serve to strengthen the production, availability, delivery and application of science-based climate monitoring and prediction services, which will serve decision-makers and other end-users.

Following a national workshop to conceptualise the GFCS, DEA and SAWS developed a roadmap for the framework's national implementation in 2013. Like the GFCS, the NFCS is designed to mainstream climate science into decision-making at all levels and help ensure that South Africa and its climate-sensitive sectors are well equipped to access and apply the relevant climate information.

At the outset of its development, it is envisaged that the NFCS would also contain the key components of the global framework and be closely aligned with the following GFCS elements:

- Observations.
- Climate research, modelling and prediction.
- A climate services information system.
- A climate user interface programme.
- Capacity building.

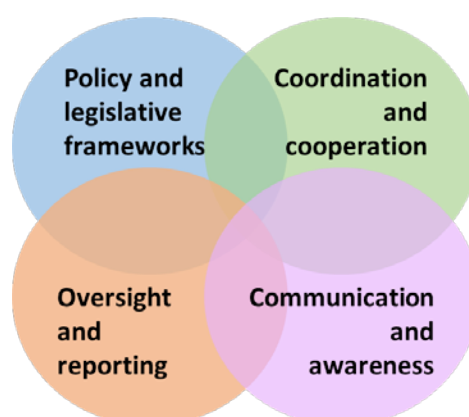
It should be noted, however, that all the elements identified above already exist within South Africa's current institutions and governance mechanisms. In particular, SAWS is responsible for observations, analysing and identifying meteorological and climate trends, and providing weather forecasts (as well as actual data sets) to users.

Climate modelling and prediction capacity already exists, both at the CSIR and at the University of Cape Town's Climate Systems Analysis Group. The benefit of an NFCS would be a more integrated, accessible and user-friendly system, thereby supporting science-based decision-making by a diverse range of stakeholders who may not find current channels as accessible.

## 9. IMPLEMENTATION AND RESOURCE MOBILISATION INSTRUMENTS

### 9.1 Recommended governance and institutional arrangements

The IPCC (2015) has acknowledged the challenges presented by the design of appropriate institutional structure for adaptation planning and implementation, and indicates repeatedly the importance of relevant national circumstances. Adaptation to climate change is complex and requires the mainstreaming of policies and interventions across a wide array of government departments, together with the close participation and cooperation of the business sector and civil society. While adaptation should be integrated with development planning, the uncertainties in future climate change impacts do not allow the clear identification of a single pathway, but introduce a need for flexibility and re-evaluation as future impacts become more certain. There is also a need to consider how adaptation and mitigation responses could reinforce each other, or at least avoid undermining one another.



It is important, therefore, that national, provincial and local institutions:

- Integrate climate change mitigation and adaptation into policy and regulatory frameworks, and further into day-to-day operations in ways that permit flexibility, reassessment and redirection if indicated.
- Coordinate their climate change adaptation programmes and interventions with other sectors or spheres of government to maximise mutual reinforcement of both adaptation and mitigation goals.
- Ensure both internal and external communication about the adaptation measures being taken, as well as the expected benefits and actual results. This allows adaptation measures to be iterative, and widespread awareness allows broader participation, learning and engagement.
- Commit to and operationalise measurement, reporting, verification and M&E to feed continuous re-evaluation in an effective way.

In efforts to improve governance frameworks, the way in which the various institutions and structures provide input to aligned policy and legislative frameworks must be considered and redirected, if necessary, to enable coordinated and cooperative approaches and action. These, in turn, must support communications and the development of improved awareness, and perform an oversight and reporting role. Many institutions and structures involved in climate change response in South Africa already support several of these important functions, providing a base from which to build.

While good progress has been made, more coordinated effort is needed to promote a coherent approach to climate change adaptation between the different spheres of government. Unfortunately, we have to recognise that despite the existence of multiple relevant institutions there is a significant degree of fragmentation within the climate governance frameworks.<sup>264</sup> Efforts to address these coordination and integration challenges are important.

Climate change is a cross-cutting issue. It cannot be the sole prerogative of one government department. Effective integration of adaptation and mitigation measures require the buy-in and prioritisation of climate change within many government departments at levels and across the administration as a whole (i.e. including decentralised spheres of government and parastatal entities). Furthermore, many actors are increasingly intervening and influencing discussions and actions. Policymakers would benefit by taking these features into account and address the governance of climate change as a complex, cross-cutting, multilevel, multi-actor process that is deeply embedded in local realities.<sup>265</sup> This includes creating an enabling environment and providing the necessary tools and platforms for individuals at all levels to be able to improve their adaptive capacity and thus build resilience.

It is essential that governance takes place cooperatively between various departments (horizontally), between various institutions in the various spheres of government and functioning at differing spatial and administrative scales (vertically), between various legislative and policy frameworks that address similar issues, and between various sectors where there are common issues to address.

This will require identifying an appropriate institutional platform for such cooperative climate change governance, and specifically empowering it with a mandate as well as the necessary resources to be a hub or convening entity for interdepartmental, inter-sectoral, and cross-spatial planning, programmes, and implementation of climate change resilience.

### **9.1.1 National institutional arrangements**

An institutional structure is needed to guide, coordinate and integrate climate change adaptation efforts across sectors and at all levels of government. Such a structure should focus on enhancing preparedness, planning, response and implementation, and monitoring the adaptation response chain. It should explicitly avoid unnecessary bureaucratic processes that slow progress, especially where strong capacity exists, but it should be empowered to enhance capacity where this is lacking. It should be guided by the imperative for alignment between development needs and resilience-building, and be able to assess and provide guidance on achieving synergies between mitigation and adaptation opportunities where feasible. It should be strongly informed by the need for flexibility and adjustment in response implementation on the basis of updated climate and performance information. The set of skills and information required to maintain such an institutional capacity would need to be supported by close links with the producers of climate information, and with a strong tertiary education and training system that is more closely informed by adaptation needs than is currently the case.

On the basis of IPCC (2015) perspectives relating to national circumstances, it is appropriate to identify whether a candidate institutional architecture for coordinating adaptation responses already exists in South Africa. A potentially relevant option does exist in the form of the National Disaster Management Centre (NDMC). Disaster readiness and response is one of the most natural entry points into addressing the larger challenge of climate change adaptation. Furthermore, at a higher administrative level, such an institutional architecture may best be situated within a ministry with the mandate of enhancing cooperative governance due to the need for a cross-governmental role in adaptation response. CoGTA presents such an opportunity, especially given the inter-departmental and inter-ministerial considerations involved in adaptation response.

An adaptation response chain that is vertically and horizontally integrated could usefully be based on the design of the NDMC, and benefit from the many lessons learned in its legislative development, implementation and through its ongoing activities. Under South Africa's National Disaster Management Framework, the NDMC is already directed to work with provincial and local disaster management authorities and to ensure alignment of provincial, local *and* sectoral disaster management plans. While the intergovernmental linkages and coordination mechanisms already exist within CoGTA and the NDMC, careful consideration would be required in how to bolster, fully implement and enhance both current disaster risk and response in the specific area of climate change impacts, while developing the legislation and institutional mechanisms to provide for the additional overarching mandate of coordinating climate change adaptation planning and response.

Under such an arrangement, consideration would also have to be given to mandates, roles and responsibilities of DEA as the focal department for climate change, and the institution implementing adaptation responses. It is desirable for DEA to continue to provide policy and strategic direction to climate change adaptation, but coordination of planning and on-the-ground implementation, and monitoring of effectiveness could be carried out through an institutional arrangement such as CoGTA's architecture and network, and specifically an enhanced institution based on the NDMC's design.

To ensure that the adaptation efforts are optimally synchronised and aligned with climate change mitigation efforts across South Africa, consideration would need to be given to how this institution would coordinate assessments of adaptation/mitigation synergies. Linkages with the departments of Transport, Energy, Mineral Resources and Agriculture, and significant GHG-emitting sectors would therefore be a component of the design of this institutional arrangement, in addition to appropriate channels of communication with the relevant authority in the DEA.

A priority for the institutional mechanism is to launch a joint planning and implementation process, involving all sectors, that integrates and operationalises necessary systemic changes across government, taking into account both adaptation and mitigation outcomes, and that supports economy-wide resilient development.

A direct approach to formalising this modified governance arrangement would be to provide statutory guidance through a National Climate Change Act. Such an act would build on the NCCRP White Paper, and would crystallise the appropriate institutional arrangements for implementation, planning, engagement in research and M&E in the climate change field.

### **9.1.2 Sub-national institutional arrangements**

Adaptation response planning and implementation is required at all levels of government, and across public and private sectors. While national level strategy guides planning and implementation and indicates the range of priority response options, the sub-national level is critical for bringing these options to bear, applying them, and tailoring them to local circumstances based on experience. Some recommended institutional responses or actions at the subnational (provincial and local) levels could therefore include:

- Include provincial roles, responsibilities and mandates in the proposed National Climate Change Act, and provide guidance on best practice in integrating the work of provincial units or departments with the national institution focused on climate change adaptation and disaster risk reduction and management. Integration with the national architecture would need full consideration given the desired outcome of both flexibility and coordination.
- Establish relationships between sub-national structures and tertiary training and education to promote ongoing research and capacity development on climate change adaptation at the sub-national scale.
- Establish sub-national climate change forums to ensure that climate change and response performance information is shared and coordinated.

These forums could also serve as platforms for the national architecture to disseminate climate change information on funding and other developments. These platforms should integrate with disaster management forums and link with intergovernmental advisory forums already in existence.

- Build technical and human capacity within provincial climate change units and line departments to ensure that climate change science is understood and that responses to climate change are incorporated into existing work.
- Contribute to developing and implementing effective climate change adaptation M&E systems tailored to local circumstances.
- Support municipality-level capacity relating to climate change adaptation response and M&E. This could include guidance on best practice relating to roles and responsibilities.
- Improve communication and knowledge sharing at the sub-national level between climate change experts and development practitioners.
- Improve the availability of localised climate change data and information. A central knowledge portal is required to allow local municipalities to access information. It is recommended that the information available provides both an adaptation and mitigation function, especially in sectors such as agriculture.

## **9.2 Partnerships for implementation**

As a multiplicity of non-state national and transnational actors (i.e. businesses, trade unions, civil society organisations and research institutions) engage in adaptation responses, produce knowledge and implement actions, collaboration with these actors will be useful in supporting the attainment of government objectives. The challenge is to integrate these efforts into the governance system and to coordinate them.<sup>266</sup> This will hinge on effective communication and collaboration. In addition, while government must play a leading role in efforts to ensure adaptation, partnerships with business and industry, civil society and academia are all essential in improving coordination, as well as resolving innovative and pragmatic approaches to resilience. While the NCCRP highlights existing institutions such as the National Climate Change Committee (NCCC) and the National Economic Development and Labour Council (NEDLAC) as important platforms for engagement with stakeholders, there is a need to reassess these platforms and determine the most appropriate way to engage across society in support of adaptation implementation.

### **9.2.1 Business and industry**

Business has a critical part to play in supporting government to meet its development objectives (such as providing jobs) and boosting South Africa's economy. It is essential that government not only creates an enabling environment, but also provides the required tools to enable adaptation to climate change-related risks. Partnerships with business and industry are important to ensure that their capacity is harnessed and focused. The continued input of business and industry into the development and maintenance of the National GHG Inventory is an important part of the reporting systems needed.

A critical but less understood area of climate change adaptation is the response by business. Climate change impacts businesses just as it impacts others in society. In particular, it poses risks for several sectors' business models, including through potential changes to supply chains, as well as more direct risks to operations and assets.

As business becomes more attuned to such risks and becomes more proactive about addressing them, there are significant opportunities to be explored in terms of leveraging insights, experiences and resources from the private sector's adaptation efforts, and having the public sector benefit from these. At the same time, there are value chains and market-based models to be explored, arising from one company's adaptation efforts potentially benefiting another.

According to the NCCRP, government also recognises the importance of private sector funding in achieving national climate change response actions and will work with the financial sector to explore the most appropriate mechanisms to achieve efficient funding flows. Private sector funding is critical in supporting our drive to deliver on climate response actions. Hence, government will continue to work with the financial sector to explore appropriate mechanisms to develop sustainable funding streams to underpin these actions. The insurance sector also has a critical role to play in supporting disaster management and adaptation, and providing incentives for adaptation and proactive risk reduction to reduce the impacts of climate change.

Additionally, the private sector (business and industry) could be a key source of climate information services, including reporting data, which feeds into a broader system.

### **9.2.2 Civil society and labour**

Civil society and labour have a critical role to play in providing advice and supporting government and private sector adaptation initiatives, and are directly affected both by climate change impacts and the opportunities created by new adaptation arrangements.

Civil society can help create awareness about climate adaptation, enable debate, and support and monitor local implementation. The ability of civil society to work across spatial and socioeconomic boundaries can increase the reach of adaptation response to the more marginalised groups of society. A broader view of civil society would also include traditional authorities and traditional knowledge. Knowledge carried within communities should be harnessed to allow for more innovative responses to climate change. This could play an especially important role in building resilience through rural development, such as in boosting food security levels.

Climate change impacts are highly relevant to labour, via changes both in working conditions and in work opportunities. Labour has been a major instrument in redressing past inequities in South Africa and it is an influential agent of change and transformation. Labour forms part of the economy's broader value chain and thus it is important to weigh up adaptation responses in the context of whether and how they help the country's labour force build resilience to climate change.

### **9.2.3 Academia**

The role of academia in improving the understanding of climate science, the key vulnerabilities and impacts of climate change, as well as providing information on appropriate responses across sectors and communities, is of vital importance. Academia could work more collaboratively with government both to build capacity and develop systems that help in making timely decisions. The many institutions in place that focus on climate change should be capacitated and financed to help support the development of our understanding of climate change as well as help monitor its impact.

## **9.3 Financing the cost of adaptation**

In South Africa, financing the cost of climate adaptation entails developing and/or accessing innovative mechanisms such as investment strategies and frameworks and climate funds. The country needs to be firmly positioned to readily access finance from a variety of sources. As a developing country, South Africa recognises that international resources (as envisaged under the UNFCCC) need to complement domestic resources in order to adequately finance the cost of transition to a climate-resilient society. New market-based instruments as well as environment-related financial reforms in the private and public sectors will seek to fundamentally transform South Africa into a climate-resilient economy and society. Furthermore, government recognises that improved finance policy coordination is critical to creating a sustainable climate finance architecture for South Africa.<sup>267</sup> To fill the finance needs gap that currently exists, it is necessary to capitalise potential sources of financial support, including bilateral and multilateral funders, the Green Climate Fund, the Adaptation Fund, carbon markets and REDD+ mechanisms.

Internationally, economic analysis of adaptation is moving away from a pure emphasis on efficiency, market solutions and cost-benefit analysis towards the inclusion of non-monetary and non-market measures, risks, inequities, behavioural biases, barriers and limits, and ancillary benefits and costs.<sup>268</sup> To enable robust economic analysis, South Africa requires a standardised approach for costing adaptation, and for assessing the benefits and trade-offs between different sectors and development objectives.

## **9.4 Finance and resource mobilisation**

[Note this section serves as a placeholder until consultant is brought on board]

An essential part – or even prerequisite – of implementation is the level of financial resources required to give effect to adaptation.

While there is some momentum towards developing financing mechanisms for adaptation in South Africa, there are many opportunities to advance the emerging groundswell. South Africa does not yet have an effective, efficient, transparent process to document funds spent on adaptation and mitigation. There is also no comprehensive database for projects of this nature, making it difficult to track the funding levels, and to assist funders in choosing where to invest. An outline of the main stakeholders and international and national financing mechanisms are provided in the three sections below. This outline provides a starting point for building a comprehensive climate adaptation finance strategy.

#### **9.4.1 Key funding stakeholders**

A wide variety of stakeholders in South Africa influence the level of adaptation funding available to the country. DEA is the custodian of environmental, climate and sustainable development policy in South Africa. It works through the Intergovernmental Committee on Climate Change to mainstream climate action into wider government structures and processes, and works with other national departments and the Multi-Stakeholder Technical Working Group to engage on issues that ensure a robust financing partnership between the private and public finance sector.

The country's financial institutions, such as the Development Bank of Southern Africa,<sup>269</sup> the Banking Association of South Africa,<sup>270</sup> insurance companies and pension funds, represent an important source of potential adaptation funding. The National Business Initiative drives South Africa's private sector climate change agenda. It acts as a collective voice for business regarding environmental legislation and as a capacity-building agency by providing information and research on climate change threats, risks and opportunities. Some leading South African companies have used innovative approaches to turn climate change-related risks into opportunities. Examples of these companies and their approaches include:

- Santam, which has engaged in partnerships with local government and NGOs to reduce risks, and thus insurance claims.
- Woolworths' Farming for the Future initiative, which aims to make its supply chain sustainable.
- South African Breweries' support of barley farmers to adapt to a changing climate to maintain supplies.
- Oceana's adaptation of its cold storage facilities to reduce its water use.
- FirstRand's development of agricultural products to offset the impact of weather patterns on the commodity cycle.

In addition, there are private sector funds in the country that are used or could be used for adaptation work. These include:

- Business Partners Ltd Green Fund (R300 million), which finances and supports projects that impact positively on the environment while creating jobs.
- AgriSA has set up a Drought Disaster Fund to support the agricultural sector.
- The World Wildlife Fund/Nedbank Green Trust funds diverse community-based conservation projects. Civil society plays an important role. International organisations such as the World Wildlife Fund and Greenpeace are active in South Africa, and SANBI represents civil society interests, as well as implementing UNFCCC's Adaptation Fund in South Africa.

Other organisations working on adaptation initiatives include Conservation International and the Adaptation Network.

#### **9.4.2 International adaptation finance**

South Africa benefits from access to several formal and informal international climate finance resources, despite the lack of a formalised mechanism for doing so. Such mechanisms ensure that funding is aligned with local priorities and is used effectively. GIZ classifies the country to be in a state of "readiness",<sup>271</sup> as does the World Bank, in terms of its partnerships for "market readiness".<sup>272</sup> The following international funds support adaptation objectives.

- The Adaptation Fund. Established under the UNFCCC, the fund finances adaptation projects and programmes in developing countries party to the Kyoto Protocol. SANBI implements the fund in South Africa, focusing on vulnerable communities in particular. Current projects in South Africa are the uMngeni Resilience Project (about US\$7.5 million) and the Community Adaptation Small Grants Facility Project (about US\$2.4 million).

- Global Environment Facility (GEF). Serving as the financial mechanism for the UNFCCC, the fund supports the implementation of multilateral environmental agreements and is the most important source of climate finance for South Africa, despite its bias towards mitigation projects. It administers several other UNFCCC funds, including the Least Developed Countries Fund and the Special Climate Change Fund. It is the interim secretariat for the Adaptation Fund. GEF has approved 42 projects in South Africa worth US\$163.8 million in grants and US\$1.1 million in co-financing.<sup>273</sup>
- Green Climate Fund. Set up within the UNFCCC, the fund acts as a mechanism to help developing countries formulate adaptation and mitigation practices. The fund has a national designated authority in place in South Africa and the Development Bank of Southern Africa, Nedbank and SANBI are in the process of being accredited as national implementing entities. No projects have been approved yet for South Africa, but work is underway to develop a financing strategy to use the funds to help South Africa meet its Intended Nationally Determined Contributions.
- Other funds focused on adaptation. These include the Adaptation for Smallholder Agriculture Programme (not yet active in South Africa); the United Kingdom's International Climate Fund to help developing countries adapt to climate change, embark on low-carbon growth and tackle deforestation (active in South Africa); Germany's International Climate Initiative, which finances and supports climate change mitigation, adaptation and biodiversity projects with climate relevance to help trigger private investments (active in South Africa); and Japan's Fast Start Finance, which pledged US\$15 billion to help developing countries achieve economic growth in ways that contribute to climate stability (active in South Africa).

### 9.4.3 National, provincial and local finance

Adaptation initiatives are spread across government departments, and very often not labelled as adaptation projects. There is also no clear budgeting process or funding for climate change activities. The primary funding for adaptation activities is therefore through direct allocations from the national budget including expenditure on research programmes and activities that directly contribute to building and supporting resilience.<sup>274</sup> DEA, through its Climate Change and Air Quality Unit, is responsible for South Africa's response to climate change. Subdivisions within this unit focus on adaptation, mitigation, M&E, international climate change relations, negotiations and air quality management.<sup>275</sup>

The unit received R240.1 million for its work in the 2015/16 budget. Adaptation measures are, however, also covered in other line items, such as biodiversity and conservation and environmental programmes.

#### South African Green Fund

DEA established this fund to catalyse the transition to a green economy, with an allocation of US\$1.1 billion. More than 50 percent has already been disbursed to approved project proposals. The fund operates across three themes: green cities and towns, low-carbon economy, and natural resources management,<sup>276</sup> and includes categories such as investment, capacity building and research. Examples of adaptation-orientated projects include:

- Camdeboo Satellite Aquaculture Project (R232 million).
- Muthi Futhi to pioneer the commercial production of indigenous medicinal plants (R3.06 million).
- Farming the Wild to promote greening of rural economies (R22.73 million).
- eThekweni Municipality Reforestation Programme (R36.94 million).

There is also indirect funding for adaptation work as DAFF and the departments of Environmental Affairs, Water and Sanitation, Disaster Management, Rural Development, Infrastructure, Health and Human Settlements also run programmes aligned with adaptation responses. While various sectors are drafting or already have climate change plans in place, it is only the Department of Health's National Climate Change and Health Adaptation Plan (2014–2109) that has dedicated funding. The plan allocates R1.09 million to establish a structure, conduct assessments, build capacity, integrate monitoring, conduct research, manage and coordinate responses, and conduct evaluations.

There is no dedicated fund for adaptation financing at the provincial and local levels of government. Provinces such as Gauteng, however, have identified various ways to potentially raise both adaptation and mitigation funding (see below).



Gauteng has also proposed establishing a Climate Innovation Centre for the province that would provide financial and technical assistance to entrepreneurs in the climate change field. Potential financing mechanisms include:

- Green bonds.
- Municipal revenue sources.
- Increasing the subsidy for low-income housing to include basic equipment.
- Increased budget for monitoring air pollution and GHG emissions.
- Feed-in tariffs.
- Carbon taxes.
- The Clean Development Mechanism.

Other provinces, such as the Western Cape, have tapped into private and donor funding to support adaptation projects, such as the Table Mountain Fund, the Greater Cederberg Biodiversity Corridor Small Grants Fund, the Nedbank Green Trust and the British High Commission. Other identified finance options include:

- R&D cooperation grants.
- Commercial finance through debt and equity.
- Concessionary finance and risk insurance.
- Specialised environmental funds and new capital market innovations, such as green and climate bonds.

Integrating finance for biodiversity and other environmental resources, such as paying for ecosystem goods and services, would enhance the measures outlined above.

## 10. MONITORING, EVALUATION AND REPORTING

Adapting to climate change will be an ongoing process that requires effective monitoring, evaluation and reporting to understand progress made towards attaining specific targets. These targets may necessarily change, which is part of an adaptive cycle of management. It is important to understand the differences between monitoring and evaluation.

- **Monitoring** is a regularised and ongoing collection of data and information in order to ascertain whether an intervention is progressing according to schedule and is achieving set objectives.
- **Evaluation** is the systematic assessment of the effectiveness or value of an intervention, at a specific point in time, with regards to set objectives.<sup>277</sup>

The NAS's adaptation interventions aim broadly to improve South Africa's adaptive capacity while reducing our vulnerability to a range of impacts. M&E becomes critically important to ascertain the efficacy of these interventions and enable us to:

- **Manage:** Determine whether we are on track and adjust the course of action.
- **Learn:** Evolve and improve our understanding of context, needs and experience.
- **Account:** Report on progress and results.

This M&E takes place at different levels involving different stakeholders at varying scales of assessment.

NATIONAL M&E	
National government	Adaptive capacity and reduction of vulnerability at the country and sector level, and how government policies, plans and interventions are contributing.
PROVINCIAL M&E	
Provincial departments	Adaptive capacity and reduction of vulnerability at the provincial level, and how government policies, plans and interventions are contributing.
LOCAL M&E	
Local government, civil society and local NGOs	Adaptive capacity and reduction of vulnerability at the local, household or individual levels and how interventions are contributing.

Figure 5: The differing levels of adaptation M&E<sup>278</sup>

The information generated from M&E interventions will help to ensure the continued support (political, sectoral and societal) needed for ongoing adaptation. It will help to:

- Strengthen sustainable development strategies by demonstrating how adaptation interventions can safeguard and support development goals.
- Demonstrate the importance of incorporating adaptation considerations into sectoral strategies through reflection on progress and results.
- Create support for adaptation across civil societies and local communities through demonstration.
- Showcase national results at the international level.

## 10.1 Structuring M&E

There are significant challenges associated with the M&E of adaptation initiatives, particularly on a national scale. These challenges include:

- **Navigating the institutional complexity:** South Africa has three spheres of government, and M&E needs to consider horizontal (sectoral) and spatial (national, provincial and local) scales. The resultant matrix of interventions is complex and can be difficult to report on. This complexity is exacerbated by cross-sector issues, differences between the various entities in terms of systems and financial reporting timeframes, as well as overall capacity constraints.  
**A lack of common metrics to measure success:** There is no common set of metrics to measure adaptation success and metrics are largely qualitative in nature.
- **Extended time frames:** Climate change occurs over extended periods of time.
- **Uncertainty regarding impacts:** The actual impacts of climate change are not always clear, which makes it difficult to understand what a particular intervention will contribute to adaptation.
- **Intervening factors:** Ongoing socioeconomic and environmental changes make it difficult to determine whether a change can be attributed to a particular intervention.
- **Insufficient data:** Lack of data (quantity and quality) may undermine the ability to effectively report on progress.

In this context, national M&E can focus to varying degrees upon the inputs leveraged, the processes undertaken and the adaptation outcomes realised. Inputs would be the resources required for adaptation interventions and include both financial and human resources. Processes refer to the implementation of policies, plan and interventions towards promoting adaptation. Adaptation outcomes are the changes realised from the implementation of the policies, plans and interventions. The development of capacity becomes a critical enabler that unlocks inputs, processes and outcomes.

It is often difficult to directly attribute outcomes to direct inputs and processes. As a result it is only possible to reflect some form of contribution to the attainment of an outcome (see figure below).

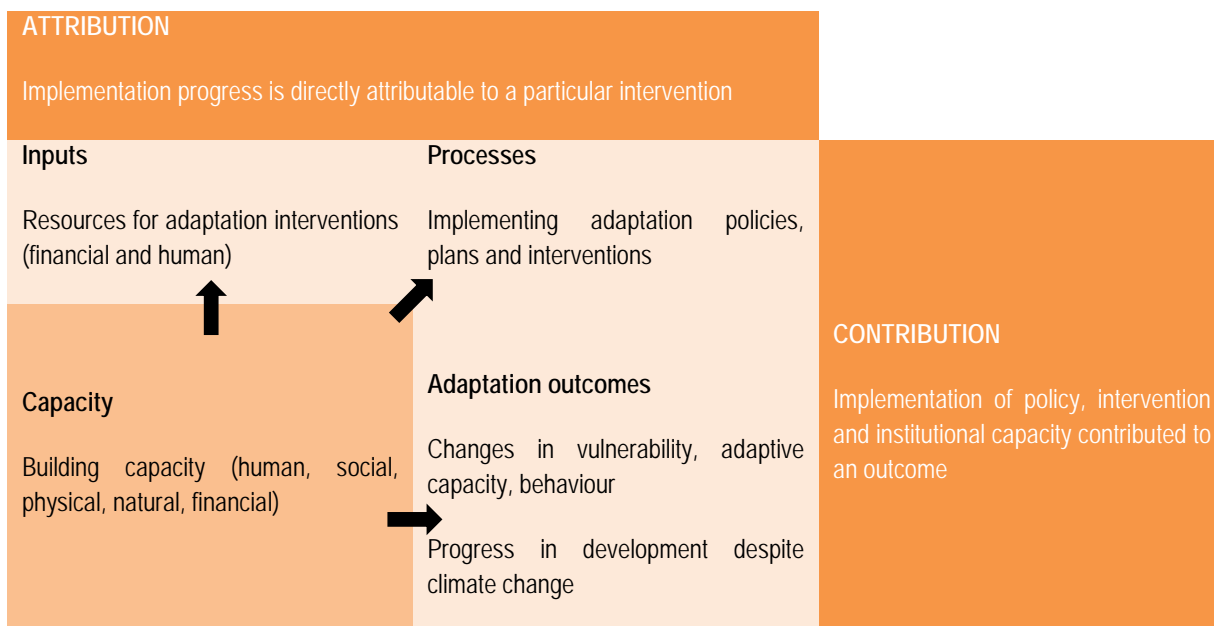


Figure 6: M&E of adaptation processes and outcomes<sup>279</sup>

It is important to fully understand our underlying assumptions when assessing the degree to which outcomes are being attained. These assumptions may be generic, but they may also vary from sector to sector. For example, using the figure above, one can assume that by building capacity that behaviour will change and that this will influence the policy environment. While this may or may not happen, it does provide the opportunity to question why something was, or was not, successful and then adapt the approach taken, as well as its underlying assumptions.

Importantly, the focus of the M&E system is based upon the purpose for which it is undertaken, namely to:

- Improve South Africa's adaptive management.
- Synthesise lessons to underpin the country's adaptive response.
- Be accountable to stakeholders for the resources expended, the interventions undertaken and the outcomes achieved.

Reporting will be improved and strengthened over time. As a better understanding of the nature of adaptation outcomes and possible metrics is developed, reporting will increasingly shift from focusing on inputs and processes across sectors and between spheres of government to a hybrid M&E system that accounts for both processes and outcomes.

M&E of the country's climate change programme is structured around the outcomes-based system established by the Presidency and is reported on through the delivery forums for these various outcomes. The Department of Performance Monitoring and Evaluation in the Presidency is responsible for reviewing progress across the spheres of government and across the outcomes. As such, it ensures that climate change implementation is reported on by the various departments. Key outcomes that are reported against include:

- **Outcome 4:** Decent employment through inclusive growth.
- **Outcome 5:** A skilled and capable workforce to support an inclusive growth path.
- **Outcome 7:** Vibrant, fair and sustainable rural communities and food security for all.
- **Outcome 8:** Sustainable human settlements and an improved quality of household life.
- **Outcome 9:** Responsive, accountable, effective and efficient local government system.
- **Outcome 10:** Environmental assets and natural resources that are well protected and continually enhanced.
- **Outcome 11:** Creating a better South Africa and contributing to a better (and safer) Africa and a better world.

## 10.2 Operationalising M&E

DEA, as the responsible coordinating department, will lead the development of the M&E system and the associated reporting mechanisms. It will thus define and communicate roles and responsibilities at the various levels within the system and assess the resource requirements to support the system.

The NAS's implementation plan will form the basis for monitoring the effectiveness of this strategy. It will monitor in the first instance inputs and process. This requires clarity of roles and responsibilities, together with a system for information gathering and progress reporting. In addition, the indicators developed need to align with those of the key line functions so that reporting is in effect business as usual. This will still require key role players to synthesis information into one holistic report that meets the requirements of the NAS.

Importantly, these reporting requirements need to be aligned with internationally agreed on reporting requirements in order to avoid duplication of effort or misinterpretation of results. DEA will outline and develop these. The development of the M&E system will include:

- Providing background documents about the system.
- Outlining roles and responsibilities.
- Providing training for those involved in the M&E system.
- Developing tools where necessary to support data collection.
- Facilitating ongoing engagement sessions that provide an opportunity to discuss and improve the system and assist in the development of a community of practice.

DEA will outline the frequency and timing of data submission linked to the development of an annual adaptation progress report.

## 10.3 Improving South Africa's data collection

Measurement, monitoring and reporting on climate change responses is critical for effective implementation. Given the nature and implications of climate change and the economic and social implications of effective climate change responses, decisions must be based on accurate, current and complete information in order to reduce risk and ensure that interventions are effective.<sup>280</sup> Thus, access to information enables adaptive management and the effective implementation of adaptation responses actions.

Climate change will have significant socioeconomic impacts on South Africa, and, as such, it will be important to be able to make decisions based on accurate and up-to-date data. This provides the basis for reducing risk as well as more effective actions. This data also supports the improvement of medium- and long-term climate modelling and provides the basis for an understanding of the range of climate outcomes and impacts, as well as the associated risks.

It is therefore imperative to establish mechanisms for measuring financial, human and ecological risks related to climate change impacts. The following are essential actions:

- **Maintain and improve climate monitoring systems:** It is essential to maintain and, in some cases, improve nationwide monitoring networks of climate change and key atmospheric indicators. Key climatic indicators that require monitoring include rainfall, ambient air temperature, humidity, soil moisture, wind, solar radiation, lightning, extreme weather event characteristics and their impacts, selected atmospheric GHGs, gas fluxes from selected vegetation, soil and marine carbon pools, sea levels, sea surface temperature, ocean current behaviour and acidity. Data analysis, synthesis, archiving, interpretation and dissemination will be key components of this effort.
- **Maintain and improve impact monitoring:** The impacts realised across sectors need to be monitored, including such aspects as ecosystem goods and services, hydrology and water resources, agricultural and forestry production, and distribution of climate-sensitive diseases. Gender and poverty dimensions are a critical part of this impact monitoring. Synthesis, reporting and, because of the cross-sectoral dimensions, information exchange are important to inform decision-making.

It is recognised that financial and capacity constraints have hampered South Africa’s ability to maintain and improve its monitoring networks, across a wide range of sectors. All sectors must look to ways to strengthen these networks if the country is going to be able to adapt. Research and innovation will play a key role in supporting this drive.

## 11. CONCLUSIONS

[Still to come]

### ANNEX 1: IMPLEMENTATION PLAN

[Still to come]

### ANNEX 2: CONTEXT FOR CLIMATE ADAPTATION

Climate change is already a measurable reality as a result of the accumulation of long-lived GHG emissions since the industrial revolution. Along with other developing countries, South Africa is especially vulnerable to its impacts. Therefore, given that poor countries and communities are least responsible for the problem of global climate change but are the most vulnerable to its impacts, adaptation is a global responsibility and concern.<sup>281</sup> Sustained warming and increasing rainfall variability will have increasingly adverse effects on key sectors of South Africa’s economy in the absence of effective adaptation responses. South Africa is particularly vulnerable to climate change because of its dependence on climate-sensitive economic sectors, high levels of poverty and the interrelated impacts of HIV/AIDS.<sup>282</sup> The poor typically have limited opportunities and, consequently, are disproportionately affected by the negative impacts of climate change. This is especially true because climate change will directly affect the sectors upon which the poor are dependent, namely agriculture, biodiversity, ecosystems and water supplies.<sup>283</sup>

#### Climate risk, vulnerability and adaptive capacity

The concept of “climate change vulnerability” helps us to better comprehend the cause/effect relationships behind climate change and its impact on people, economic sectors and socioecological systems.<sup>284</sup> The IPCC defines climate change vulnerability as the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change, and the variation to which a system is exposed, its sensitivity and its adaptive capacity.<sup>285</sup> Climate vulnerability has some key components, each of which has a specific relationship with the other components. Although these elements are defined differently depending on the source, the core essence of the components is provided below.<sup>286</sup>

Exposure	Sensitivity	Adaptive capacity
This is the measure of the magnitude and extent (i.e. temporal and spatial) of the climate-related aspects that will impact a system at a certain location (i.e. it is a function of geography). It refers to the extent to which a given system will be subject to or come into contact with a climate change impact, such as an increase in temperatures or a change in rainfall patterns.	This is an assessment of the inherent qualities of a system that make it susceptible to changes in climate aspects. It refers to the degree to which a system is likely to respond when exposed to a climate-induced stress. Therefore, if a system is modified as a result of changes in climatic aspects, it is considered sensitive to climate change.	This is the ability of a system to adapt to the impacts, cope with the consequences, minimise potential damages, or to take advantage of opportunities offered by climate change or climate variability. Factors that shape the adaptive capacity of individuals, households and communities are their access to and control over natural, human, social, physical, and financial resources.

Figure 7: Components of a vulnerability assessment  
(Sources: Text adapted from Climate and Development Knowledge Network and ARA-Sul, 2015)

As prescribed by the IPCC,<sup>287</sup> the combination of exposure and sensitivity amount to the potential climate “risk” to the system. This implies that the exposure of a system to a specific climatic process, as well as how sensitive that system is to that exposure, defines the level of risk. Merely because a system (or sector) is exposed to climate change, it does not automatically qualify as being at risk of potential impacts.

If the sensitivity to climate is low, then the risk is moderated. Similarly, if a system is sensitive to changes in climate but not exposed, then risk is low. In addition, merely because a system faces a risk of climate impacts does not automatically make it vulnerable; it's ability to respond or adapt to a risk influence the vulnerability.

Therefore, that concept of "adaptive capacity" recognises that human and ecological systems have some capacity to respond to the climate effects, and that such coping capacity needs to be considered in determining vulnerability.<sup>288</sup> The greater the adaptive capacity the lower the vulnerability of the system (regardless of the magnitude of the risk). Similarly, a low adaptive capacity results in a high vulnerability, but only when risk is established.<sup>289</sup> This relationship is illustrated in the figure below.

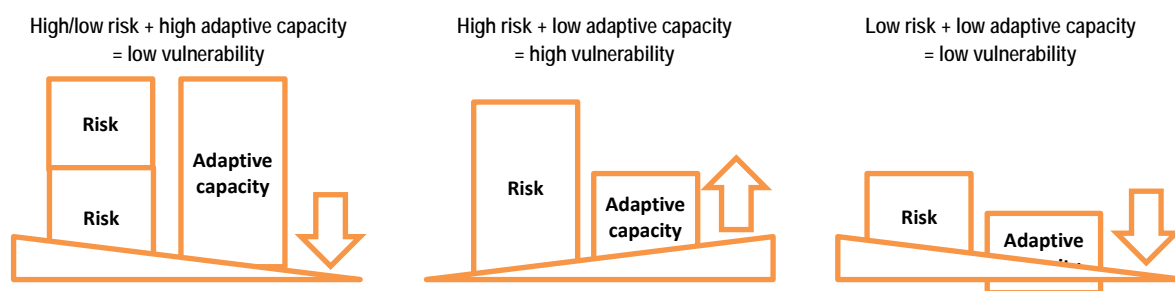


Figure 8: Relationship between adaptive capacity, risk and vulnerability

Therefore, to build resilience, measures could be aimed at reducing the vulnerability of the sectors by either decreasing the exposure or decreasing the sensitivity of the sectors. Reducing either of these is a means of enhancing adaptation, as is increasing the actual ability to cope with change (i.e. strengthening adaptive capacity, regardless of change in exposure or sensitivity). For this to be successful, it is strongly recommended that a cross-sectoral, integrated approach towards building climate resilience and mainstreaming climate change resilience into economic development planning is adopted. More broad-based resilience through increased education, income and access to services is critical. Without such an effort, sector-based strategies will not bring about the required climate resilience.<sup>290</sup>

## Climate adaptation and mitigation

Responding to current and future climate variability or climate change typically take the form of adaptation or mitigation. A key distinction between the two concepts is that mitigation focuses on reducing or preventing GHG emissions, and thus minimising climate exposure, while adaptation focuses on adapting to the impacts of climate variability and climate change. A brief description of what these two concepts entail is provided in the figure below.

Climate mitigation	Climate adaptation
Mitigation refers to measures that reduce or prevent emissions. These include technological changes and substitutions that reduce resource inputs and emissions per unit of output. Governance measures, such as introducing and implementing policies to reduce GHG emissions and enhance sinks, can also be considered as mitigation measures. Therefore, mitigation can mean using new technologies (such as renewable energy), improving energy efficiency, changing consumer behaviour and management practices.	Adaption refers to adapting to life in a changing climate. This includes initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist; for example, anticipatory and reactive, private and public, and autonomous and planned. Examples are raising river or coastal dikes (to prevent flooding or sea level encroachment), the substitution of sensitive plants with more temperature shock-resistant ones (to promote agriculture resilience), etc.

Figure 9: Climate mitigation and climate adaptation (Source: Adapted from the IPCC's Fourth Assessment Report)

The IPCC's Fourth Assessment Report in 2007 started to elevate climate change adaptation in order to deal with the potential impacts of climate change. Adaptation goals are often expressed in a framework of increasing resilience, which encourages consideration of broad development goals, multiple objectives and scales of operation, and often better captures the complex interactions between human societies and their environment.<sup>291</sup>

### Why climate change adaptation is important

Humans have always adapted to changes. It is a matter of survival. However, the unprecedented pace of current changes and the increasing complexity of our societies and economies suggest the isolated, spontaneous and self-regulated adaptation mechanisms are not sufficient anymore. Climate change adaptation is a dynamic social process determined partly by our ability to act collectively. It is important to note that even if the world succeeded in limiting and reducing GHG emissions, the planet will take another 50 years to recover from the GHG already in the atmosphere. Regardless of what we do now to mitigate climate change, we will be faced with the impact of climate change for at least two or three generations. We therefore need to take (collective) measures to adapt and limit the impacts of climate on our societies and economies. (Source: DEA 2015<sup>1</sup>)

Effective response to climate change impacts requires both mitigation and adaptation measures. Some climate change action measures can work synergistically to achieve GHG reductions while at the same time making communities more resilient to expected climate change impacts. For instance, hydroelectric power that contributes low carbon energy while also providing energy security and potentially in sync with a water storage facility. Similarly, reforestation and catchment management, which improves flows, also contributes to carbon sequestration.<sup>292</sup> It is, however, critical to note the contradictions between climate change adaptation and mitigation that can be witnessed. A key feature of adaptation responses is that they have a much stronger local context than mitigation responses, and their benefits may appear much faster and are often more tangible (such as an improvement in local environmental quality). Effective adaptation responses can also potentially create many jobs, particularly “green jobs”, and could contribute significantly to sustainable development goals. Well-planned adaptation responses can thus be effectively integrated with sustainable development policies.<sup>293</sup>

## Building climate resilience

In building climate resilience, it is important to select strategies that are either low cost and easy to implement, or strategies that are either win-win or no-/low-regret investment options (i.e. where the investment in the project will result in benefits regardless of the extent of climate change, and would not cause detriment). While the uncertainty over the scale and frequency of climate change impacts should influence how adaptation measures are prioritised and applied, uncertainty over the impact of climate change should not stand in the way of taking immediate steps to improve climate resilience.<sup>294</sup> In the context of uncertainty, international research has highlighted the potential for strategies that are robust to uncertainty. Robust strategies have been generally defined as those that:

- Are **low regret**, as they are functional and provide societal benefits under a wide range of climate scenarios.
- Are **reversible**, as they keep the cost of being wrong to a minimum.
- Provide safety **margins** that allow for climate change in the design of current infrastructure or easy retrofitting.
- Use **soft strategies** that avoid the need for expensive engineering and institutionalise a long-term perspective in planning for climate resilience.
- Reduce the **decision time horizons** of investments.
- Are **flexible** and mindful of actions being taken by others to either mitigate or adapt to climate change.<sup>295</sup>

Options that are known as “no regrets” and “low regrets” provide benefits under a broad range of climate change scenarios, although they may not be optimal for every future scenario, and are recommended when uncertainties over future climate change directions and impacts are high.<sup>296</sup> These low-regrets adaptation options typically include improvements to coping strategies or reductions in exposure to known threats.<sup>297</sup> No-/low-regrets investments have the key characteristic of delivering benefits under almost any future climate scenario and building confidence in the long term sustainability of development activities. Fast-tracking these investments allows action now, despite the large uncertainties in the future climate.<sup>298</sup> Thus, investments in resilience building should ideally not be “climate justified” or be contingent on the emergence of very specific frequency or intensity of climate change impacts.

### Examples of low-regret policy options

EbA is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to facilitate the adaptation of humans and ecosystems to climate change. Overall, EbA improves the livelihoods of local communities, improves socioeconomic well-being and enables ecosystems resilience, and thus adaptation to climate change. Initiatives such as EbA are becoming increasingly important and are dependent on functioning ecological infrastructure. EbA includes a wide range of initiatives that will increase the adaptive capacity of livelihoods in addition to maintaining and restoring biodiversity and ecosystem services. EbA may present a cost-effective, low-regret policy option. In addition to further expansion of EbA into existing legislation, other incentives to improve natural resource management are required. Current initiatives include the EPWP, which is aimed at maintaining, rehabilitating or restoring ecosystems and natural landscapes, while at the same time providing livelihood opportunities for vulnerable communities. (Source: DEA 2013<sup>1</sup>; DEA 2015<sup>1</sup>)

## ANNEX 3: SECTORAL R&D NEEDS AND PRIORITIES

NEEDS	PRIORITIES
<p><b>Agriculture</b></p> <ul style="list-style-type: none"> <li>• Research into climate impacts on all species and climate-resilient alternative crops and livestock, as well as into climate-resilient agri-business, which are relevant for specific regions.</li> <li>• Investment in research into water, nutrient and soil conservation technologies and techniques, climate-resistant crops and livestock, as well as into agricultural production, ownership and financing models to promote the development of CSA.</li> <li>• Identification of crops that are best suited and adaptable to changing climatic patterns, and the impacts of heat stress (particularly at the local level).</li> <li>• Climate advisory services to ensure that the most current research and knowledge is shared between researchers and farmers and foresters (particularly at the local level).</li> </ul>	<ul style="list-style-type: none"> <li>• Research climate impacts, and climate-resilient species and agricultural practices. <i>(Responsibility: national government, provincial government, academia)</i></li> <li>• Continuous research (i.e. monitoring) into sectoral climate impacts. <i>(Responsibility: national government, provincial government, local government, private sector)</i></li> <li>• Research and information sharing on agri-business for various business sizes, including cost-effective adaptation options. <i>(Responsibility: national government, private sector, academia)</i></li> <li>• Invest in research on water, nutrient and soil conservation technologies and techniques, climate-resilient crops and livestock, agricultural production, ownership and financing to promote climate-smart agricultural development in South Africa. <i>(Responsibility: national government, provincial government, local government)</i></li> <li>• Research and investigation into modern emergency ration food preservation technologies and supplies. <i>(Responsibility: local government, private sector, academia)</i></li> </ul>
<p><b>Forestry</b></p> <ul style="list-style-type: none"> <li>• Understanding of the impact of climate change and extreme weather events on invasive species, diseases and pests, natural forest, woodlands and plantations; the role mangroves (defined as forests in the National Forests Act (1998)) can play in helping us adapt to sea level rise and storm events; the impact of settlements on natural forests and their ecological integrity as well as the ability of these natural forests to adapt to climate change; the impact of climate change on woodlands and how adaptable they will be, and the impact this will have on other biomes like savannah and grasslands.</li> <li>• Identification of species that are best suited and adaptable to changing climatic patterns.</li> <li>• Climate advisory services to ensure that the most current research and knowledge is shared between researchers and farmers and foresters (particularly at the local level).</li> </ul>	<ul style="list-style-type: none"> <li>• Research climate impacts and climate-resilient species (as per sector needs). <i>(Responsibility: national government, provincial government, academia)</i></li> <li>• Continuous research (i.e. monitoring) on sectoral climate impacts. <i>(Responsibility: national government, provincial government, local government, private sector)</i></li> <li>• Research into cross-sectoral linkages and the impacts on the forestry sector, particularly at local level. This should also be continuously researched (i.e. monitoring). <i>(Responsibility: national government, provincial government, local government)</i></li> <li>• Invest in research on water, nutrient and soil conservation technologies and techniques to promote climate-friendly forestry practices. <i>(Responsibility: national government, provincial government, local government)</i></li> </ul>
<p><b>Fisheries</b></p> <ul style="list-style-type: none"> <li>• Understanding of temperature changes, as they will result in migration of fish species, which will affect local economies and tourism (particularly at the local level).</li> <li>• Monitoring of the linkages between climate change and the fisheries industry (particularly at the local level). This includes understanding fisheries resources and oceanographic trends,</li> </ul>	<ul style="list-style-type: none"> <li>• Research climate impacts and climate-resilient species (as per sector needs). <i>(Responsibility: national government, provincial government, academia)</i></li> <li>• Continuous research (i.e. monitoring) into sectoral climate impacts. <i>(Responsibility: national government, provincial government, local government, private sector, academia)</i></li> </ul>



<p>and modelling of fish population dynamics.</p> <ul style="list-style-type: none"> <li>• Exploration of sustainable fishing practices and alternative species for aquaculture.</li> <li>• Adoption of climate change into existing marine policies or develop new policy on climate change for marine and aquaculture.</li> <li>• Integration of climate change into coastal management plans; for example, the relocation of development away from coastal areas, reinstating natural beach dunes and vegetation, and increasing natural shoreline buffers to protect against increased runoff from more intense storms.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop sustainable supply chains with sustainable fishing approaches and influence demand with awareness campaigns. <i>(Responsibility: national government, local government)</i></li> <li>• Research into cross-sectoral linkages and the impacts on the forestry sector, particularly at local level. This should also be continuously researched (i.e. monitoring). <i>(Responsibility: national government, provincial government, local government)</i></li> <li>• Build robust early warning systems and safety at sea mechanisms for adaptation for fisherman and to protect livelihoods. <i>(Responsibility: national government, local government)</i></li> <li>• Research on projected climate change impacts on marine and freshwater fisheries, including considering complex relationships between species distribution patterns, variations in their abundance, habitat needs and productivity rates, habitat changes in response to climatic changes, and the impacts of overfishing and other stressors. <i>(Responsibility: national government, local government, academia)</i></li> </ul>
<p><b>Biodiversity and ecosystems</b></p>	
<ul style="list-style-type: none"> <li>• Prioritisation of climate change research into marine and terrestrial biodiversity and ecosystem services.</li> <li>• Effective monitoring indicators to monitor and evaluate climate change resilience in the major biomes.</li> <li>• The nature and extent of current/future risks, impacts and vulnerabilities from climate change, for every biome.</li> <li>• Robust research on the impacts and opportunities of adaptation interventions, including on transboundary or cross-border implications – for regional efforts at conservation, with joint adaptation responses across multiple countries.</li> <li>• More credible and defensible research on natural capital or natural resource accounting, to help better gauge the economic value of resources within South Africa.</li> <li>• Biodiversity and climate change incorporated into management plans and practices using the best available science regarding projected climate changes.</li> <li>• Understanding of how climate change will affect or alter fire regimes in the different biomes.</li> <li>• Climate-resilient tree species for commercial forestry (Mpumalanga), and the impacts on species – loss of bird species in the Limpopo basin (Limpopo).</li> </ul>	<ul style="list-style-type: none"> <li>• Research climate impacts and climate-resilient species (as per sector needs). <i>(Responsibility: national government, provincial government, academia)</i></li> <li>• Continuous research (i.e. monitoring) into climate impacts on the sector. <i>(Responsibility: national government, provincial government, local government, private sector)</i></li> <li>• Research the appropriate use of fire and animals to maintain biodiversity of grassland systems versus potential mitigation benefits of endemic woody plant encroachment. <i>(Responsibility: private sector, academia)</i></li> <li>• Formally establish and draw resources for scientific research projects to better understand the loss of bird species richness in South Africa at a provincial level. <i>(Responsibility: provincial government, private sector, academia)</i></li> </ul>
<p><b>Water</b></p>	
<ul style="list-style-type: none"> <li>• Impact studies for all catchments and the relative importance of climate change on water</li> </ul>	<ul style="list-style-type: none"> <li>• Regular research (that is shared) on the status of water resources, as well as the potential</li> </ul>

<p>resources versus other stressors will be assessed.</p> <ul style="list-style-type: none"> <li>• Research into the potential impacts of climate change on water, including water quality issues, and research into the social elements of adapting to climate change.</li> <li>• Further research to increase the accuracy of possible future climate change predictions by improving the scientific basis and initiating additional research into climate and water models to develop more robust and dependable results.</li> <li>• Availability of relevant, accurate, complete and current data analysis tools with focused monitoring to ensure the efficacy of water adaptation approaches.</li> <li>• Understanding water availability and demand management measures.</li> <li>• Sustain water-related research and capacity development to ensure availability of adequate data (particularly at the local level).</li> <li>• Focused monitoring and research in order to ensure the efficacy of water adaptation approaches over the long term (particularly at the local level).</li> </ul>	<p>impacts of climate change, at all catchment scales. This is essential to enable effective planning by other sectors. <i>(Responsibility: national government, water service providers)</i></p> <ul style="list-style-type: none"> <li>• Research into existing gaps in scientific understanding, such as impact studies on land use, sedimentation, groundwater, water quality, dam safety, flooding, infrastructure sustainability, and evaporation, the socioeconomic costs, and new elements of the process such as stilling and its effect on evaporation. <i>(Responsibility: national government, water service providers)</i></li> <li>• Strengthen the M&amp;E of water and climate data. Agree on standardised reporting protocols and implement through a coordinated effort by the departments of Environmental Affairs and Water and Sanitation, and SAWS. <i>(Responsibility: national government, water service providers)</i></li> <li>• Integrate climate change into reserve determination methodologies, informed by steadily improving science. <i>(Responsibility: national government, provincial government)</i></li> <li>• Create awareness campaigns and provide information to communities on how to save water through water use efficiency and by incorporating rainwater harvesting plans, low-flush toilets, water recycling and reuse, and low-flow showerheads. <i>(Responsibility: local government)</i></li> <li>• Create or strengthen local water conservation programmes in anticipation of changing drought frequencies. Municipalities may have to consider water restrictions in the face of water stress. This requires balancing the needs of competing users when water availability is reduced, and should be planned carefully. <i>(Responsibility: local government)</i></li> </ul>
<p><b>Health</b></p>	
<ul style="list-style-type: none"> <li>• Strengthened understanding of the linkages between disease and climate change, such as linkages between weather events and climate-sensitive diseases.</li> <li>• Trends of heat stress due to exposure to elevated temperatures in South Africa.</li> <li>• Understanding the health impacts of climate change on occupational groups (i.e. labour force).</li> <li>• The effect of climate impacts from neighbouring countries on South Africa.</li> <li>• The impact of climate change on food production and a healthy (nourished) society – e.g. the impact of red tide poisoning in coastal municipalities (particularly at the local level).</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct health sector climate vulnerability assessments to support decision-making. <i>(Responsibility: national government, provincial government, local government)</i></li> <li>• Develop and implement an integrated surveillance system for climate-related diseases and integrate this with an early-warning system for disaster events like flash floods, fires, etc. <i>(Responsibility: national government, provincial government, local government, academia)</i></li> <li>• Research ecosystem-based approaches that can support the health sector in its adaptation efforts. <i>(Responsibility: local government, academia, civil society)</i></li> <li>• Research for new insights and innovative solutions to health problems, such as modelling and research on optimal adaptation strategies. <i>(Responsibility: local government, academia, civil society)</i></li> <li>• Investigate climate change impacts on health and food production (e.g. red tide poisoning in coastal municipalities). <i>(Responsibility: local government, academia, civil society)</i></li> </ul>

	<ul style="list-style-type: none"> <li>• Understand the impacts of climate change on food security linked with health (such as effect of malnutrition). <i>(Responsibility: local government, academia)</i></li> <li>• Monitor health status to identify and solve community health problems (e.g. tracking of disease and trends related to climate change). <i>(Responsibility: local government)</i></li> </ul>
<b>Disaster management</b>	
<ul style="list-style-type: none"> <li>• Understanding the impact of climate change on disaster risks at a local level.</li> <li>• Understanding the sectors directly and indirectly affected by climate change risks.</li> <li>• Climate change-related disaster risks including identification of hotspots, in different climate scenarios, and best practices on responding to repeated coastal inundation.</li> <li>• Availability of research and climate science to enable the mining sector to conduct climate risk and vulnerability studies (particularly at local level).</li> </ul>	<ul style="list-style-type: none"> <li>• Research and document cross-sectoral impacts of natural disasters to contribute to the understanding and development of such responses to climate change. <i>(Responsibility: national government, academia)</i></li> <li>• Review the resilience of existing water supply systems with a particular focus on improved integration and diversification of the current stand-alone water resources systems. <i>(Responsibility: national government, academia)</i></li> <li>• Identify communities most at risk from climate change exacerbated disasters. <i>(Responsibility: provincial government, local government, academia)</i></li> <li>• Promote public awareness about climate change-related disaster risks and responses. <i>(Responsibility: national government, provincial government, local government)</i></li> <li>• Identify and implement coastal setback lines to reduce exposure to sea level rise and increased coastal storms. <i>(Responsibility: national government, provincial government, local government)</i></li> <li>• Develop an information-sharing system and build/strengthen partnerships where research and lessons learned are shared – where business can have easy access to science and data, to help protect essential services from climate change. <i>(Responsibility: national government, academia)</i></li> </ul>
<b>Human settlements</b>	
<ul style="list-style-type: none"> <li>• Availability of climate science, and the downscaling of climate change projections to the local scale for disaster risk reduction and management linked with planning of human settlements.</li> <li>• Urban design options (research and planning) that increase resilience to climate change. (particularly at the local level).</li> <li>• Research and monitoring, building on the back of the current scenario-planning process (updated climate modelling and quantification of impacts), to identify when particular land-use options become maladaptive (e.g. land under agriculture).</li> <li>• Investigating behaviour change and social cohesion, which is critical to community-based</li> </ul>	<ul style="list-style-type: none"> <li>• Identify areas vulnerable to flooding and reduce settlement and urban development in these areas. <i>(Responsibility: local government, academia)</i></li> <li>• Strengthen the identification of settlements and social groups that are priorities for reducing vulnerability. <i>(Responsibility: local government, academia)</i></li> <li>• Support ongoing research on the impacts of climate change on livelihoods, and ways to build climate resilience and ensure service provision for rural and urban populations. <i>(Responsibility: local government, academia)</i></li> <li>• Develop an information-sharing system where local government has easy access to recent science and data. <i>(Responsibility: local government, academia)</i></li> </ul>

<p>adaptation at all levels of society.</p>	<ul style="list-style-type: none"> <li>• Research urbanisation as a channel for climate resilience. <i>(Responsibility: local government, academia)</i></li> <li>• Research design options for urban, rural and coastal settlements that increase their resilience to climate change, and work with the planning and building standards sectors to analyse and revise planning systems, including building codes, standards and storm water and sewerage guidelines, as well as new drainage systems that protect roads from floods in order to increase resilience to climate change. This includes a review of low-cost housing designs and selection of the materials with projected climate changes in mind. <i>(Responsibility: local government, academia)</i></li> <li>• Prioritise technologies for climate change adaptation within rural areas, including low water-use irrigation systems, improved roll-out of rainwater harvesting strategies and drought-resistant seed varieties. <i>(Responsibility: local government, academia)</i></li> <li>• Understand and demonstrate where effective ecosystem-based approaches are being used and are effective in urban, rural and coastal settlements. <i>(Responsibility: local government, academia)</i></li> </ul>
<p><b>Mining</b></p>	
<ul style="list-style-type: none"> <li>• Research into direct climate impacts on each operation (e.g. flooding of roads close to mine operations, climate impacts on the labour force).</li> <li>• Research into supply chain impacts on the mining sector – this looks at operations that are external to the company's sphere of influence, but are central to its sustainability (e.g. energy, water supply).</li> <li>• Research into the economic lens of climate impacts and vulnerabilities of the mining sector, focusing on the sustainability of the sector as a key contributor to the economy.</li> <li>• Availability of research and climate science to enable the mining sector to conduct climate risk and vulnerability studies (particularly at local level).</li> <li>• Regulatory and institutional environments that enable business to explore and implement R&amp;D, including technology innovation.</li> </ul>	<ul style="list-style-type: none"> <li>• Strengthen research into the risks and vulnerabilities of the mining sector from climate-related impacts. <i>(Responsibility: private sector, academia)</i></li> <li>• Explore implications of a changing business model for the sector in response to climate mitigation imperatives. <i>(Responsibility: private sector, academia)</i></li> <li>• Conduct an assessment of climate risk to the mining industry in South Africa. <i>(Responsibility: national government, private sector (business and industry), academia)</i></li> <li>• Develop an information-sharing system and build/strengthen partnerships where research and lessons learned are shared – where business can have easy access to science and data. <i>(Responsibility: national government, private sector, academia)</i></li> <li>• Research the regulatory and institutional environment mechanisms that will create an enabling environment for business to adapt to climate impacts and explore R&amp;D innovation. <i>(Responsibility: national government)</i></li> </ul>
<p><b>Energy</b></p>	
<ul style="list-style-type: none"> <li>• Research into direct climate impacts on each operation (e.g. damage to infrastructure, flooding of roads close to mine operations, climate impacts on the labour force).</li> <li>• Research into the economic lens of climate impacts and vulnerabilities of the energy sector,</li> </ul>	<ul style="list-style-type: none"> <li>• Strengthen research into the risks and vulnerabilities of the energy sector from climate-related impacts. <i>(Responsibility: private sector, academia)</i></li> <li>• Conduct an assessment of climate risk to the energy industry and economy of South Africa.</li> </ul>

<p>focusing on the sustainability of the sector as a key contributor to the economy.</p> <ul style="list-style-type: none"> <li>• Research into supply chain impacts on the energy sector – this looks at operations that are external to the company's sphere of influence, but are central to its sustainability (e.g. mining, water supply).</li> <li>• Availability of research and climate science to enable the energy sector to conduct climate risk and vulnerability studies (particularly at local level).</li> <li>• Availability of research and climate science to warn the energy sector about imminent climate impacts, such as an early warning system for floods and droughts (particularly at local level).</li> <li>• Regulatory and institutional environments that enable business to explore and implement R&amp;D, including technology innovation.</li> </ul>	<p><i>(Responsibility: national government, private sector (business and industry), academia)</i></p> <ul style="list-style-type: none"> <li>• Develop an information-sharing system where entities have easy access to recent science and data, to help protect essential services from climate change. <i>(Responsibility: national government, private sector, academia)</i></li> <li>• Build/strengthen partnerships where research and learnings are shared – where business can have easy access to science and data, to help protect essential services from climate change. <i>(Responsibility: national government, private sector, academia)</i></li> <li>• Research the regulatory and institutional environment mechanisms that will create an enabling environment for business to adapt to climate impacts and explore R&amp;D innovation. <i>(Responsibility: national government)</i></li> </ul>
<b>Transport and infrastructure</b>	
<ul style="list-style-type: none"> <li>• Research into direct climate impacts on transport and infrastructure (e.g. damage to infrastructure, flooding of roads close to mine operations, climate impacts on the labour force).</li> <li>• Research into transport and infrastructure sustainability during climatic extremes.</li> <li>• Availability of research and climate science to enable the transport and infrastructure sector to conduct climate risk and vulnerability studies (particularly at local level).</li> <li>• Monitoring the impacts of climate on the transport and infrastructure sector.</li> <li>• Availability of climate-friendly transport and infrastructure options in South Africa.</li> <li>• Availability of research and climate science to warn the transport and infrastructure sector about imminent climate impacts, such as an early warning system for floods and droughts (particularly at local level).</li> </ul>	<ul style="list-style-type: none"> <li>• Develop climate change risk and vulnerability assessments for priority infrastructure assets and transportation systems (based on importance for national socioeconomic development as well as asset value). <i>(Responsibility: national government, local government)</i></li> <li>• Continuous research (i.e. monitoring) into climate impacts on the transport and infrastructure sector. <i>(Responsibility: local government, private sector)</i></li> <li>• Research climate-resilient options and implement/transfer technology innovation for the sector (e.g. green infrastructure, climate-resilient buildings). <i>(Responsibility: national government, private sector, academia)</i></li> <li>• Develop an information-sharing system where entities have easy access to recent science and data, to help protect essential services from climate change. <i>(Responsibility: national government, private sector, academia)</i> <ul style="list-style-type: none"> <li>○ Information and data should also be made available to consumers, to enable them to make informed travel decisions. <i>(Responsibility: national government, private sector, academia)</i></li> </ul> </li> </ul>

## ANNEX 4: SECTORAL TRAINING & CAPACITY BUILDING NEEDS AND PRIORITIES

NEEDS	PRIORITIES
<p><b>Agriculture</b></p> <ul style="list-style-type: none"> <li>• An independent research body as a repository of mitigation and adaptation information and best practice.</li> <li>• Improved capacity within DEA to provide mechanisms and oversight for measuring, reporting and verifying sectoral emissions.</li> <li>• Addressing the deficit in staff capacity to monitor and enforce administrative mechanisms in the sector.</li> </ul>	<ul style="list-style-type: none"> <li>• Build and expand capacity in extension support, especially to small-scale, smallholder and commercial farmers, with climate-smart, ecosystem-based approaches.</li> <li>• Improving and extending entrepreneurial skills development in the agricultural sector.</li> <li>• Providing training in how to transfer information from vulnerability assessments to land-use maps that can be used for decision-making.</li> <li>• Training farmers in the use of decision support to support adaptation actions on the farm. Decision support in this context is defined as information systems that support and guide farmers to respond to potential climate impacts and understand the potential impacts of various responses.</li> <li>• Training and capacitating additional and existing agricultural extension officers to provide adaptation advice. Expertise should focus on, for example, guidelines on managing heat stress within livestock on farms. A system should also be developed to allow for integrated knowledge management for extension support that is easily accessible to farmers.</li> <li>• Promoting adaptation options such as education, entrepreneurial training, and training in the agricultural sector, marine tourism and sustainable aquaculture (to prevent the potential deterioration of social conditions in fisher communities associated with climate change).</li> </ul>
<p><b>Fisheries and forestry</b></p> <ul style="list-style-type: none"> <li>• Including climate change in educational curricula<sup>299</sup> and increasing the number of postgraduate studies on climate change relating to forestry.</li> <li>• Climate change bursaries for government employees to study at national or international institutions.</li> <li>• Skills Education Training Authorities-accreditation of all courses on climate change relating to forestry and agriculture.</li> <li>• NGO-sector study groups for participants in climate change courses.</li> <li>• Sector community involvement in training – using methods such as participatory rural appraisal.</li> </ul>	<ul style="list-style-type: none"> <li>• DAFF ensuring that trained officials are imparting climate change information and transferring skills to sector communities, and integrating ecosystem-based approaches into current management (in partnership with DEA).</li> <li>• Training the consumer and retail industry on the demand and supply of sustainable fish, building on concepts such as the World Wildlife Fund's SASSI project.<sup>300</sup></li> <li>• Training fishermen in early warning systems and safety-at-sea mechanisms, including training on the Abalobi initiative.<sup>301</sup></li> <li>• Identifying approaches to fisheries management that support socioecological resilience to the expected increase in variability and methodologies for integrated inter-sectoral approaches to management of human activities related to the ocean.</li> <li>• Further capacitating department task teams on climate change to work with other sectors on climate change planning and implementation.</li> </ul>

<b>Biodiversity and ecosystems</b>	
<ul style="list-style-type: none"> <li>• Capacity within local governments to include biodiversity considerations into their IDPs.</li> <li>• National Skills Development Framework prioritises skills development to maintain sustainable infrastructure.</li> <li>• A sustained training and awareness campaign regarding ecosystems, their vulnerabilities to climate change and their role in assisting in adaptation to climate change, including awareness on alien invasives and their impact on natural ecosystems.</li> </ul>	<ul style="list-style-type: none"> <li>• Improved understanding of climate change impacts and adaptation responses among those engaged in biodiversity management and conservation, across all spheres of government.</li> <li>• Training in EbA, what it entails and how it translates into implementation.</li> <li>• Training people in community-based natural resource management.</li> <li>• Improving capacity for valuation and assessment (e.g. natural resource accounting).</li> <li>• Capacitating local municipalities, districts and provinces to underpin their planning with ecosystem- and community-based community approaches.</li> <li>• Training on “biodiversity checklists” to ensure biodiversity considerations are integrated within municipal funding mechanisms.</li> </ul>
<b>Water</b>	
<ul style="list-style-type: none"> <li>• Improvement of the National Water Resource Strategy with regards to adaptation and climate change.</li> </ul>	<ul style="list-style-type: none"> <li>• Improved communication skills at the national level – especially involving DEA and the Department of Water and Sanitation – so that technical climate science information can be translated into an accessible format.</li> <li>• Technical support and delivery mechanisms to accelerate infrastructure development; improved municipal capacity to implement water and sanitation projects (engineering skills deficit to be addressed). Learning organisations focused on green technology and water saving, for example, should be established.</li> <li>• A climate change and water adaptation science committee to communicate the latest developments and findings among relevant bodies.</li> <li>• Increased hydrological skills at municipal level, and capacity building in hydrological sciences in the Department of Water Affairs and elsewhere in government; improved institutional capacity (structure and mandate).</li> <li>• At the provincial level: Department of Water and Sanitation should run climate change provincial workshops.</li> <li>• At the local level: Water service authorities need to communicate climate change interventions and responses to their stakeholders.</li> </ul>
<b>Health</b>	
<ul style="list-style-type: none"> <li>• Improved knowledge with regards to implementing projects that help the health sector adapt to climate change.</li> <li>• Documentation and dissemination of successful adaptation projects need to be documented and disseminated.</li> <li>• The National Development Plan’s environmental section offers a valuable perspective on</li> </ul>	<p>The National Development Plan’s environmental section offers a valuable perspective on building adaptive capacity, which could be expanded to include health impacts and integrated with the plan’s health section. The National Climate Change Health and Adaptation Plan 2014–2019<sup>302</sup> outlines several key training and capacity-building needs:</p> <ul style="list-style-type: none"> <li>• Strengthen the provincial epidemic preparedness and response teams through scaled-up</li> </ul>

<p>building adaptive capacity, which could be expanded to include health impacts and integrated with the plan's health section.</p>	<p>training initiatives.</p> <ul style="list-style-type: none"> <li>• Design and produce educational material on diarrhoeal diseases and meningococcal meningitis to increase community awareness.</li> <li>• Resuscitate the Water, Sanitation and Hygiene Committee to plan and coordinate key activities toward the prevention and control of sanitation and water-related diseases.</li> <li>• Strengthen programmes and activities related to improved industrial and household waste management for the prevention of disease, including health education and awareness.</li> <li>• Improve surveillance and reporting of cases toward early detection and case management of key diseases. This includes developing and distributing case management guidelines; conducting health education programmes; and collaborating with stakeholders such as the National Institute for Communicable Diseases and DAFF.</li> <li>• Improve awareness and training on malaria and cholera outbreaks, and how these can be dealt with proactively and prevented.</li> </ul>
<p><b>Disaster management</b></p>	
<ul style="list-style-type: none"> <li>• Access to finance mechanisms for disaster risk reduction and management.</li> <li>• Coordination and collaboration between line departments, and developing and updating cross-sectoral disaster management plans.</li> </ul>	<ul style="list-style-type: none"> <li>• Mainstreaming disaster risk and management into planning, programmes, new developments or projects across all spheres of government, and learning how to allocate (and report on) funding for disaster risk reduction and management, which is often embedded in other budget items.</li> <li>• Effective participation of disaster management practitioners in the IDP process and project planning and implementation phases, and clarifying roles and responsibilities of local, district and metropolitan municipalities.</li> <li>• Understanding the role of ecosystems and ecological infrastructure in the context of disaster risk reduction and management.</li> <li>• Effective dissemination of severe weather warnings and seasonal forecasts as well as longer-term climate information, including the role of social media, civil society and NGOs for enhancing disaster risk reduction and management; for example, collecting local-level climate change-related data and disseminating early warning information.</li> <li>• Engagement with vulnerable communities and the planning and implementation of community-based risk and vulnerability assessments.<sup>303</sup></li> </ul>
<p><b>Human settlements</b></p>	
<ul style="list-style-type: none"> <li>• Building adaptation capacity by strengthening planning capabilities within local government.</li> <li>• A framework to strengthen the education and training of planners and other spatial</li> </ul>	<ul style="list-style-type: none"> <li>• Training government officials on ecosystem- and community-based approaches towards enhanced settlements.</li> </ul>



<p>professionals, and promote research.</p> <ul style="list-style-type: none"> <li>• Capacity building should be addressed in the codes and regulations related to human settlements. Identified needs include:</li> </ul>	<ul style="list-style-type: none"> <li>• Improving capacity to deliver services and build resilience within all human settlements.</li> <li>• Training DAFF officials to support farmers on CSA and provide business training for farmers, particularly small-scale farmers, to improve farm management and production.</li> </ul>
<p><b>Mining</b></p>	
<ul style="list-style-type: none"> <li>• Education and training to improve sector-wide understanding of climate change risks, and how climate impacts assets and operations (including essential inputs like water and energy, damage and depreciation of mining infrastructure, etc.).</li> <li>• Technical capacity within key sector institutions (such as the Department of Mineral Resources and the Chamber of Mines) that is dedicated to climate change adaptation.</li> </ul>	<ul style="list-style-type: none"> <li>• Organise knowledge-sharing events and forums focused on the mining industry's impacts and response to climate change, as well as looking at cross-sectoral implications and approaches</li> <li>• Develop a repository of information on likely climate change impacts (for example, temperature increases and rainfall), and resources that enable the sector to operationalise climate response into their business. Such interventions could be implemented by the Department of Mineral Resources in collaboration with industry associations.</li> </ul>
<p><b>Energy</b></p>	
<ul style="list-style-type: none"> <li>• Education and training to improve sector-wide understanding of climate change risks, and how climate impacts assets and operations (including energy demand, energy consumption patterns, damage and depreciation of energy infrastructure, availability of water for power generation and energy industries, etc.).</li> <li>• Technical capacity within key sector institutions (such as the Department of Energy, Eskom, South African National Energy Development Institute and the National Energy Regulator of South Africa) that is dedicated to climate change adaptation and resilience.</li> </ul>	<ul style="list-style-type: none"> <li>• Obtain further feedback from stakeholders in this sector is needed to determine the relative importance of R&amp;D versus training and capacity building.</li> </ul>
<p><b>Transport and infrastructure</b></p>	
<ul style="list-style-type: none"> <li>• Education and training to improve sector-wide understanding of climate change risks, and how climate impacts assets and operations (including damage and depreciation).</li> <li>• Technical capacity within key sector institutions that can be dedicated to climate change adaptation and resilience.</li> </ul>	<ul style="list-style-type: none"> <li>• Obtain further feedback from stakeholders in this sector is needed to determine the relative importance of R&amp;D versus training and capacity building</li> </ul>

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Note all references will be checked and formatted if needed in next editing round.

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