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Climate change in South Africa: Risks and opportunities for climate-resilient development in the IPCC Sixth Assessment WGII Report

Significance:

South Africa is wrestling with increasing climate change impacts and how to respond. The 2022 IPCC Working Group II Report synthesises the latest evidence on climate change impacts, vulnerability and adaptation, and what this means for climate-resilient development. In this commentary, South African authors on the Report reflect on its key findings and the implications for the country. The commentary highlights challenges and opportunities for cities, the food-water-energy-nature nexus, knowledge and capacity strengthening (which includes climate services, climate change literacy, and indigenous and local knowledge), climate finance, equity, justice and social protection, and climate-resilient development pathways. The piece closes with a reflection on research gaps requiring attention and the importance of urgently ramping up climate action to secure a liveable future for all South Africans.

The Intergovernmental Panel on Climate Change (IPCC) reports, published about every 7 years, present policy-relevant assessments of the causes and consequences of climate change, and future options for preventing and adapting to climate change. South Africa is well represented in the IPCC process, with Dr Debra Roberts as Working Group II (WGII) co-chair and numerous South African lead and contributing authors.

In this Invited Commentary, seven South African authors of the recent *Climate Change 2022: Impacts, Adaptation and Vulnerability* IPCC Sixth Assessment Report (henceforth the 'WGII report') discuss key findings on climate risk and opportunities for climate-resilient development in South Africa, as identified in this report. The commentary draws primarily on Chapter 9 ('Africa')¹, which 'presents the clearest and most comprehensive review of [climate change assessment issues on] the continent ever contained in an IPCC report'². It also draws on Chapter 6 ('Cities, Settlements and Key Infrastructure') and two synthesis chapters: 16 ('Key Risks Across Sectors and Regions') and 17 ('Decision-making Options for Managing Risks').

Key risks for South Africa

The evidence of widespread loss and damage to natural and societal systems caused by human-induced climate change, highlighted in the WGII report, is stronger than ever before. This is especially true of South Africa, where human-induced climate change has already warmed mean annual surface temperatures by 1.2 °C (relative to the 1850–1900 climate), with the six hottest years ever recorded having occurred in the last decade.³ Human-induced climate change has led to increases in the number of extremely hot days, a reduction in rainfall over the winter rainfall region of the country, an increase in multi-year drought events (including the Cape Town drought of 2016–2018), and an increase in the number and intensity of extreme precipitation events (such as those that resulted in the 2022 Durban floods) and of marine heat waves along the coastline. This accelerated warming has exacerbated water shortages and reduced economic growth in South Africa.

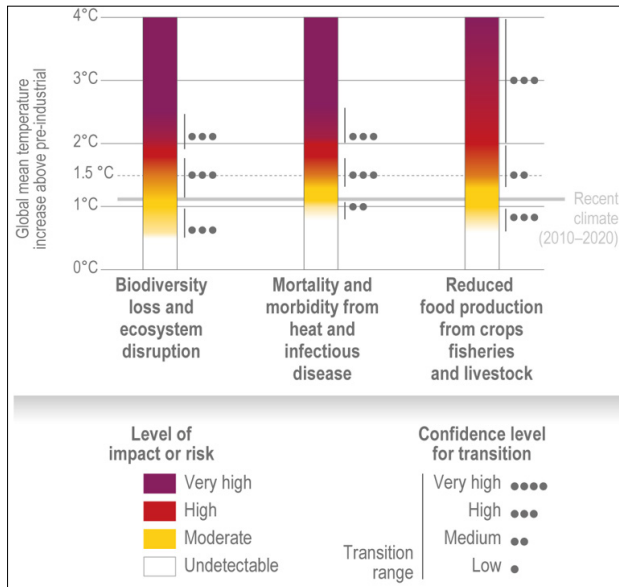
The accelerated warming over the last decade, alongside a fuller understanding of climate change impacts and vulnerability, means that the IPCC's assessment of climate change risk in Africa for biodiversity and ecosystems, human mortality and morbidity, and food production has increased from low levels in the fifth assessment to moderate risk in the sixth assessment, at the current level of global warming (around 1.2 °C; Figure 1). Examples of loss and damage at this moderate risk level include reduced agricultural productivity, local extinction of species, and human mortality from extreme heat.

The risk to people and ecosystems by global warming levels of 1.5 °C and higher is projected to become high – that is, there will be severe and widespread loss and damage across Africa. The WGII report also shows risk has increased due to compound and cascading extreme climate events starting to occur simultaneously (e.g. a combined heatwave and drought) or consecutively (e.g. drought followed by heavy rainfall). The report also predicts that multiple risks (e.g. pandemics and climate change) will interact.⁴ Urgent action is therefore required to keep global warming levels below 1.5 °C to reduce these risks, thereby limiting loss and damage to nature and society.

Climate-resilient development (CRD) is the process of implementing (1) greenhouse gas mitigation and (2) adaptation options to support sustainable development for all (see 'CRD pathways' below). The concept of CRD has grown in importance, and has been picked up recently in South Africa. On the mitigation front, however, South Africa's updated nationally determined contributions, as required by the United Nations' Paris Agreement, remain inadequate and the implementation of these promises even slower. In terms of adaptation, while South Africa has well-developed national adaptation strategies, and even a climate change bill sitting with parliament, resilience building has not progressed much beyond policy formulation. The WGII report shows that Africa lags behind internationally in terms of institutional responses, with the majority of the reported responses occurring autonomously in households, often through behavioural changes.⁵ The South African government would be wise to take heed and put significant effort into mitigating and adapting to current and future climate impacts.

Emerging evidence on human responses to climate change in South Africa

In light of the well-documented increase in biophysical and societal risk caused by the observed and projected impacts of anthropogenic climate change, we present several key themes we argue should be prioritised and integrated into CRD in South Africa.



Source: Figure 9.6 in Chapter 9 of the WGII report.¹

Figure 1: Risks increase with rising levels of global warming, as shown in this ‘burning embers’ figure displaying selected key risks for Africa resulting from climate change. While specific assessments at country scale were not included in the WGII report, these risk levels are, in our opinion, a good representation of the South African situation.

The food-water-energy-nature nexus

Increasingly strong intersectoral relationships between food production, water supply, energy generation and space for natural ecosystem function are emerging in South Africa and southern Africa at large. This stems from the growing demand for these resources, which intensifies the various interactive links between them. The inevitable trade-offs that result when making decisions around food, water and energy are exacerbated by the need to include the natural environment in this critical nexus, in support of environmental sustainability.⁶ The inclusion of nature is vital in southern African settings due to increased reliance on wild food and energy resources in communities exposed to adverse circumstances, and the services – such as pollination for agriculture – that nature provides.⁷

Chapter 9 (‘Africa’) of the WGII report showed that recent extreme variability in rainfall and river discharge across Africa has had largely negative impacts on water availability and on water-dependent sectors. Climate change may in future undermine regional plans to rapidly expand hydropower generation and irrigation infrastructure, and compound the overall water-energy-food-nature nexus risk.⁸ For example, hydropower revenues in the Orange River basin could be anywhere between 30% lower to 50% higher than current revenues under the driest and wettest climate scenarios. This presents severe challenges to planning and highlights the need to adopt transboundary and nexus approaches to fully understand trade-offs between decisions made for water, energy, food and nature for South Africa.^{9,10} Water stress is also projected to be a key driver of migration, especially internal migration.^{1,11}

Ecosystem-based adaptation – the use of ecosystem management to increase resilience and reduce the vulnerability of people and ecosystems to climate change – can reduce risks resulting from climate change, while providing other social, economic and environmental benefits. In particular, ecosystem protection and restoration, sustainable land management and

integrated catchment management can support CRD. South Africa has prioritised ecosystem-based adaptation in its *National Climate Change Adaptation Strategy*, but there is still considerable uncertainty on its effectiveness, except with regard to enhancing water security.¹²

Ecosystem-based adaptation is increasingly framed as a nature-based solution for adapting to climate change and reducing the high atmospheric carbon dioxide concentrations. However, nature-based solutions can be contentious if they are not seen as one part of a broader solution, as they can do no more than contribute to reducing climate change risks. For example, ecosystem restoration is unlikely to be a stand-alone solution to climate change for an area. Moreover, the contribution from nature-based solutions will likely be reduced at high levels of global warming when climate extremes are expected to lead to irreversible damage to the carbon storage capacity of ecosystems, such as mass forest die-back.

Cities

Chapter 6 (‘Cities, Settlements and Key Infrastructure’) of the WGII report emphasises that cities are, on the one hand, areas of concentrated risk because of the high density and interconnection of people, infrastructure and assets; on the other hand, they are areas of concentrated opportunity for action.¹³

In terms of developing adaptation plans, African cities are lagging behind internationally, and they show limited evidence of proactive adaptation. In many African cities, adaptation has primarily been driven by experiences of excess rainfall and flooding.¹ Potential exists for African cities to better harness ecosystem-based adaptation, as such interventions can be more cost effective than traditional hard infrastructure (e.g. using wetlands and mangroves rather than sea walls for protection against coastal storm surges).

Those urban adaptation efforts in African cities that have been documented span the range of soft and hard measures, from strengthening early warning systems and using hard infrastructure to reduce coastal hazards to employing green infrastructure. Cities such as Beira and Maputo have restored mangroves (see Table 9.9. in Chapter 9 of the report)¹ and eThekweni has invested in ecosystem-based adaptation by, for example, enhancing the ecological infrastructure for water security in the Palmiet Catchment¹⁴. Note, however, that nearly all these actions are experimental and supported by international rather than local finance.

Unfortunately, the theoretically well-established need for collaboration, participation and the co-production of adaptation action across the spheres of civil society, government and the private sector has not been met with sufficient action in South African cities. There is, however, a growing number of innovative co-production projects being undertaken to support urban adaptation, including projects in eThekweni, Johannesburg and Cape Town.¹⁵⁻¹⁸

Given the increasing extent and frequency of extreme and slow-onset climate events, along with the rapid growth of African cities, it is critical that adaptation pathways are prioritised as part of long-term urban planning. A central component of this planning should be securing climate justice for the most at-risk urban residents – a theme that is gaining traction as part of the South African government’s just transition focus. However, because the just transition threatens existing development pathways and the status quo, climate justice will be hard to achieve in practice. In addition, the feasibility and effectiveness of many urban adaptation actions are currently constrained by limited institutional, financial and technological access and capacity.^{1,19}

Knowledge and capacity

Chapter 17 (‘Decision-Making Options for Managing Risk’) of the WGII report notes the increasing evidence that knowledge and the capacity to respond – across all levels, from individuals to communities, enterprises, cities and nations – are crucial enabling factors for effective responses to climate change. It also highlights that the capacity to respond is often lower in developing countries than in richer nations.²⁰ Several issues around the multifaceted phenomena of knowledge and capacity are reported as particularly problematic in Africa (see Chapter 9 of the

WGII report¹), with direct relevance for southern Africa and South Africa. These issues are climate services, climate change literacy, indigenous and local knowledge, and climate finance.

Climate services

The term ‘climate services’ refers to the generation, tailoring and provision of climate information for purposes of decision-making, including decision-making for adaptation. Currently, there is low uptake of climate service products in Africa because they are often hard to access, unavailable, expensive, not scale-relevant, poorly communicated and/or distrusted.

Furthermore, observation data and research that underpin climate services products are inadequate. Ground observation networks essential for climate trend analysis, the calibration of satellite-derived climate products, and extreme event attribution studies are sparse, and many stations do not capture data accurately. The number of reporting stations in South Africa, Lesotho and Eswatini has declined from approximately 2100 in the 1970s to roughly 800 in 2009 – fewer than in 1920.²¹

Climate change literacy

Climate change literacy includes being aware of both climate change and its anthropogenic causes. Together with climate services, it underpins informed mitigation and adaptation responses. South Africa is one of just five African countries in which fewer than half (41%) of its citizens have heard of climate change.²² South African provincial climate change literacy rates constitute some of the lowest sub-national rates on the continent, varying from as low as 15% in KwaZulu-Natal to 41% in Mpumalanga (Figure 2). Ranked at 29 out of 33 countries surveyed in Africa, South Africa’s national rate is 28%.^{1,23} National rates on the continent range from only 23% to 66% of the population.

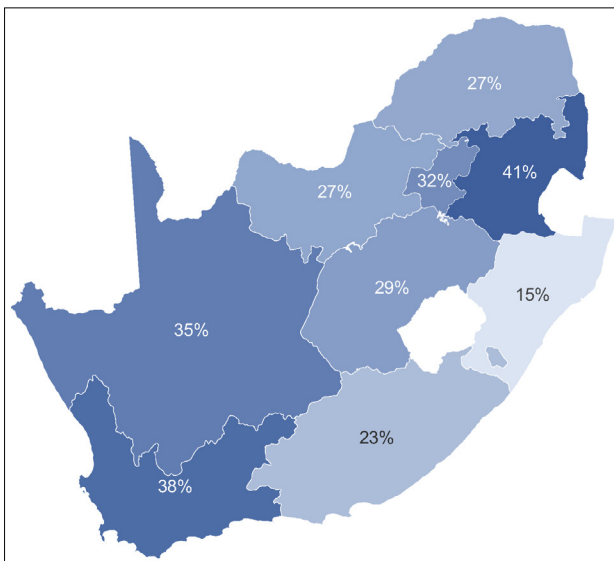


Figure 2: Mean climate change literacy rates in South Africa (i.e. the percentage of the population who have heard about climate change and think that human activity is its sole or partial cause).

The WGII report found that increasing climate change literacy rates affords a concrete opportunity to mainstream climate change adaptation in African development agendas, thereby strengthening CRD. Education and mobility are strong positive predictors of climate change literacy, while poverty has a negative effect. Rates are lower among women than men in South Africa (24.5% vs 31.9%), a concerning statistic seeing as women are often more vulnerable to climate impacts.^{1,21} Because the factors driving climate change literacy overlap with broader developmental challenges faced by South Africa, policies targeting these factors can potentially yield co-benefits for both climate change adaptation and progress towards sustainable development goals, particularly those concerning education, mobility and gender equality.^{1,23}

Indigenous and local knowledge

The WGII report highlights the critical role of indigenous knowledge and local knowledge in climate and weather forecasting that informs adaptation actions at local scale in Africa.¹ Within South Africa, communities and smallholder farmers are using indigenous and local knowledge for short-term weather and climate forecasting, which has helped to inform the implementation of anticipatory adaptation responses. The richness of African indigenous languages plays an important role in the effective interpretation and communication of locally based weather and climate forecasting.⁹ Although responses informed by indigenous and local knowledge feed directly into the day-to-day management of agricultural activities, they are mostly supportive and are best implemented together with other measures to achieve transformative climate adaptation.²⁴ For example, South African communities’ traditional drying of food for preservation purposes can help mitigate drought impacts, and traditionally harvested rainwater can supplement irrigation to address drought-related water scarcity.¹

Climate finance

Adaptation efforts remain poorly funded relative to mitigation projects, both globally and in Africa specifically. Internationally, the last decade has seen adaptation financing remain between 4% and 8% of total climate financing; in South Africa, only 7% (ZAR4.3 billion) of recent (2017–2018) climate financing was allocated to adaptation efforts.²⁵ In South Africa, and across the wider continent, annual finance flows targeting adaptation are far below even the lowest adaptation cost estimates for near-term climate change. Finance for adaptation efforts in South Africa has come from public sources alone, either via grants from climate funds or government budget allocations or blends of these two sources. One major reason for the lack of private financing for adaptation is the difficulty demonstrating how to extract viable financial returns on investment for many types of adaptation efforts, especially when the benefits are enhanced public good or avoided damages. The problem with a lack of private financing is that grant-based financing is unlikely to ever meet the expected adaptation finance needs. As such, new approaches to debt financing of adaptation efforts are needed, one being the practice of building avoided impacts into financial models. A further challenge for the future financing of adaptation efforts is enhancing access to funding for local adaptation and reducing transaction costs for local actors. Very little of the adaptation financing provided to date has reached vulnerable and marginalised communities and municipalities, in part because it is difficult for them to access finance but also because fiduciary rules or risk aversion make it hard to invest.

Another key area for increased investment to drive CRD is funding research on climate change risks and response options.¹ From 1990 to 2019, research on Africa received just 3.8% of climate-related research funds globally. Moreover, 78% of the funding for climate-related research on Africa went to institutions in the EU, UK and USA. More direct funding of African researchers can provide more actionable insights on climate risks and solutions for Africa.

Equity, justice and social protection

The themes of equity and justice are reflected strongly across the WGII report, being mentioned in 15 of the 18 chapters. This is an important focus for South Africa too. The report draws attention to three principles of justice, namely:

*distributive justice, which refers to the allocation of burdens and benefits among individuals, nations and generations; procedural justice, which refers to who decides and participates in decision-making; and recognition, which entails basic respect and robust engagement with and fair consideration of diverse cultures and perspectives.*²⁶

In the South African context, it is critical to consider justice, because of the country’s apartheid history, its stark levels of inequality, and the future challenges related to a just transition, such as prioritising decarbonisation and a move away from fossil fuels without reducing economic

development and individual well-being. These justice principles must be front and centre in developing CRD pathways in South Africa.

Building the adaptive capacity of individuals, often through community-based adaptation efforts, can strengthen resilience to climate shocks.²⁷ Securing social safety nets (a form of social protection) is one way to build individual adaptive capacity. These safety nets include, for example, the provision of cash or other social transfers that reduce the impacts of economic shocks and disasters, public works programmes and healthcare access. Social protection programmes must be carefully coordinated between actors and agencies, and integrated with climate data and risk management instruments such as insurance to reduce vulnerability to climate change most effectively.²⁸ Such coordination and integration have not been sufficiently explored in the South African context.

CRD pathways

During the sixth assessment process, the concept of development pathways grew in prominence as a framework for action on climate change within the context of sustainable development. Chapter 18 of the WGII report ('Climate Resilient Development Pathways') provides compelling evidence that achieving all sustainable development goals (SDGs) will be near impossible without climate action, and that climate action is strongly enabled by progress on the other SDGs.²⁹ While the synergies between climate action (SDG 13) and the other SDGs are many, there are also potential trade-offs. CRD pathways – 'development trajectories that successfully integrate mitigation, adaptation, and sustainable development to achieve development goals'²⁹ – are proposed as a tool to operationalise or steer CRD and to make sure that synergies are maximised, while trade-offs and maladaptation are minimised.

CRD offers the opportunity to develop a set of context-relevant principles against which socio-economic development options can be assessed, but this does not often happen in practice. Chapter 18 notes that many countries are currently on development trajectories that are *not* climate resilient. While IPCC reports generally avoid country-level assessments and rankings, South Africa is clearly part of this group. As such, it would serve the country well to use the evidence and suggested approaches in the report to critically interrogate, stress test and adjust its current development plans – at multiple governance levels – towards ensuring CRD outcomes. The South African Presidential Climate Commission's recent engagement with the concept of CRD is a welcome first step, but operationalising CRD remains a huge practical challenge that requires major transitions (rather than mere adjustments) in five key systems: energy, industry, urban and infrastructure, land and ecosystems, and societal.

Gaps, research questions and IPCC reflections

It is critical for South Africa to engage with the emerging work on CRD pathways because it helps to contextualise climate issues (including mitigation, adaptation and broader development) within the country's complex context. The establishment of the Presidential Climate Commission proves that climate action is no longer recognised and promoted in research and policy alone; at a national level, it is now regarded as central to decisions and action relevant to the economy, livelihoods and the broader environment, and as part of the country's just transition. Pathways framing enables climate risk decisions to be integrated into development planning and, importantly, helps clarify how decisions made now could have future implications and what the trade-offs might be.

Throughout the WGII report, knowledge gaps are identified that could inform climate- and development-related research in South Africa and more widely. This is especially timely, given that South Africa is about to implement its Science, Technology and Innovation Decadal Plan, 2021–2031. Knowledge gaps identified in the WGII report's chapter on Africa include, among others, research on: (1) the impact of climate change on, and possible adaptation responses for, marine ecosystems, agriculture, migration and health; (2) climate impact attribution and its contribution to understanding loss and damage; (3) the costs, benefits, limits, feasibility and financing of different adaptation options as climate warming progresses; (4) system-level climate impacts and responses, such as those affecting food systems; and (5) the role of political economy, governance and collaboration in responding to climate risk.

South Africa has much in place to ramp up climate action. Although planning and consultation are important, excessive time cannot be spent on trying to plan the perfect response. Learning by doing is necessary, accompanied by the reflections of a broad group of stakeholders. Funding commitments of a unique nature are needed to support this, and training and research efforts by the academic community will likely require novel transdisciplinary approaches not comfortably situated within current academic structures. International climate financing must be actively sought, but funding from the national government also needs to be scaled up and distributed across levels. The necessary climate action will require new partnerships and collaboration across actor groups that have not worked together before. Action must be co-designed and co-implemented, with government – especially at the local level – working more creatively with civil society and the private sector to meet the scale of the challenge.

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Competing interests

All authors were authors of the WGII contribution to the IPCC Sixth Assessment Report. We have no competing interests to declare.

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