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# Climate vulnerability of Southern Africa

**Brent Cloete**

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Economic Research Southern Africa is one of many regional partners which support the Climate Vulnerability Monitor, 3rd Edition (CVM3), which is commissioned by the Climate Vulnerable Forum (CVF) and the Vulnerable Twenty Group (V20). Climate Analytics, Finres, the Lancet Countdown, and the CVF and V20 secretariat, hosted at the Global Center on Adaptation, formed the Consortium of organizations contributing to the CVM3.

## Summary

Global temperatures have already increased by 1.1°C relative to pre-industrial levels. Further climate change is inevitable and each fraction of a degree of additional warming increases the adaptation challenge for the vulnerable and poor. The five Southern African countries (Botswana, Lesotho, Namibia, Eswatini, South Africa) warm at above the global average. Average temperatures in Botswana, as the most exposed of the five, could increase by an additional 5.1°C. Even if global warming is contained below 2°C, 10.6 additional severe drought events are expected in the region every 20 years and 14,460 additional elderly people will die a year by the 2090. **Climate-resilient urban redesign can help protect populations against extreme temperatures. This includes better insulation of buildings, more green spaces and cost effective solutions like cool roofing and cool pavements.**

Climate change increases the risk of malaria in Lesotho and the risk of dengue fever in the other four countries. In South Africa, even 1.5°C of global warming creates conditions where an outbreak of dengue fever can trigger an epidemic unless measures are put in place to contain it. **Health systems should be strengthened and surveillance, early warning, and response systems put in place to identify, prevent, and manage evolving climate-related threats.**

Southern Africa is one of the regions most exposed to climate-linked food insecurity in the world. Rising temperatures will significantly reduce wheat and maize yields in the region. Soy yields are expected to increase, but less so once global temperatures increase above 1.5°C. The increased frequency of droughts will also negatively impact food production. **Policies that increase the affordability and availability of food to the most vulnerable in society are required to address food insecurity.**

The Namibia, Botswana and South Africa have relatively average resilience to climate change by global standards. Lesotho and Eswatini have lower resilience. The rest of Sub-Saharan Africa, however, is significantly more vulnerable to climate change. The marked difference in vulnerability means that significant climate-linked migration to Southern Africa is possible. Climate change will slow economic growth in the region and the impact will be most acutely felt in the largest economy in the region, South Africa. Immigration in a low growth environment has already created social instability in South Africa and this could be exacerbated by climate change. **A just low carbon transition in the region is critical to drive sustainable economic development, strengthen social cohesion and fund increased food imports.**

## Introduction

Climate impacts are seen, felt, and measured today. Global temperatures are higher now than at any time during the previous 125 000 years. The current 1.1°C **increase in temperatures** relative to pre-industrial levels **is driving severe negative impacts on all human and natural systems.** This is impacting health and development outcomes, threatening cities and rural settlements, and disrupting economies. These impacts are unequivocal, and **attribution science is increasingly able to uncover the direct link between climate change caused by human activity and its impacts.** A clearer understanding of the link between climate change and physical impacts paves the way for a frank discussion between developing and industrialised countries around **payments for loss and damage.**

**Further climate change is inevitable and requires long-term planning.** The challenge is particularly severe in Africa. It is expected to warm more than the global average and existing socioeconomic challenges means it lacks resilience to deal with the impacts of climate change. The third edition of the Climate Vulnerability Monitor (CVM3), consistent with the views of the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report and the earlier 1.5°C Report, finds that climate impacts become exponentially worse as global temperatures increase beyond 1.5°C – an outcome that is looking increasingly likely. Beyond 1.5°C vulnerable countries and communities will struggle to adapt. **CVM3 stresses that no amount of adaptation efforts that can make up for a failure to contain global average temperature rise to 1.5°C.** The current decade is therefore critical for climate action.

## Biophysical impacts

Mean land temperatures are expected to increase by an additional 1.05°C in Africa, 0.90°C in the Americas, 1.05°C in Asia-Pacific, and by 0.98°C in Europe by the end of the century under a 2°C of climate change scenario. **The average increase in SADC countries will be 1.1°C, and in the five Southern African countries (Botswana, Lesotho, Namibia, Eswatini, South Africa) will be 1.3°C.** Should global warming accelerate to 3.6°C because the climate system turns out to be more sensitive to greenhouse gases (GHGs) than expected, or because mitigation action is less effective or widespread than expected, mean maximum surface temperature in Southern African will increase by an additional 4.2°C. In Botswana, mean extreme temperatures will increase by 5.1°C.

The five Southern African countries will experience **on average 10.6 additional severe drought events every 20 years** compared to the 1995-2014 baseline by the end of the century if the global temperature increase is kept below 2°C. **At the same time, however, the risk of extreme precipitation events also increase** in these countries – with the highest increase occurring in Botswana (5.3%). While the increase in occurrences of extreme drought are very similar between the 5 Southern African countries and the rest of the SADC region, the risk of extreme precipitation is much higher in the other SADC countries (9.3% versus 3.1%).

## Health and wellbeing

### Heat exposure

Increased exposure to extreme heat puts people at risk of heat stress and heat stroke, aggravating cardiovascular and respiratory disease, causing kidney injury, worsening pregnancy outcomes and deteriorating mental health. Risk of exertional heat stress also reduces the window for safe outdoor physical activity to support an active lifestyle and reduces the productivity of labourers who work outdoors or without cooling indoors. This jeopardises livelihoods and reduces socioeconomic outcomes which indirectly impact health outcomes. Extreme heat also disrupts services and infrastructure and will place additional stress on already overstretched power grids in Southern Africa as demand for air conditioning increases.

**At a 2°C increase in global temperatures a total of 14,460 additional people over the age of 65 will die a year in the 5 Southern African countries by the end of the century.** The majority of these deaths will occur in South Africa, with 12,000 elderly heat-related deaths compared to 820 in 2005. In a 1.5°C world the number of deaths in all 5 countries fall to 1660 per year. In a 2°C world, by the end of the century an average of **4.3% of the hours worked outdoors with no protection from the sun will be lost in the 5 countries.**

### Wildfire

Wildfires pose risk from life-threatening burn injuries, negative respiratory outcomes and eye damage from exposure to smoke. They also threaten assets and infrastructure and disruption of essential service. Increased natural disasters will place additional stress on infrastructure and services in an area like Southern Africa with limited resources to recover and rebuild.

**In a 2°C world by the end of the century each person in the 5 Southern African countries is exposed to an additional 11.14 days with exposure to very high or extremely high wildfire danger.** The lowest additional risk is in Lesotho (3.76 days) and the highest is in Botswana (26.38 days). In a 1.5°C world this risk falls to an additional 6.71 days on average for the 5 countries.

### Infectious diseases

Changing weather conditions cause shifts in the distribution of infectious diseases between and within regions. 2°C of warming has a limited impact on the transmission of Malaria in the region. **Suitable conditions for the transmission of malaria is in place for 0.5 months longer by the end the century in Lesotho,** is largely unchanged in South Africa, and is marginally reduced in the other 3 Southern African countries. The pattern is similar in a 3.6°C world, although the risk of malaria in Lesotho is then significantly increased with almost 2 extra months in which conditions support transmission.

**There is a significant increase in the prevalence of dengue fever,** a mosquito-borne disease responsible for a high disease burden globally, **in all the Southern African countries apart from Lesotho.** The change is particularly worrying in South Africa, where even 1.5°C of global warming causes the basic reproduction number, which represents the expected number of secondary infections resulting from one single primary infected person in a susceptible population, to increase from below 1 currently (0.89) to 1.17 by 2030 – meaning that an outbreak will continue to spread unless measures are implemented to contain it.

### Food Insecurity and Undernutrition

Higher temperatures can shorten the life cycle of crops, leading to lower crop yields. As the climate changes, however, it may become conducive to different crops. These impacts are visible in tables 1 and 2 below. **Wheat yields are significantly impacted by climate change, and the impact increases with global temperatures.**

*Table 1 Impact of climate change on wheat yields in Southern Africa by 2090*

Average global temp increase	winter wheat yield			spring wheat yield			Soy yield		
	1.5°C	Below 2°C	3.6°C	1.5°C	Below 2°C	3.6°C	1.5°C	Below 2°C	3.6°C
Botswana	-4.3%	-4.8%	-18.0%	-3.8%	-6.5%	-17.6%	1.2%	1.3%	-3.7%
Lesotho	-1.0%	-2.8%	-8.9%	2.3%	1.1%	5.3%	12.0%	11.6%	13.0%
Namibia	-2.1%	-2.5%	-7.3%	-0.2%	-0.6%	-4.7%	2.8%	2.3%	-1.1%
Eswatini	-4.3%	-11.5%	-29.9%	-0.3%	-2.2%	-0.1%	5.0%	5.2%	5.4%
South Africa	-1.1%	-2.6%	-11.1%	0.5%	-0.7%	0.3%	4.2%	3.9%	4.9%
<b>Average</b>	<b>-2.6%</b>	<b>-4.8%</b>	<b>-15.0%</b>	<b>-0.3%</b>	<b>-1.8%</b>	<b>-3.4%</b>	<b>5.0%</b>	<b>4.8%</b>	<b>3.7%</b>

Source: Author calculations based on CVM3 Data

**While some climate change is beneficial to soy yields in the region, there is clearly a threshold effect and increases become smaller as global temperatures increase. The impact on maize, a major staple in the region, is particularly severe.** Table 2 shows that climate change is expected to significantly reduce crop growth duration of maize relative to a 1995-2014 baseline. A shorter growing season reduces the amount of time a crop has to accumulate biomass. **Under the extreme global warming scenario Lesotho is the country where maize crop maturity during is the most severely impacted globally, and South Africa is the second most significantly impacted.** More prevalent heatwaves and droughts are also expected to increase food insecurity via heat stress impacting crop yields, agricultural and non-agricultural labour productivity declining (and thus on crop production and income), upward pressure on food prices and disruptions to supply chains. The table below shows **an increase in the frequency of heatwaves will increase the prevalence of moderate or severe food insecurity in the region.**

*Table 2 Climate change impact on food insecurity*

Average global temp increase	Maize crop maturity (days) <sup>1</sup>			Change in food insecurity (%) <sup>2</sup>		
	1.5°C	Below 2°C	3.6°C	1.5°C	Below 2°C	3.6°C
Botswana	-8.00	-10.00	-34.00	5.90	3.20	18.30
Lesotho	-34.00	-44.00	-76.00	6.60	3.70	19.70
Namibia	-9.00	-13.00	-38.00	6.00	3.30	18.90
Eswatini	-10.00	-15.00	-42.00	5.80	3.20	18.10
South Africa	-21.00	-27.00	-61.00	5.40	3.00	17.30
<b>Average</b>	<b>-16.40</b>	<b>-21.80</b>	<b>-50.20</b>	<b>5.94</b>	<b>3.28</b>	<b>18.46</b>

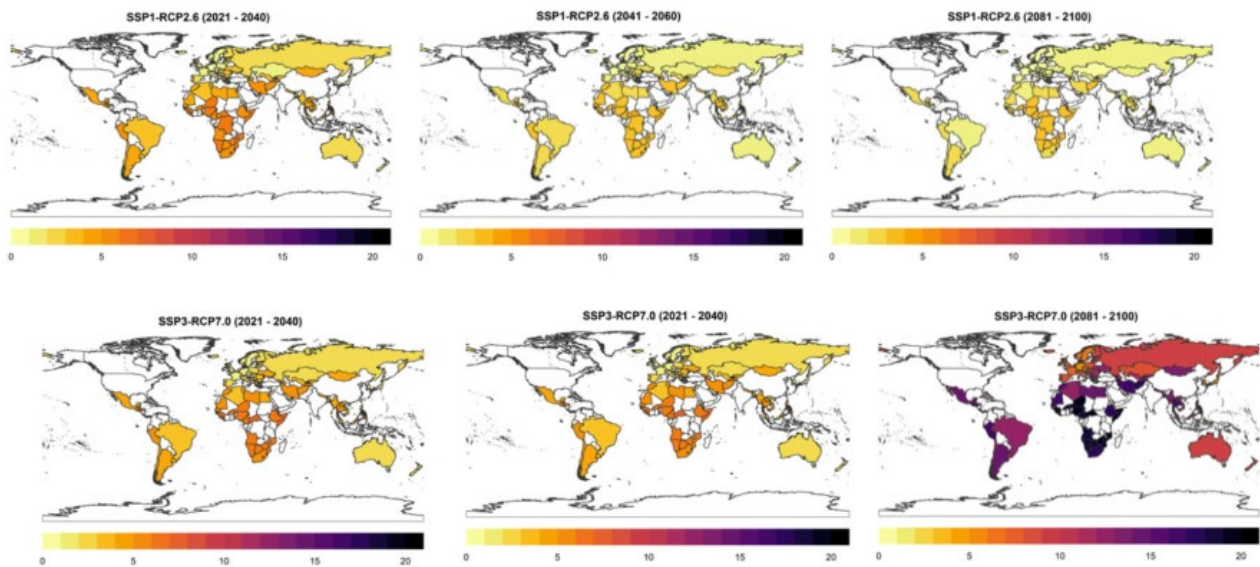
<sup>1</sup> Temperature-driven 20-year mean change in the time it takes for maize to reach maturity by 2090 (number of days)

<sup>2</sup> Change in moderate-severe food insecurity due to change in the number of heatwave days by 2090 [%-points]

Source: Author calculations based on CVM3 Data

Considering a global perspective, Figure 1 shows that the **countries in Southern Africa are amongst the most exposed to climate-induced food insecurity under all three the temperature pathways.**

*Figure 1 Change in moderate to severe food insecurity linked to heatwave days relative to 1995–2014 baseline*



Source: Climate Vulnerable Forum & V20 (2022:104)

### Climate risk and vulnerability

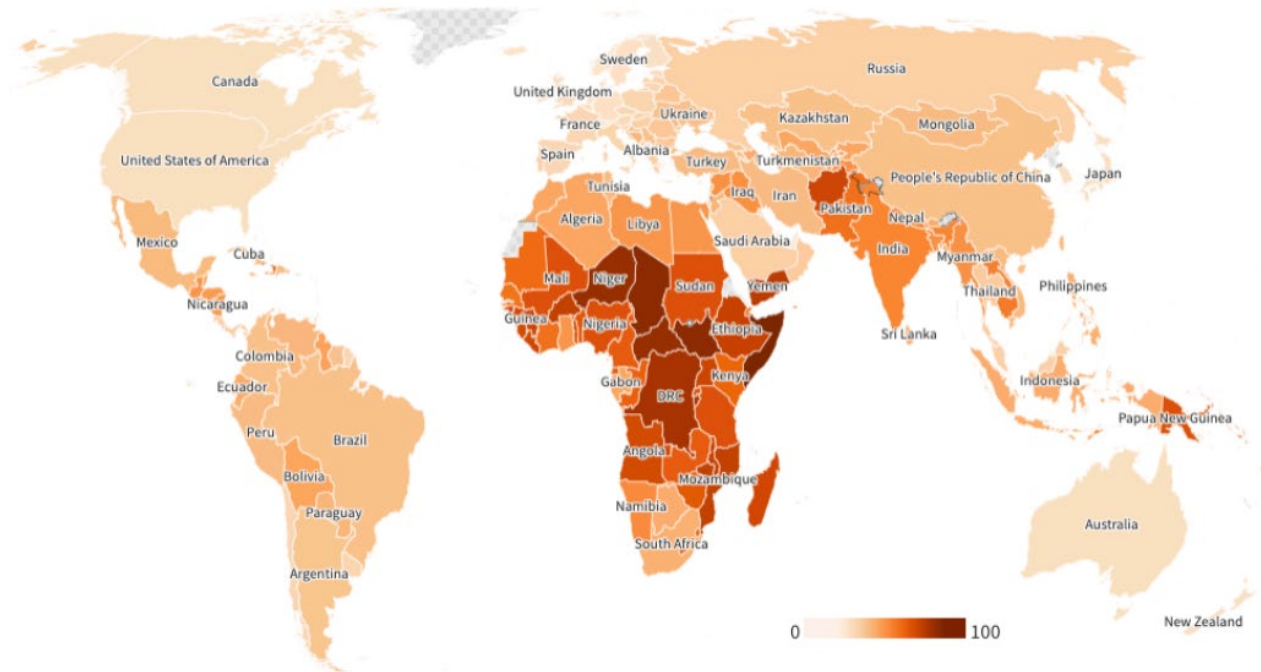
Biophysical and socioeconomic factors determine the vulnerability of people and the environment to that climate hazards and are critical factors of climate risk. Furthermore, vulnerability can be reduced through adaptation and building resilience.

The Global Data Lab (GDL) Vulnerability Index considers information on economic development, inequality, human development, education, gender, health, infrastructure, access to communication, governance, demography and urbanization to assess the vulnerability of countries to climate change impacts. The Index scale runs from 0 to 100, with 0 indicating the lowest and 100 the highest vulnerability.

Figure 2 shows that the three largest countries in Southern Africa (Namibia (52.4), Botswana (40.2) and South Africa (41.7)) have relatively average vulnerability scores globally. Lesotho (66.5) and Eswatini (58.6), however, are more vulnerable to climate impacts.

The IPCC *Sixth Assessment Report* defines vulnerability as “the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt”.

Figure 2 GDL Vulnerability Index (2020)



Source: Climate Vulnerable Forum & V20 (2022:44)

Countries within the rest of Sub-Saharan Africa, however, are significantly more vulnerable to the impacts of climate change and many are of the most vulnerable countries globally. Socioeconomic conditions will intensify climate impacts and will lead to significant risk to life and livelihoods in these countries. While climate-attributable displacement and migration have not been addressed in CVM3, the marked difference in vulnerability between the three largest economies in Southern Africa and the rest of Sub-Saharan means that significant migration to these countries is likely in response to climate disruption and natural disasters elsewhere on the continent. The potential of immigration to create social instability in an unequal and low growth environment is already plainly visible in South Africa. Climate change could exacerbate this problem.

### Macroeconomic consequences of climate change

Climate change can impact economies directly via the impacts discussed previously, including the destruction of assets and disruption to supply chains. It can also influence macroeconomic variables indirectly via, for example, demand for inputs, goods and services driving inflation in the wake of natural disasters. Inflationary pressures can then put upward pressure on interest rates as policymakers seek to avoid inflationary expectations becoming entrenched. Higher interest rates make investments more costly which can negatively impact economic and social development and hold back climate change mitigation and adaptation efforts.

Climate change is expected to reduce economic growth (as measured by an increase in GDP per capita) globally, and Southern Africa is no exception. **At 2°C of global warming an average reduction in GDP per capita growth per year of 2.32% is expected for the 5 Southern African countries by the end of the century. Under conditions of extreme climate change, however, this increases to a 10% reduction in growth rate per year.** At that level annual reductions are going to compound rapidly, and the countries will end up on a much lower growth trajectory. The impact will be most acutely felt in by far the largest economy in the region, South Africa. In a 3.6°C world, South Africa's annual GDP per capita growth is reduced by 13.5% per year by the end of the century. It should be noted that these estimates only take account of climate impacts within countries. In reality, and particularly under an extreme climate change scenario, offshore impacts on export markets, supply chains or international commodity markets will impact on in-country economic growth. There are significant real and financial linkages between the economies in the region facilitated by membership of the Southern Africa Customs Union (SACU) and regional currencies being directly or indirectly (in the case of Botswana) pegged to the South African rand. Domestic or imported climate shocks affecting South Africa, as largest economy in the region, are therefore likely to be felt in the rest of the region. **The impact of climate change on economic growth in the region is thus probably underestimated.**

Climate change is expected to lead to an increase in inflation (CPI) of on average 0.58% points for the five Southern African countries by 2090 if global temperature rise can be contained to 2°C, and by 1.94% points if it cannot. This is relatively low compared to the expected impacts elsewhere and only Lesotho



experiences an increase in inflation of more than 2 % points. Combined with the impact on GDP, this is expected to lead to an increase in interest rates of 19 basis points by the end of the century in a below 2°C world, and 60 basis points in a 3.6°C world. Lesotho is most impacted and, experiences a 115 basis points increase, whereas South Africa, which is the least impacted, only sees interest rates increase by 34 basis points. Again, however, it should be emphasised that these impacts are driven purely by in-country climate disaster. Chronic in-country impacts, like a persistent deterioration in food security, or increased climate-related migration, could place upward pressure on inflation and interest rates. Food insecurity will not only directly drive food price inflation, but increased imports of food will negatively impact the current account which could create additional upward pressure on interest rates. In world of integrated supply chains and capital markets, higher climate-induced inflation and interest rates abroad are likely to be transmitted to countries in Southern Africa. **The impacts of climate change on inflation and interest rates are therefore probably underestimated.**

#### Knowledge gaps

**There is significantly less country-specific research into physical climate impacts and adaptation strategies in Africa relative to the rest of the world.** In some areas, like adaptation to sea level rise, Africa-specific literature is almost entirely absent. With the exception of South Africa, this is true for Southern Africa. Consequently, most of the information that is available is based on assumptions, models and parameters that have not been locally calibrated. **Adaptation research also focuses heavily on economic sectors while neglecting the environment, health and infrastructure areas.** In terms of types of adaptation, **behavioural and cultural responses and ecosystems-based adaptation approaches are favoured**, and less attention is paid to institutional and technological or infrastructural responses. While this probably reflect realities like a lack of access to capital and institutional challenges in Africa, and is therefore likely appropriate, **it is possible that a lack of research and understanding is restricting the scope of activities being undertaken and may be limiting the uptake of available concessional adaptation finance.**

#### Recommendations for policymakers

Action to increase resilience to climate change should be prioritised in five areas:

1. Climate change will significantly increase exposure to extreme temperatures in the region. **Climate-resilient urban redesign** can help protect populations against extreme temperatures. This includes better insulation of buildings, more green spaces and cost effective solutions like cool roofing and cool pavements.
2. Climate change will increase temperature-induced health risks and influence the distribution of infectious diseases in the region. **Health systems should be strengthened and surveillance, early warning, and response systems put in place** to identify, prevent, and manage evolving climate-related health threats.
3. Southern Africa will be one of the regions most affected by climate-related food insecurity globally. **Policies that increase both the affordability and availability of food to the most vulnerable are required** in response. These could include, for example, expanding social safety nets, supporting climate smart agriculture and resilient food systems, strengthening regional food value chains and using competition policy to moderate food prices.
4. The relative resilience of the three largest economies in Southern Africa to climate change and the very weak adaptive capacity in the rest of Sub-Saharan African increases the likelihood of climate-driven immigration to the region. **A just low carbon transition in the region is critical to manage increased immigration by driving sustainable economic development and strengthening social cohesion.**
5. A relative dearth of country-specific research into physical climate impacts and adaptation strategies in Africa relative complicates adaptation planning. Increased funding for **research into country- and Southern African-specific climate impacts and adaption strategies** will support more effective adaption in the region.
6. Many of the interventions suggested will require a regional approach and will generate significant positive externalities beyond national borders - reducing the incentive for national governments to implement them given pressing domestic socioeconomic and development challenges within the region. This creates an **important role for multilateral and bilateral development assistance and regional development finance institutions.**

## Conclusion

The recent IPCC Sixth Assessment Report warned that the impacts of climate change are materialising much faster and much more intensely than expected. The IPCC 1.5°C Report identified Southern Africa as a ‘climate hotspot’ and this was confirmed by the Sixth Assessment Report. The CVM3 analysis strengthens this message by illustrating **how real, significant and present climate risks are in the region.**

CVM3 emphasises the **value of intra- and inter-regional approaches when responding to climate change and the importance of addressing knowledge gaps** to ensure that limited adaptation funding is spent as effectively and efficiently as possible.

While the CVM3 results are a stark reminder of how quickly time to prepare for rapidly accelerating climate impacts is running out, areas in which interventions should be prioritised are clearly identified. Furthermore, the **CVM3 data explorer provides powerful and easy-to-use tool to support the design of interventions to increase regional resilience** and to assess the relative benefits of interventions in different areas.

Action to increase resilience to climate change should be prioritised in five areas:

## Abbreviations

Abbreviations	
IPCC	Intergovernmental Panel on Climate Change
GHG	Greenhouse gas
CVM3	Climate Vulnerability Monitor, 3rd Edition

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